

# JULIAN KATZKE - CV

**Affiliations:** <sup>a</sup>National Museum of Natural History **Email:** Julian.Katzke@oist.jp  
<sup>b</sup>Okinawa Institute of Science & Technology  
**Address:** Natural History Bldg. E519, 10th St. & **Tel.:** +49 1575 0617013  
Constitution Ave NW, Washington DC 20560 +81 80 9290 5047  
**ORCID:** 0000-0002-1447-9660

## SYNOPSIS

I am an early career evolutionary biology Peter Buck Postdoctoral Fellow at the Smithsonian National Museum of Natural History with Hannah Wood, Ted Schultz, and Seán Brady at the Smithsonian National Museum of Natural History. My research falls in the emerging field of biodiversity phenomics and focuses on applying comparative methods linking 3D data, biomechanics, ecology, and phylogenies to investigate the evolution of morphology in arthropods, particularly trap-jaw ants and spiders in a systems approach. My interest in the macroevolution of invertebrates originates from a fascination for their sheer diversity and disparity across evolutionary history.

## RESEARCH OUTPUT

### Publications:

17. **Katzke, J.**, Hita Garcia, F., Lösel, P.D., Azuma, F., Faragó, T., [...], Economo, E.P., van de Kamp, T. (2026). High-throughput phenomics of global ant biodiversity. *Nature Methods*. *In press*.

16. Casadei-Ferreira, A., Billen, J. Büsse, S., **Katzke, J.**, Mizuno, R., Richter, A. Economo, E.P. (2025). Pumping Venom: Valvilli Architecture and Implications for Stinger Functionality. *bioRxiv*, 2025.08. 28.672817.

15. Hamer, M.T., **Katzke, J.**, Hita Garcia, F., Economo, E.P., Guenard, B., (2025). A revision of the rare *Strumigenys mnemosyne* (Formicidae; Myrmicinae) group using micro-CT scanning, with the description of three new species, and the virtual repair of a broken paratype. *PLOS ONE*. 20 (9), e0331762.

14. Matte, A.C., Guenard, B., Gautam, S., Azuma, F., **Katzke, J.**, Hita Garcia, F., van de Kamp, T., Economo, E.P. (2025). The evolution of cheaper workers facilitated larger societies and accelerated diversification in ants. *Science Advances*. 11 (51), eadx8068.

13. Lacava, S.A., Isilak, N., Ranawat, N., **Katzke, J.**, Hoedemaker, J.F.H., Yoshida, Y., Uusisaari, M.Y. (2024) A vestibulospinal pathway for context-dependent motor control of the mouse tail. *Cell Reports*. 44 (7).

12. Baierlein, D., Kubicka, A.M., Adamski, Z., Hein, J., Zuber, M., **Katzke, J.**, van de Kamp, T. (2025). Morphology of mandibles of clown beetles (Coleoptera: Histeridae): hidden diversity, sexual dimorphism, and implications for prey-range. *Zoological Journal of the Linnean Society*. 204, zlaf038.

11. Gautam, S., McKenzie, S., Yoshida, T., **Katzke, J.**, Hita Garcia, F., Yamamoto, S., Economo, E.P. (2024). Evolution of odorant receptor repertoires across Hymenoptera is not linked to the

evolution of eusociality. *Proceedings of the Royal Society B*. 291 (2031), 20241280.

10. Brannoch, S.K., **Katzke, J.**, Taylor, D.S., Economo, E.P., Ogawa, Y., Narendra, A., Svenson, G.J., Martin, J.P. (2024). A new leaf sensing organ in a predatory insect group, the praying mantises (Mantodea). *bioRxiv*. 2024.04.14.589444.

9. Aibekova, L., Keller, R.A., **Katzke, J.**, Allman, D.A., Hita Garcia, F., Labonte, D., Narendra, A., Economo, E.P. (2023). Parallel and divergent morphological adaptations underlying the evolution of jumping ability in ants. *Integrative Organismal Biology*. 5(1).

