

Marcelo Araya-Salas


Assistant Professor/Research Associate | Universidad de Costa Rica


Centro de Investigación en Neurociencias & Escuela de Biología, Universidad de Costa Rica, San Pedro, San José, Costa Rica
(+506) 8712-4353 (Costa Rica) / (+1) 916-936-2723 (US)


✉ marcelo.araya@ucr.ac.cr  marceloarayasalas.weebly.com  www.github.com/maRce10


Publications ✳ [undergraduate mentee](#) | [open data/ reproducible research](#)


Peer Reviewed


Beltrán DF, **M Araya-Salas**, JL Parra, Stiles FG & A Rico-Guevara. 2022. The evolution of sexually dimorphic traits in ecological gradients: an interplay between natural and sexual selection in hummingbirds. *Proceedings of the Royal Society B*, 1989(289). 


Chaverri, G, M Araya-Salas, JP Barrantes, T Uribe-Etxebarria, M Peña-Acuña, AL Varela & J Aihartzta. 2022. Landing manoeuvres predict roost-site preferences in bats. *Journal of Experimental Biology*, 225(21). 


Montes-Rivas R✳, V Gamarra-Toledo, E López, & **M Araya-Salas**. 2022. Variación de la estructura del canto del Gorrión de Collar Rufo (*Zonotrichia capensis*) a lo largo de un gradiente urbano en el suroeste del Perú. *Ornitología Neotropical*, 133-141. 


Odom K, KE. Cain, ML. Hall, NE. Langmore, RA. MS. Kleindorfer, J. Karubian, L. Brouwer, ED. Enbody, JA. Jones, JL. Dowling, AV. Leitão, EI. Greig, C. Evans, AE. Johnson, KKA. Meyers, **M Araya-Salas**, MS. Webster. 2021. Sex role similarity and sexual selection predict male and female song elaboration and dimorphism in fairy-wrens. *Ecology and Evolution*. 


Keen SC, KJ Odom, MS Webster, GM Kohn, TF Wright & **M Araya-Salas**. 2021. A machine learning approach for classifying and quantifying acoustic diversity. *Methods in Ecology and Evolution*. 


Odom K, **M Araya-Salas**, J Morano, R Ligon, G Leighton, C Taff, A Dalziell, A Billings, R Germain, M Pardo, L Guimarães, D Hedwig, S Keen, Y Shiu, R Charif, M Webster & A Rice. 2021. Comparative bioacoustics: a roadmap for quantifying and comparing animal sounds across diverse taxa. *Biological Reviews*. 


Keenan EL, Odom KJ, **M Araya-Salas**, KG Horton, M Strimas-Mackey, MA Meatte, NI Mann, PJ Slater, JJ Price, and CN Templeton. 2020. Breeding season length predicts duet coordination and consistency in Neotropical wrens (Troglodytidae). *Proceeding of the Royal Society B*. 20202482. 


Grabarczyk E, **M Araya-Salas**, Vonhof M, Gill S. 2020. Anthropogenic noise affects female, not male house wren response to change in signaling network. *Ethology*. 2020; 00: 1–10. 


Araya-Salas M, A Hernández-Pinsón N Rojas✳, G Chaverri. 2020. Ontogeny of an interactive call-and-response system in Spix's disc-winged bats. *Animal Behaviour*. 166, 233-245. 


Smith-Vidaurre G, **M Araya-Salas**, T. Wright. 2019. Individual signatures outweigh social group identity in contact calls of a communally nesting parrot. *Behavioral Ecology*. 31(2): 448-458. 


Griessot A, **Araya-Salas M**, Jakubas D, Kidawa D, Boehnke R, Katarzyna Błachowiak-Samotył, Katarzyna Wojczulanis-Jakubas. 2019. Parental coordination of chick provisioning in a planktivorous Arctic seabird under divergent conditions on foraging grounds. *Frontiers in Ecology and Evolution*. 7 (349):1-13. 


Araya-Salas M, G Smith-Vidaurre, DJ Mennill, P González-Gómez, J Cahill, TF Wright. 2019. Social group signatures in hummingbird displays provide evidence of co-occurrence of vocal and visual learning. *Proceedings of the Royal Society B*. 286: 20190666 


Araya-Salas M, G. Smith-Vidaurre, M. Webster. 2017. Assessing the effect of sound file compression and background noise on measures of acoustic signal structure. *Bioacoustics* 4622, 1–17 

González-Gómez P, **M Araya-Salas**. 2019. Perspectives on the Study of Field Hummingbird Cognition in the Neotropics. In: *Behavioral Ecology of Neotropical Birds*. Juan Carlos Rebores, Vanina D. Fiorini & Diego T. Tuero (eds) 


Rivera-Cáceres KD, E Quirós-Guerrero E, **M Araya-Salas**, CN Templeton, WA Searcy. 2018. Early development of vocal interaction rules in a duetting songbird. *Royal Society Open Science*. 5, 171791. **press coverage:** [Scientific American Podcast](#) 

