

Camrin D. Braun

School of Aquatic and Fishery Sciences
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EDUCATION

- Ph.D.** **Massachusetts Institute of Technology** Cambridge, MA
 Woods Hole Oceanographic Institution Woods Hole, MA
 Biological Oceanography, MIT-WHOI Joint Program in Oceanography Aug 2018
 Dissertation title: Oceanographic drivers of large pelagic fish movements
 in the North Atlantic Ocean. *Advisor: Dr. Simon Thorrold*
- M.Sc.** **King Abdullah University of Science and Technology** Thuwal, KSA
 Marine Science and Engineering, Red Sea Research Center July 2013
 Thesis title: Movement ecology of *Manta alfredi* in the eastern Red Sea.
 Advisor: Dr. Michael Berumen
- B.Sc.** **The College of Idaho** Caldwell, ID
 Environmental Studies and Conservation Biology, Summa cum laude May 2011
 Honors thesis title: Movements of juvenile whale sharks (*Rhincodon*
 typus) in the Red Sea. *Advisors: Dr. Chris Walser, Dr. Rochelle Johnson*

PROFESSIONAL EXPERIENCE

- 2019-present **Assistant Professor:** School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA USA.
- 2018-2019 **Postdoctoral Research Associate:** Applied Physics Laboratory, University of Washington, Seattle, WA USA. *Advisor: Dr. Peter Gaube.*
- 2013-2018 **Graduate Student:** Earth, Atmospheric and Planetary Sciences Department (MIT) and Biology Department (WHOI), Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program in Oceanography, Woods Hole, MA, USA. *Advisor: Dr. Simon Thorrold.*
- 2012-2013 **Graduate Student:** Red Sea Research Center, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia. *Advisor: Dr. Michael Berumen.*
- 2011-2012 **Research Assistant I:** Fish Ecology Lab, Biology Department, Woods Hole Oceanographic Institution. *Advisor: Dr. Simon Thorrold.*
- 2010 **Undergraduate Researcher:** NSF Research Experience for Undergraduates, Woods Hole Oceanographic Institution. *Advisors: Dr. Chris Walser and Dr. Simon Thorrold.*
- 2009 **Fisheries BioAide and Field Technician:** Anadromous Fish Program, Idaho Department of Fish and Game. *Supervisor: Chuck Warren.*

RESEARCH GRANTS AND FELLOWSHIPS

2018-2021	<i>New Investigator Program</i> , NASA: "Developing a mechanistic understanding of the influence of (sub)mesoscale features on the distribution and behavior of pelagic predators." PI: P. Gaube, APL. Co-I: C. Braun, APL	\$381,387
2018-2021	<i>Biodiversity and Ecological Forecasting</i> , NASA: "Supporting climate-ready, sustainable fisheries using satellites." PI: R. Lewison, SDSU. Co-I: C. Braun, APL	\$852,084
2017-2018	<i>The Explorers Club - Rolex Exploration Grant</i> : "The Secret Life of the World's Largest Fish." PI: C. Braun, MIT-WHOI	\$10,000
2016-2018	<i>Earth and Space Science Fellowship</i> , NASA: "The influence of mesoscale physical/biological interactions on large pelagic predators: a synergistic analysis of shark behavior and satellite observations." PI: C. Braun, MIT-WHOI	\$74,670
2016-2018	<i>Population Dynamics Fellowship</i> , NOAA Fisheries & Seagrant (<i>declined</i>): "Improved marine animal geolocation using hidden Markov models for data poor species." Co-PIs: C. Braun, MIT-WHOI and S. Thorrold, WHOI	\$78,434
2017	<i>Amazon Web Services Cloud Credits for Research Grant</i> , Amazon Web Services: "Developing predictive movement models for sharks in the open ocean." Co-PIs: C. Braun, MIT-WHOI and P. Gaube, APL-UW	\$16,848
2016-2017	<i>Ocean Ventures Fund</i> , Woods Hole Oceanographic Institution: "Mesoscale biophysical interactions drive large pelagic predators: a synergistic analysis of shark behavior and satellite observations." PI: C. Braun, MIT-WHOI	\$5,000
2016	<i>Steven Berkeley Marine Conservation Fellowship</i> , American Fisheries Society (<i>runner-up</i>): "Improved marine fish geolocation using hidden Markov models for data poor species." PI: C. Braun, MIT-WHOI	\$1,000
2015	<i>Martin Family Society of Fellows for Sustainability Fellowship</i> , Massachusetts Institute of Technology: "Human influence on pristine coral reefs and implications for management." PI: C. Braun, MIT-WHOI	\$60,000
2015	<i>John S. Hennessy Fellowship</i> , MIT: "Pristine coral reef foodwebs and implications for management." PI: C. Braun, MIT-WHOI	\$60,000
2015	<i>Grassle Fellowship</i> , Woods Hole Oceanographic Institution: "Biophysical interactions span trophic levels in the open ocean." PI: C. Braun, MIT-WHOI	\$10,000
2015	<i>Grants-in-Aid of Research</i> , Sigma Xi: "Human influence on pristine coral reefs and management implications." PI: C. Braun, MIT-WHOI	\$500
2015	<i>Summer Study Grant</i> , MIT Center for International Studies: "Multinational cooperation over the world's largest fish." PI: C. Braun, MIT-WHOI	\$3,150
2014-2016	<i>Access to the Sea Grant</i> , Woods Hole Oceanographic Institution: "The RAFOS Ocean Acoustic Monitoring (ROAM) tag: A new tool for tracking marine megafauna." Co-PIs: C. Braun, MIT-WHOI and S. Thorrold, WHOI	\$54,712
2014	<i>Young Explorer Grant</i> , National Geographic: "Pelagic pupping: reproduction in the world's largest fish." PI: C. Braun, MIT-WHOI	\$5,000
2013	<i>Coastal Ocean Institute Grant</i> , Woods Hole Oceanographic Institution: "Pelagic pupping: reproduction in the world's largest fish." PI: C. Braun, MIT-WHOI	\$1,500

