

Camrin D. Braun

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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.*

RESEARCH GRANTS AND FELLOWSHIPS

- 2018-2021 *New Investigator Program, 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 *Biodiversity and Ecological Forecasting, NASA: "Supporting climate-ready, sustainable fisheries using satellites."* PI: R. Lewison, SDSU. Co-I: C. Braun, APL \$852,084
- 2017-2018 *The Explorers Club - Rolex Exploration Grant: "The Secret Life of the World's Largest Fish."* PI: C. Braun, MIT-WHOI \$10,000
- 2016-2018 *Earth and Space Science Fellowship, 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 *Population Dynamics Fellowship, NOAA Fisheries & Seagrant (declined): "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
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

HONORS AND AWARDS

2016 Outdoor 30 Under 30 Fellow

2012 King Abdullah University of Science and Technology Provost Award

PEER-REVIEWED PUBLICATIONS

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 press. *Scientific Reports*.

Cochran J. E. M., **C. D. Braun**, E. F. Cagua, M. F. Campbell, R. S. Hardenstine, A. Kattan, M. A. Priest, T. H. Sinclair-Taylor, G. B. Skomal, L. Sun, S. R. Thorrold, M. L. Berumen. Multi-method assessment of whale shark (*Rhincodon typus*) residency, distribution, and dispersal behavior at an aggregation site in the Red Sea. In press. *PLoS One*.

Braun C. D., P. Gaube, T. H. Sinclair-Taylor, G. B. Skomal, S. R. Thorrold. 2019. Mesoscale eddies act as conduits connecting pelagic predators to mesopelagic ecosystems. *Proceedings of the National Academy of Sciences* 35.

Queiroz, N.,..., **C. D. Braun**,...D. W. Sims. 2019. 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]

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*.

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 October 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 December 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).

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

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, Coral Reefs, 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

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