Araya-Salas M, P González-Gómez, K Wojczulanis-Jakubas, V López III ✨ & TF Wright. 2018. Spatial memory is as important as weapon and body size for territorial ownership in a lekking hummingbird. *Scientific Reports*, **press coverage:** [Cornell Chronicles](#), [Phys.org](#), [LongRoom News](#), [AAAS EurekAlert!](#), [Adirondack Almanack](#), [La Nación](#) 


Wojczulanis-Jakubas K, **M Araya-Salas**, D Jakubas. 2018. Seabird parents provision their chick in a coordinated manner. *PLOS One*. 13, e0189969 


Araya-Salas M, G Smith-Vidaurre. 2017. warbleR: an R package to streamline analysis of animal acoustic signals. *Methods in Ecology and Evolution*. 8, 184-191. 


Araya-Salas M, K Wojczulanis-Jakubas, E Phillips ✨, DJ Mennill, and TF Wright. 2017. To overlap or not to overlap: context-dependent coordinated singing in long-billed hermits. *Animal Behaviour*. 124, 57-65. 


Rivera-Caceres K., E. Quirós-Guerrero, **M. Araya-Salas**, W.A. Searcy. 2016. Neotropical wrens learn new duet as adults. *Proceedings of the Royal Society B*. 285, 20161819. 


Ibarra, V, **M. Araya-Salas**, Y.P. Tang, C. Park, A. Hyde, T.F. Wright, W. Tang. 2015. An RFID Based Smart Feeder for Hummingbirds. *Sensors*. 15: 31751-31761. 


Medina-Garcia, A., **M. Araya-Salas**, T. Wright. 2015. Does vocal learning accelerate acoustic diversification? Evolution of contact calls in Neotropical parrots. *Journal of Evolutionary Biology*. 28: 1782–1792. 


González-Gómez P., P. Razeto-Barry, **M. Araya-Salas**, C. F. Estades. 2015. Does Environmental heterogeneity promote cognitive abilities? *Integrative and Comparative Biology*. 


Rico-Guevara, A., **M. Araya-Salas**. 2015. Bills as daggers? A test for sexually dimorphic weapons in a lekking hummingbird species. *Behavioral Ecology*. 26, 21-29. **Both authors contributed equally** (Editor's choice, OTS Graduate Student Paper Award, **press coverage:** [Discovery News](#), [IFL Science](#), [Science News](#), [La Vanguardia](#)) 

Rodríguez R **M. Araya-Salas**, David A. Gray, M. Reichert, L. Symes, M. Wilkins, R. Safran, G. Höbe. 2015. How acoustic signals scale with individual body size: common trends across diverse taxa. *Behavioral Ecology*. 26, 168-177. 


Araya-Salas M, T. Wright. 2013. Open-ended song learning in a hummingbird. *Biology Letters*. 9, 20130625 (Press coverage: [earthtimes.org](#), [National Geographic](#)) 

Araya-Salas M, G. Barrantes. 2013. Variación geográfica y posibles mecanismos de evolución cultural en *Microcerculus philomela*. *Zeledonia*. 17, 24-34. 

Arévalo, JE, **M. Araya-Salas**. 2013. Collared Forest-Falcon preying on Chestnut-mandibled Toucan in Costa Rica. *Wilson Journal of Ornithology*. 125, 212-216. 

Araya-Salas, M. 2012. Is bird song music? Evaluating harmonic intervals in songs of a Neotropical songbird. *Animal Behaviour*. 84: 309-313. *Editor's choice*. *press coverage*: *Radio Leonardo* WDR 5 (Germany), *ScienceNOW*, *Psychology Today*, *La Nacion*. 

Non-Peer Review

Araya-Salas, M. 2012. Is bird-song music? *Significance Magazine*. 9. 4-7. 

Working Papers

Beltrán DF, M Araya-Salas, JL Parra, FG Stiles, A Rico-Guevara. *In review*. The evolution of sexually dimorphic traits in ecological gradients: an interplay between natural and sexual selection in hummingbirds.

Gioiosa M, M Araya-Salas, C Castillo-Salazar, S Chaves-Ramirez, M Gioiosa, N Rojas, M Sanchez, D Scaravelli, G Chaverri,. *In review*. Landing manoeuvres predict roost-site preferences in bats.

Montes-Rivas R, V Gamarra-Toledo, E López, M Araya-Salas. *In review*. Variación de la estructura del canto del gorrión de collar rufo (*Zonotrichia capensis*) a lo largo de un gradiente urbano en el Suroeste del Perú

Chaverri G, M Araya-Salas, JP Barrantes, T Uribe-Etxebarria, M Peña-Acuña, AL Varela, J Aihartza. *In review*. Landing manoeuvres predict roost-site preferences in bats.

Araya-Salas M, X Obregón, C Sánchez, J Sánchez. *In prep*. Evidence suggests heterospecific vocal imitation in scaly-breasted hummingbirds.