8. Wang, C., Chung, F.-Y., Lin, C.-C., **Katzke, J.**, Economo, E.P., Billen, J. (2023). Morphology of the metapleural gland and its associated novel atrial cone gland in *Strumigenys* ants. *Micron*. 171, 103463.

7. Richter, A., Boudinot, B.E., Yamamoto, S., **Katzke, J.**, Beutel, R.G. (2022). The First Reconstruction of the Head Anatomy of a Cretaceous Insect, †*Gerontofornica gracilis* (Hymenoptera: Formicidae), and the Early Evolution of Ants. *Insect Systematics and Diversity*. 6(5).

6. Boudinot, B.E., Richter, A., **Katzke, J.**, Chaul, J.C.M., Keller, R.A., Economo, E.P., Yamamoto, S., Beutel, R.G. (2022). Evidence for the evolution of eusociality in stem ants and a systematic revision of †*Gerontofornica* (Hymenoptera: Formicidae). *Zoological Journal of the Linnean Society*. 195(4), 1355–1389.

5. Gómez, K., Kouakou, L.M., Fischer, G., Hita Garcia, F., **Katzke, J.**, Economo, E.P. (2022). *Pheidole klaman* sp. nov.: a new addition from Ivory Coast to the Afrotropical *pulchella* species group (Hymenoptera, Formicidae, Myrmicinae). *ZooKeys*. 1104: 129-157.

4. **Katzke, J.**, Puchenkov, P., Stark, H., Economo, E.P. (2022). A Roadmap to Reconstructing Muscle Architecture from CT Data. *Integrative Organismal Biology*. 4(1).

3. Richter, A., Garcia, F.H., Keller, R.A., Billen, J., **Katzke, J.**, Boudinot, B.E., Economo, E.P., Beutel, R.G. (2021). The head anatomy of *Protanilla lini* (Hymenoptera: Formicidae: Leptanillinae), with a hypothesis of their mandibular movement. *Myrmecological News*, 31.

2. Peeters, C.P., Keller, R.A., Khalife, A., Fischer, F., **Katzke, J.**, Blanke, A., Economo, E.P. (2020). The evolutionary loss of flight enabled the remarkable strength of ant workers. *Frontiers in Zoology*, 17(1), 1-13.

1. **Katzke, J.**, Barden, P., Dehon, M., Michez, D., Wappler, T. (2018). Giant ants and their shape: revealing relationships in the genus *Titanomyrma* with geometric morphometrics. *PeerJ*, 6:e4242. (cover page)

## Oral Conference Presentations:

12. **Katzke, J.** (November 2025). The evolution of ant mandibles. Snodgrass Memorial Award Address. *Entomology 2025*, Portland, USA.

11. **Katzke, J.**, Economo, E.P. (January 2025). Predation and multifunctionality in the macroevolution of ant mandibles. *Society for Integrative and Comparative Biology AM 2025*, Atlanta, USA.

10. **Katzke, J.**, Economo, E.P. (August 2024). The roles of predation and multifunctionality in the macroevolution of ant mandible form and function. *International Congress of Entomology 2024*,

Kyoto, Japan.