2010-2011 *Student Research Grant*, The College of Idaho: "Movements of juvenile whale sharks in the Red Sea." PI: C. Braun, C of I \$1,500

HONORS AND AWARDS

2016 Outdoor 30 Under 30 Fellow
 2012 King Abdullah University of Science and Technology Provost Award
 2011 Graduated *Summa Cum Laude* at The College of Idaho
 2011 The College of Idaho Nel Tobias Award
 2011 The College of Idaho Scarab Award in recognition of academic excellence
 2010 Research Experience for Undergraduates Fellowship, National Science Foundation & Woods Hole Oceanographic Institution.
 2010 Abbott Award at The College of Idaho: "For scholarship, character, and effective participation in the life and work of the College."
 2010 Outstanding Environmental Studies Student Award at The College of Idaho
 2010 Best Poster in Ecology, Idaho Academy of Sciences Meeting
 2007 Heritage Scholarship (4 years full tuition) at The College of Idaho
 2007 Dean's Honors List at The College of Idaho, 11 of 12 semesters

PEER-REVIEWED PUBLICATIONS

Queiroz, N.,..., **C. D. Braun**,...D. W. Sims. in press. Global spatial risk assessment of sharks under the footprint of fisheries. *Nature*.

Braun C. D., P. Gaube, P. Afonso, J. Fontes, G. B. Skomal, S. R. Thorrold. 2019. Assimilating electronic tagging, oceanographic modeling, and fisheries data to estimate movements and connectivity of swordfish in the North Atlantic. *ICES Journal of Marine Science*, fsz106.

Arostegui M. C., P. Gaube, **C. D. Braun**. 2019. Movement ecology and stenothermy of satellite-tagged shortbill spearfish (*Tetrapturus angustirostris*). *Fisheries Research* 215: 21-26.

Arostegui M. C., **C. D. Braun**, P. Gaube. 2019. Movement patterns and thermal niche of the first satellite-tagged Mediterranean spearfish (*Tetrapturus belone*). *Fisheries Oceanography* 28: 327-333.

Gaube P., **C. D. Braun**, A. Della Penna, G. L. Lawson, D. J. McGillicuddy Jr., G. B. Skomal, S. R. Thorrold. 2018. Mesoscale eddies influence white shark movements in the open ocean. *Scientific Reports* 8: 7363.