9. **Katzke, J.**, Economo, E.P. (November 2023). Predation as a driver of morphological diversification in ant mandibles. *Entomology 2023*, National Harbor, USA.
8. **Katzke, J.**, Hita Garcia, F., Azuma, F., Loesel, P.D., Farago, T., van de Kamp, T., Economo, E.P. (September 2023). antscan - a comprehensive open access database for 3D ant anatomy. *2023 Japan Evolutionary Society Meeting*, Nishihara, Japan.
7. **Katzke, J.** (August 2022). Evolution of morphological diversity in ant mandibles. *5th International Congress on Invertebrate Morphology*, Vienna, Austria.
6. **Katzke, J.** (February 2022). Procedural Diversity: Analysis and visualization of ant mandibles over the course of four years. *Young Researcher Meeting Morphology*, Göttingen, Germany (online).
5. **Katzke, J.** (January 2022). A limited number of convergently evolved ecomorphs underlie the morphological diversity of ant mandible shapes. *The Society for Integrative and Comparative Biology Annual Meeting*, Phoenix, USA (online).
4. **Katzke, J.**, Economo, E.P. (March 2021). Functional archetypes underlie diverse morphological varieties in the evolution of ant mandibles and muscles. *The 68<sup>th</sup> Annual Meeting of the Ecological Society of Japan*, Okayama, Japan (online).
3. **Katzke, J.** (October 2019). A morphospace odyssey: Quantifying mandible diversity across the ant phylogeny. *XXIV Simpósio de Mirmecologia*, Belo Horizonte, Brazil (invited as symposium speaker).
2. **Katzke, J.**, Friedman, N.R., Hita-Garcia, F., Fischer, G., Blaimer, B., Fisher, B.L., Economo, E.P. (November 2018). Form follows phylogeny? Insights into *Crematogaster* ant evolution by combining micro-CT and geometric morphometrics. *Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual Meeting*, Vancouver, Canada.
1. **Katzke, J.** (March 2017). Giant ants and their shape: Revealing relationships in the genus *Formicium* by applying geometric morphometrics. *88th Annual Meeting of the German Palaeontological Society*, Münster, Germany.

### **Poster Conference Presentations:**

3. **Katzke, J.**, Hita Garcia, F., Azuma, F., Loesel, P.D., Farago, T., van de Kamp, T., Economo, E.P. (November 2023). antscan - High-throughput Synchrotron  $\mu$ CT scanning across the ant tree of life. *Entomology 2023*, National Harbor, USA.
2. **Katzke, J.**, Economo, E.P. (October 2022). Predation drives the morphological diversity of ant mandibles. *OIST-Tohoku University Joint Workshop on Biodiversity*, Sendai, Japan.
1. **Katzke, J.** (October 2018). Inside or outside? Different opportunities for evolutionary Studies by comparative CT-scanning. *Young Scientists Meeting "Chanpuru" (RIKEN and OIST)*, Onna, Japan.

## **APPOINTMENTS & FUNDING**

- 2026-2028: **Smithsonian National Museum of Natural History**  
Peter Buck Postdoctoral Fellow (134,000 USD)
- 2025-2026 **Karlsruhe Institute of Technology**  
International Excellence Fellow (11,900 USD)
- 2025: **Okinawa Institute of Science & Technology Graduate University**  
Junior Research Fellow (5,500 USD)

## RESEARCH EXPERIENCE

- December 2020,  
June 2025 **High-throughput synchrotron micro-CT**  
(Karlsruhe Institute of Technology)
- Imaging at the TOPO-TOMO (Topography, microradiology and microtomography) and IMAGE (X-Ray imaging) beamlines in collaboration with the Institute for Photon Science for the Antscan initiative
- January 2019  
- February 2025: **PhD candidate with Evan Economo (OIST)**  
**Evolution of ant mandibles**
- Macroevolution and diversification of phenotypes and functional traits
  - Using and refining 3D imaging workflows to observe insect anatomy in high quantities
  - Implementing modern methods to quantify morphology and develop new ways to acquire functional traits from morphology
- September 2018  
- December 2018: **PhD rotation student with Ulf Skoglund (OIST)**  
**Applying phylogenetic comparative methods to cryo-Electron Tomography**
- Combining knowledge of systematics to the demands of molecular tomography, using hierarchical clustering for protein conformations
  - Laying out a framework to use shape as a more reliable basis of clustering
- June 2018  
- August 2018: **PhD rotation student with Thomas Bourguignon (OIST)**  
**Metagenomics of termite-gut bacteria**
- Creating a single gene phylogeny from bacterial sequences of 23 termite metagenomes
  - Focus on learning phylogenetic methods, such as sequence alignment, model selection and tree reconstruction, familiarization with programming pipelines in phylogenomics
- January 2018  
- November 2018: **PhD rotation student with Evan Economo (OIST)**  
**Morphological diversification of *Crematogaster* ants in Madagascar**
- Part of a larger ongoing project quantifying radiations of ant biodiversity of Madagascar
  - Geometric morphometrics in 3D to question whether *Crematogaster* morphology is defined by ecology or phylogenetic affinity after repeatedly colonizing Madagascar
- March 2017  
- May 2017: **Evaluating Image Manipulation Software (Zoologisches Forschungsmuseum König, Bonn)**
- Testing and evaluating the Adobe alternatives Affinity Photo and Affinity Designer, creating a detailed walkthrough and giving workshops
- February 2016 **MSc student with Torsten Wappler & Jes Rust (Bonn University)**