Braun C. D., B. Galuardi, S. R. Thorrold. 2018. HMMoce: An R package for improved geolocation of archival-tagged fishes using a hidden Markov method. *Methods in Ecology and Evolution* 9: 1212-1220.

Sequeira A. M. M.,...**C. D. Braun**..., M. Thums. 2018. Convergence of marine megafauna movement patterns in coastal and open oceans. *Proceedings of the National Academy of Sciences* 115, 12.

Braun C. D., G. B. Skomal, S. R. Thorrold. 2018. Integrating archival tag data and a high-resolution oceanographic model to estimate basking shark (*Cetorhinus maximus*) movements in the western Atlantic. *Frontiers in Marine Science* 5.

- Skomal G. B., **C. D. Braun**, J. H. Chisholm, S. R. Thorrold. 2017. Movements of the white shark (*Carcharodon carcharias*) in the North Atlantic Ocean. *Marine Ecology Progress Series* 580: 1-16.
- Spaet J. L. Y., C. H. Lam, **C. D. Braun**, M. L. Berumen. 2017. Extensive use of mesopelagic waters by a Scalloped hammerhead shark (*Sphyrna lewini*) in the Red Sea. *Animal Biotelemetry* 5(1).
- Cochran J. E. M., R. S. Hardenstine, **C. D. Braun**, G. B. Skomal, S. R. Thorrold, K. Xu, M. G. Genton, M. L. Berumen. 2016. Population structure of a whale shark (*Rhincodon typus*) aggregation in the Red Sea. *Journal of Fish Biology* 89(3): 1570-1582.
- Coker D. J., **C. D. Braun**, J. Cavin, S. Payet, M. L. Berumen. 2016. Remote marine protected area reveals unusual social behavior in *Chaetodon trifascialis*. *Marine Biodiversity*: 1-2.
- Braun C. D.**, G. B. Skomal, S. R. Thorrold, M. L. Berumen. 2015. Movements of the reef manta ray (*Manta alfredi*) in the Red Sea using satellite and acoustic telemetry. *Marine Biology* 162(12).
- Braun C. D.**, M. B. Kaplan, A. Z. Horodysky, J. K. Llopiz. 2015. Satellite telemetry reveals physical processes driving billfish behavior. *Animal Biotelemetry* 3(1).
- Priest, M. A., G. R. Almany, **C. D. Braun**, R. J. Hamilton, D. F. Lozano-Cortés, et al. 2014. Isolation and characterization of 29 microsatellite markers for the bumphead parrotfish, *Bolbometopon muricatum*, and cross amplification in 12 related species. *Marine Biodiversity* 45(4): 861-866.
- Berumen M.L., **C.D. Braun**, J.E.M. Cochran, G.B. Skomal, S.R. Thorrold. 2014. Movement patterns of juvenile whale sharks tagged at an aggregation site in the Red Sea. *PLoS One* 9.
- Thorrold S. R., P. Afonso, J. Fontes, **C. D. Braun**, G. B. Skomal, M. L. Berumen. 2014. Extreme diving behavior in devil rays links surface waters and the deep ocean. *Nature Communications* 5.
- Braun C. D.**, G. B. Skomal, S. R. Thorrold, M. L. Berumen. 2014. Diving Behavior of the Reef Manta Ray Links Coral Reefs with Adjacent Deep Pelagic Habitats. *PLoS One* 9.
- Werry J. M., S. Planes, M. L. Berumen, K. A. Lee, **C. D. Braun**, E. Clua. 2014. Reef fidelity and migration of tiger sharks, *Galeocerdo cuvier*, across the Coral Sea. *PLoS One* 9.
- Walter R. T.,...**C. D. Braun**,...N. E. Hussey. 2013. First record of living *Manta alfredi* x *Manta birostris* hybrid. *Marine Biodiversity* 44: 1-2.
- Braun, C. D.** and C. A. Walser. 2011. The diet and distribution of largemouth bass (*Micropterus salmoides*) in the lower Boise River, Idaho. *Western North American Naturalist* 71(3): 316-326.

PENDING PUBLICATIONS [Drafts available on request]

- Cochran J. E. M., **C. D. Braun**, G. B. Skomal, S. R. Thorrold, M. L. Berumen. Acoustic telemetry reveals stark differences in residency behavior and movement ecologies among whale shark (*Rhincodon typus*) aggregations. In revision at *Marine Biology*.
- DiBattista J. D.,..., **C. D. Braun**,...M. L. Berumen. Population genomic response to an environmental gradient by widespread and endemic fishes of the Arabian Peninsula. In revision at *Molecular Ecology*.

Braun C. D., P. Gaube, T. H. Sinclair-Taylor, G. B. Skomal, S. R. Thorrold. Mesoscale eddies act as conduits connecting pelagic predators to mesopelagic ecosystems. In review at *PNAS*.

Boissin, E., S. R. Thorrold, **C. D. Braun**, Y. Zhou, E. E. Clua, S. Planes. Contrasting global, regional and local patterns of genetic structure in gray reef shark populations from the Indo-Pacific region. In review at *Scientific Reports*.

Afonso P., Y. Papastamatiou, S.R. Thorrold, P. Gaube, **Braun C. D.**. The function and significance of deep diving by large marine predators. In preparation for submission to *Trends in Ecology and Evolution*, anticipated June 2019.

Braun C. D., P. Gaube, P. Afonso, J. Fontes, G. B. Skomal, S. R. Thorrold. Use of the ocean Twilight zone by large pelagic predators. In preparation for submission to *Current Biology*, anticipated October 2019.

INVITED TALKS AND SEMINARS

Braun CD*, Furey H, Fisher G, Rossby T, Thorrold SR. 2019. The RAFOS Ocean Acoustic Monitoring (ROAM) tag: A highly accurate fish tag for at-sea movement studies. Invited plenary presentation, Portland, Oregon USA

Braun CD*. 2019. Predator ecology in a dynamic and changing ocean. Invited Smith-Stanford Chair seminar, Caldwell, Idaho USA.

Braun CD*. 2017. Dynamic ocean management: A fish perspective. Invited oral presentation at NASA-World Resources Institute workshop on ocean health and fisheries, Washington, DC.

Braun CD*. 2017. Letters from a sinking ship. Invited oral presentation at National Geographic Society, Washington, DC.

Braun CD*, Thorrold SR. 2017. The secret lives of sharks. Invited oral presentation at National Geographic Society Family Day, Washington, DC.

Braun CD*, Thorrold SR*. 2017. The science of JAWS. Invited oral presentation at Boston Symphony Orchestra, Lenox, MA.

Braun CD*, Thorrold SR. 2016. The secret lives of sharks. Invited oral presentation at Science Made Public, Woods Hole, MA.

Braun CD*, Galuardi B, Thorrold SR. 2016. Improved marine animal geolocation using hidden Markov models. Invited oral presentation, WHOI Biology Seminar Series, Woods Hole, MA.

Braun CD*, Thorrold SR. 2015. Tracking sharks in a dynamic ocean. Invited poster presentation at MIT Museum's Nautical Nights, Cambridge, MA.

Braun CD*. Lost at sea: studying fish movements without gills of our own. 2015. Invited oral presentation at KAUST Winter Enrichment Program, Thuwal, KSA.

Braun CD*, Thorrold SR. 2014. Population and migratory connectivity in ocean ecosystems. Invited oral presentation at Sea Education Association, Woods Hole, MA.

Braun CD*, Skomal GB, Thorrold SR, Berumen ML. 2013. Movement ecology of *Manta alfredii* in the Red Sea. Invited oral presentation, WHOI Biology Seminar Series, Woods Hole, MA.

Braun CD*, Skomal GB, Berumen ML, Thorrold SR. 2011. Movements of juvenile whale sharks (*Rhincodon typus*) in the Red Sea. Invited oral presentation at The College of Idaho Environmental Studies Seminar Series, Caldwell, ID.

CONFERENCE PRESENTATIONS

Braun CD*, Gaube P, Skomal GB, Thorrold SR. 2018. Mesoscale oceanography influences highly migratory shark movements. Ocean Sciences Meeting, Portland, OR (Domestic, Oral).

Thorrold SR*, McMahon K, **Braun CD**, Houghton LA, Berumen ML, Planes S. Reconciling functional and genetic diversity in fish communities on coral reefs in the central tropical Pacific by combining compound specific stable isotope analysis, population genetics and acoustic telemetry. 2018. Ocean Sciences Meeting, Portland, OR (Domestic, Oral).