- November 2017: **Reinvestigating *Titanomyrma* giant-ant fossils**
  - Geometric morphometric methods to recover the taxonomic affinities among giant-ant fossil species, with additional palaeoecological notes, published (see above)
  
- June 2016: **Synchrotron micro-CT (DESY National Research Center, Hamburg)**
  - Using the Petra III synchrotron x-ray beamline to generate tomograms of amber embedded fossil insects
  
- September 2015  
- April 2017: **Micro-CT 3D Reconstruction (University of Bonn, Steinmann Institut)**
  - Rendering 3D images out of micro-CT-scans of shark spines that are still embedded in dense Hunsrück slates
  
- August 2015: **Palaeontology Fieldwork (Agency of Cultural Heritage, Rhineland-Palatinate)**
  - Excavation of fossils in the Konservatlagerstätte Enspel
  
- February 2014  
- October 2014: **BSc student with Jes Rust (Bonn University)**  
**Extending the ecospace concept to horizontal deposit comparisons**
  - Inferring ecology of fossil bivalves and gastropods as 125 possible modes of life in ecospace for four different geological formations increasing the palaeoecological understanding of the middle German Tethys basin in the Oligocene

## EDUCATION

- 2018-2025: **Okinawa Institute of Science & Technology**  
**PhD in Evolutionary Biology**  
PhD thesis with Evan Economo: Investigating the evolution of ant mandibles to understand the diversification of form and function
  
- 2014-2016: **University of Bonn**  
**MSc in Geosciences (graduated with a 1.3, very good, average)**  
Master's thesis with Dr. Torsten Wappler and Prof. Jes Rust: Giant Ants and their Shape: Revealing Relationships in the Genus *Formicium* and Investigating Patterns among Formicidae by Applying Geometric Morphometrics
  
- 2011-2014: **University of Bonn**  
**BSc in Geosciences (graduated with a 1.7, good +, average)**  
Bachelor's Thesis with Prof. Jes Rust: Applying the Ecospace-Concept for the Oligocene Alzey-Fm. in the Mainz Basin
  
- 2001-2010: **Bertha-von-Suttner Gymnasium in Oberhausen, Rhld., Germany**  
**Valedictorian (graduated with a 1.2, very good, average)**

## TEACHING

- October 2023: **Co-organizing OIST Evolutionary Analysis of Morphology Workshop**
  - Eight-day course on fundamentals in geometric morphometric and phylogenetic comparative methods with a focus on analysing morphological data, lecturing on designing analysis workflows for 3D data

- March 2021:** **Teacher MiniCourse ‘Blender’ at OIST**  
 • Covering topics, such as basics in lighting, animation, and Python programming
- June 2020:** **Co-teacher MiniCourse ‘Phylogenetic Comparative Methods’ at OIST**  
 • Covering topics, such as discrete and continuous characters, evolutionary models, and evolutionary rates
- 2018-2020:** **Tutor and Coordinator: R programming language Skill Clinic**  
 • Tutoring researchers at OIST, organizing weekly meetings to coordinate the attendants and guide their skill fostering