Gaube P*, Thorrold SR, **Braun CD**, McGillicuddy Jr D, Lawson G. 2017. Mesoscale eddies influence white shark movements in the open ocean. ASLO Ocean Sciences, Honolulu, HI (International, Oral).

Braun CD*, Galuardi B, Thorrold SR. 2017. An improved hidden Markov method for geolocating archival-tagged fishes. Bio-Logging Symposium, Konstanz, Germany (International, Oral).

Gaube P*, Thorrold SR, **Braun CD**, McGillicuddy Jr DK, Lawson G, Skomal GB. 2016. The Use of Mesoscale Eddies and Gulf Stream Meanders by White Sharks *Carcharodon carcharias*. Ocean Sciences Meeting, New Orleans, LA (International, Oral).

Thorrold SR*, McMahon K, **Braun CD**, Berumen ML, Houghton LA. 2016. Tracing Carbon Flow Through Food Webs on Isolated Coral Reefs in the Central Pacific Ocean Using a Compound-Specific Stable Isotope Approach. Ocean Sciences Meeting, New Orleans, LA (International, Oral).

Braun CD*. 2016. Creeping climate constraint: A case study of the North Atlantic's pelagic predators. Graduate Climate Conference, Seattle, WA (National, Poster).

Braun CD*, Skomal GB, Thorrold SR, Berumen ML. 2016. Movements of the reef manta ray (*Manta alfredi*) in the Red Sea. International Coral Reef Symposium, Honolulu, HI (International, Poster).

Braun CD*, Skomal GB, Thorrold SR. 2014. Fidelity and migration of basking sharks in the Atlantic. Ocean Sciences Meeting, Honolulu, HI (International, Poster).

Afonso P*, **Braun CD**, Vandeperre F, Fontes J, Skomal GB, Thorrold SR. 2014. Deep diving in large pelagic fishes. 65th Tuna Conference, UCLA (International, Oral).

Braun CD*, Skomal GB, Thorrold SR, Berumen ML. 2013. Movement ecology of *Manta alfredii* in the eastern Red Sea. Indo-Pacific Fish Conference, Okinawa, Japan (International, Oral).

Berumen ML, **Braun CD***, Cochran JE, Skomal GB, Thorrold SR. 2013. Seascape-scale movements of whale sharks in the Saudi Arabian Red Sea. 3rd International Whale Shark Conference, Atlanta, GA (International, Oral).

Braun CD*, Berumen ML, Skomal GB, Thorrold SR. 2011. Movements of juvenile whale sharks (*Rhincodon typus*) in the Red Sea. American Elasmobranch Society and Joint Meeting of Ichthyologists and Herpetologists, Minneapolis, MN (National, Oral).

Braun CD*, Finch SL*. 2011. Butterflyfish (*Chaetodontidae*) distribution on the Heron Reef, Great Barrier Reef, Australia. International Marine Conservation Congress, Victoria, BC (International, Poster).

- Braun CD***, Walser CA. 2011. The diet and distribution of largemouth bass (*Micropterus salmoides*) in the lower Boise River, Idaho. The College of Idaho Student Research Conference, Caldwell, ID (Institutional, Poster).
- Braun CD***, Berumen ML, Skomal GB, Thorrold SR. 2011. Movements of juvenile whale sharks (*Rhincodon typus*) in the Red Sea. The College of Idaho Student Research Conference, Caldwell, ID (Institutional, Oral).
- Braun CD***, Walser CA. 2011. The diet and distribution of largemouth bass (*Micropterus salmoides*) in the lower Boise River, Idaho. Idaho Chapter of American Fisheries Society, Boise, ID (State, Poster).
- Braun CD***, Walser CA. 2011. The diet and distribution of largemouth bass (*Micropterus salmoides*) in the lower Boise River, Idaho. Idaho Statehouse, Boise, ID (State, Poster).
- Braun CD***, Finch SL. 2010. Butterflyfish (*Chaetodontidae*) distribution on the Heron Reef, Great Barrier Reef, Australia. The College of Idaho Student Research Conference, Caldwell, ID (Institutional, Poster).
- Braun CD***, Finch SL, Yensen E. 2010. Determining Southern Idaho Ground Squirrel (*Spermophilus brunneus endemicus*) Soil Preferences Using GIS Analysis. The College of Idaho Student Research Conference, Caldwell, ID (Institutional, Poster).
- Braun CD***, Finch SL. 2010. Butterflyfish (*Chaetodontidae*) distribution on the Heron Reef, Great Barrier Reef, Australia. Idaho Academy of Sciences, Twin Falls, ID (State, Poster). **Best Poster in Ecology**
- Braun CD***. 2009. Using GIS to model populations of redband trout, *Oncorhynchus mykiss gairdneri*, in the headwaters of the Owyhee River drainage. The College of Idaho Student Research Conference, Caldwell, ID (Institutional, Poster).