## SUPERVISION

### Supervised Internship Projects:

- Henry Cerbone 2023:** **Constructing motion spaces of ant mandibles from microCT scans using vector embeddings**
- Arthur Matte 2023:** **Automated cuticle and body volume measurements from microCT scans with computer vision techniques**
- Leonardo Tozetto 2022:** **A potential convergently evolved developmental failsafe mechanism in *Strumigenys* trap-jaw ants**

## INVITED SEMINARS & LECTURES

- January 2026:** **State Museum of Natural History Stuttgart**  
 Invited by Dr. Michael Orr to present in the museum seminar series
- February 2025:** **University of Edinburgh**  
 Invited by Prof. Barbara Webb to present in her working group
- June 2022:** **University of Kiel**  
 Invited by Dr. Sebastian Büsse to present in Prof. Stanislav Gorb’s working group
- June 2022:** **University of Bonn**  
 Invited by Prof. Alexander Blanke to present in his working group
- November 2020:** **Guest Lecturer, Central Saint Martins, University of the Arts London, MA Biodesign**  
 Lecture on evolution and animal design invited by Dr. Alice Taylor

## AWARDS

- June 2025:** **Entomological Society of America**  
 Snodgrass Memorial Research Award
- January 2025:** **Society for Integrative & Comparative Biology Annual Meeting**  
 Best Student Presentation Award in the Division of Invertebrate Zoology

- August 2024:** **International Congress of Entomology 2024**  
Presentation Award for Young Scientists for best oral presentation
- March 2024:** **Entomological Society of America International Branch**  
International Branch Graduate Student Award
- November 2023:** **Entomology 2023**  
President's Prize 1<sup>st</sup> place for best presentation in Morphology category

## ACADEMIC SKILLS

### Computing:

- Computer Vision and Artificial Intelligence implementations in Python (training and application), within software frameworks, such as Torch, Tensorflow, Biomeidsa iTk, OpenCV, SciPy, etc.
- Using the programming languages **Python** and **R** to manage and analyse various data, such as 3D meshes, data sheets, phylogenetic trees, and geometric morphometric coordinates. Using
- Proficiency in the softwares **Amira/Avizo**, **Blender**, **MeshLab**, and **Drishti** to generate and process volumetric and mesh-data from  $\mu$ CT raw data
- Experience in scripting with various **Python APIs** to automate processes in software, such as Blender, Biomedisa, and Amira
- Proficiency in navigating and scripting in external computing clusters and high-performance-computing infrastructure with **bash**, **Slurm**, and **Python**

### Laboratory:

- Advanced usage of the **Zeiss Xradia 510 and 730 Versa**  $\mu$ CT scanners to generate high quality tomograms of arthropods with ethanol preserved soft tissues contrast enhanced with heavy metal staining
- Applying various protocols of **tissue fixation and staining** to obtain high-quality **micro-CT** scans, testing the effects of various fixatives, such as varying concentrations of alcohol, resins, aldehydes, tissue staining using Iodine, Phosphotungstic Acid, and Osmium
- Proficiency in setting up and using **3D printers** of the brands Formlabs using resin (SLA printing) and Ultimaker using filament (FDM printing)

### Scientific Courses Attended:

#### **The Machine Learning Summer School in Okinawa (March, 2024)**

- competitive summer school, topics at the core of modern Machine Learning, from fundamentals to state-of-the-art practice

#### **Finite Element Analysis Applied to Life Sciences (Transmitting Science, June, 2021)**

- Taught by Jordi Marcé-Nogué (Universitat Rovira i Virgili) and Josep Fortuny (Institut Català de Paleontologia), workflows and the physics background of FEA

#### **Geometric Morphometrics in R (Transmitting Science, January, 2020)**

- Taught by Julien Claude (University of Montpellier), workflows and statistics for geometric morphometric analysis in R

## **Ant Identification, Sampling and Ecology (Forestry Research Institute of Ghana & SOFIA Consortium under the Auspices of the Royal Society, January, 2019)**

- Course led by Catherine Parr (University of Liverpool) and supported by Peter Hawkes and Brian Fisher to convey the basics of myrmecology and ant sampling techniques

### **Languages:**

- English (fluent), German (native), Japanese (conversational), French and Spanish (basic), reading Cyrillic languages

## **ACADEMIC SERVICES**

### **Conference Symposium Organizer:**

The Joint Meeting of the Society of Population Ecology and Taiwan-Japan Ecology Workshop 2024. (November 2024). Ecomorphology – Measuring traits to link organisms and their environment.

### **Society Memberships:**

*Entomological Society of America*  
*International Society for Invertebrate Morphology*  
*Society for Integrative and Comparative Biology*

*Society of Evolutionary Studies Japan*  
*The Paläontologische Gesellschaft*

### **Peer Reviews for:**

*Proceedings of the Royal Society B*  
*Zoologischer Anzeiger*  
*Invertebrate Systematics*  
*Myrmecological News*  
*Journal of Hymenoptera Research*

*PeerJ*  
*Asian Myrmecology*  
*Neotropical Entomology*  
*Zoological Systematics*  
*Biol. Journal of the Linnean Soc.*

### **Visualization:**

#### **The New York Times (writer Cara Giaimo, 19 Dec 2025)**

- Ant cuticle thickness in 3D for the article “The Meek Really Did Inherit the Earth, at Least Among Ants” based on our Matte et al. 2025 *Sci. Adv.* publication

#### **Curatorial Cycle: collect, identify, process, disseminate. The curatorial cycle and the production of knowledge (Museums of the University of São Paulo, 2023)**

- 3D modelling, video editing, animation for Antscan display in the exhibition

#### **ZOMPOPA (artist Alexander Falk, 2021)**

- Creating ant 3D models for experimental short film

#### **PLoS Biology Issue Image (Vol. 19(3) April 2021)**

- *Strumigenys* head anatomy 3D rendering for article by Booher et al.

### **Outreach:**

Shuri Highschool, Naha, Okinawa (2024)

- Giving the lecture entitled “Zooming in to what makes ant special” focussing on ant diversity and morphology for Biology classes

#### **OIST Science Challenge (2023)**

- Introducing international postgraduate research to students in Japan, including an hourlong introduction to lab research at OIST and teaching how to make a good scientific poster

#### **TEDxOIST 2018**

- Organizing the event, which comprised ten talks, two performances and an attendance of more than 300 Japanese and international community members including simultaneous translation

#### **Academic Politics:**

##### **OIST Student Council (2022-2023)**

- Serving a term as the Constitutional Officer involving structural leadership, such as governing and coordinating critical assessments of the OIST Student’s Constitution, organizing and carrying out elections of the Student Council

##### **OIST Student Council (2020-2021)**

- Serving a term as executive officer for Faculty Affairs in the OIST student council involving representing student matters at the Faculty Assembly and negotiating common grounds with Graduate School administration towards OIST

## **ACADEMIC REFEREES**

### **Dr. Evan Economo**

Professor and Department Chair  
Entomology  
University of Maryland

Professor  
Biodiversity & Biocomplexity Unit  
Okinawa Institute of Science and Technology  
Graduate University

[economo@umd.edu](mailto:economo@umd.edu)  
+81 098 966 8866

### **Dr. Thomas van de Kamp**

Coordinating Scientist of Morphological  
Imaging, Head of IPS/LAS Biolab

Institute for Photon Science and Synchrotron  
Radiation (IPS), Laboratory for Applications of  
Synchrotron Radiation (LAS)

Karlsruhe Institute of Technology

[thomas.vandekamp@kit.edu](mailto:thomas.vandekamp@kit.edu)  
+49 721 608 28655