TEACHING AND MENTORSHIP

- 2018-present **Graduate mentor**, PhD candidate in MIT-WHOI Joint Program in Oceanography.
- Nov 2017 **Invited lecturer**. Birches School, Lenox, MA (50 elementary and secondary students).
- May 2017 **Invited lecturer**. Mullen Hall Elementary School, Falmouth, MA (300 elementary students).
- Nov 2016 **Invited lecturer**. Ecology, Evolution and Diversity, The College of Idaho. Instructor: C. Walser (35 undergraduate students).
- Spring 2016 **Teaching Assistant**, graduate-level Biological Oceanography, MIT-WHOI Joint Program in Oceanography. Conducted lectures and recitation sections, wrote and graded tests, problem sets and daily assignments, advised professors on student performance. Instructors: L. Mullineaux, A. Tarrant (5 graduate students).
- Feb 2015 **Invited lecturer**. Stonehill College, Easton, MA (50 undergraduates).
- Oct 2014 **Invited lecturer**. Yale School of Forestry and Environmental Studies field course, Woods Hole, MA (15 adv. undergraduates).
- Summer 2014 **Guest Lecturer**, On expedition in the Phoenix Islands Protected Area, Sea Education Association (25 advanced undergraduates).

Summer 2012 **High school mentor** for summer volunteer at WHOI.

Fall 2010 **Teaching Assistant.** Stream Ecology (lecture and lab). Instructor: C. Walser; The College of Idaho (30 undergraduates).

Spring 2010 **Course Development.** Designed and tested Advanced Geographic Information Systems syllabus.

2009 - 2011 **Student Mentor.** Heritage Scholar Program, The College of Idaho.

TECHNICAL SKILLS AND TRAINING

Programming languages: R (expert), Matlab (intermediate)

Analysis: R (writing libraries, parallel computing, statistics, mapping, graphics), High-performance computing via Amazon Web Services, L^AT_EX/Markdown, Github, Adobe Creative Suite (Illustrator, Photoshop)

Modeling: Generalized linear and additive modeling, boosted regression trees, brownian bridges, state-space, step selection functions, and other species distribution modeling approaches

GIS/Remote Sensing: GMT, QGIS, many cartographic utilities implemented in R, ArcGIS

OS: Mac, Linux/Ubuntu, Windows

Other: AAUS Scientific Diver, PADI Rescue and Advanced Diver, NAUI Drysuit and Nitrox, Part 107 certified commercial drone pilot, Wilderness First Aid

SYNERGISTIC AND SERVICE ACTIVITIES

Service: *Reviewer:* Animal Biotelemetry, Deep Sea Research Part II, Ecological Modelling, Journal of Fish Biology, Marine and Freshwater Research, Marine Ecology Progress Series, Methods in Ecology and Evolution, PeerJ, PLoS One, Science Advances

Grant reviewer: National Oceanographic Partnership Program (ONR, NASA, NSF, etc), National Science Foundation

Membership: American Elasmobranch Society, International Bio-logging Society, International Society for Reef Studies, Sigma Xi, The Oceanography Society, Society for Conservation Biology

Non-academic: *Explorer*, National Geographic; *Elected member*, The Explorer's Club; *Elected representative*, MIT-WHOI Joint Program Student Group; *Hall Director*, The College of Idaho; *Director*, Outdoor Education Program at The College of Idaho; *Resident Assistant*, The College of Idaho; *Lead Student Ambassador*, The College of Idaho Admissions; *Member*, Varsity Ski and Snowboard Team at The College of Idaho; *Student Mentor*, The College of Idaho Residence Life

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