Araya-Salas M. *In prep*. A search for harmonicity in songbird vocalizations.

Araya-Salas M, D. Caetano, M. Webster. *In prep*. Evolutionary dynamics of vocal complexity in a vocal learning clade.

A García-Rodríguez, Araya-Salas M, G Costa. *In prep*. Geography, topography and climate in the divergence of mating calls in Neotropical frogs.

Araya-Salas M, A Rico-Guevara, G Stiles, T Wright. *In prep*. Complex cultural evolution of learned vocal signals in a lekking hummingbird.

Software packages

<i>PhenotypeSpace</i> : quantifying phenotypic trait spaces	https://marce10.github.io/PhenotypeSpace	Author, Maintainer
<i>ohun</i> : optimizing acoustic signal detection	https://marce10.github.io/ohun	Author, Maintainer
<i>sketchy</i> : research compendiums for data analysis in R	https://CRAN.R-project.org/package=sketchy	Author, Maintainer
<i>dynaSpec</i> : dynamic spectrogram visualization in R	https://CRAN.R-project.org/package=dynaSpec	Co-author, Maintainer
<i>baRulho</i> : quantifying (animal) sound transmission and degradation	https://CRAN.R-project.org/package=baRulho	Author, Maintainer
<i>NatureSounds</i> : collection of example animal sounds for bioacoustic analysis	https://CRAN.R-project.org/package=NatureSounds	Author, Maintainer
<i>Raven</i> : exchange data between R and Raven	https://CRAN.R-project.org/package=Raven	Author, Maintainer
<i>warbleR</i> : analysis of animal acoustic signals	https://CRAN.R-project.org/package=warbleR	Co-author, Maintainer

Professional preparation

University of Costa Rica	Postdoctoral Research Associate	2018
Cornell University	Postdoctoral Research Associate	2016
New Mexico State University	Ph.D. in Biology	2015

Biology Department	Emphasis: Behavioral and Evolutionary Biology Dissertation: Intra-sexual selection and signaling behavior in the long-billed hermit (<i>Honorable mention</i>) Committee: Timothy Wright (advisor), Karen Mabry, William Boecklen	
University of Costa Rica Biology Department	Licenciate in Zoology Dissertation: Microgeographic song variation in the nightingale wren (<i>Honorable mention</i>)	2010
University of Costa Rica Music Department	Minor in Teaching of Music	2008
University of Costa Rica Biology Department	Bachelor of Science Emphasis: Biology	2005

Teaching

Analysis of animal acoustic signals in R Coordinator, Graduate Level	BOKU International Wildlife Lectures, University of Natural Resources and Life Sciences, Vienna, Austria	Spring 2022
Open Science and Reproducible Research Coordinator, Graduate Level	Biology Department, University of Costa Rica	Fall 2020
Bioinformatics in R Coordinator, Graduate Level	Medical School, University of Costa Rica	Fall 2020
Bioacoustic Analysis in R Coordinator, Online, Graduate Level	Organization for Tropical Studies	Spring 2020
Advance R Programming for Biological Sciences : Coordinator, Graduate Level	Cornell University	Spring 2018
Programming and Advance Statistical Methods in R Coordinator, Graduate and Undergraduate Level	Biology Department, University of Costa Rica (course website)	2019-2021
Phylogenetic Comparative Methods : Graduate and Undergraduate Level	Biology Department, University of Costa Rica	Spring 2016
Zoology Laboratory Teaching Assistant, Undergraduate Level	New Mexico State University	2011-2014
Human Biology Laboratory Teaching Assistant, Undergraduate Level	Biology Department, University of Costa Rica	2010-2011
General Ecology Lecturer, Undergraduate Level	Latin University of Costa Rica	2010
Field Biology Teaching Assistant, Undergraduate Level	Biology Department, University of Costa Rica	Spring 2010
Bioacoustics Teaching Assistant, Undergraduate Level	Biology Department, University of Costa Rica	Fall 2009

Mentoring

Advisor	MasterProgram in Biology, University of Costa Rica (Marcos Quiroz)	2021
Advisor	Licenciate Program in Science, University of Costa Rica (Fabiola Chirino)	2021
Committee Member	Master Program in Science, University of Costa Rica (Andrea Arriaga)	2021

Committee Member	Licentiate Program in Science, University of Costa Rica (Hector Andres Hernandez)	2020
Committee Member	Master Program in Science, Instituto de Ecología, A.C. Xalapa, Mexico (Paula Iturralde)	2020
Intern Mentor	Training in Analysis of Acoustic Signals in R. Cornell Lab of Ornithology. (Marco Ortiz, PhD candidate, UNAM)	2017
REU Mentor	La Selva Biological Station. Costa Rica. Coordinator: Dr. C. Ganong	2019 2015-2016
External Supervisor	El Colegio de la Frontera Sur (ECOSUR), Mexico. Master Student (Xochitl Sanloz)	2016-present
	University of Utrecht, the Netherlands Master Student Research Experience (Judith Smit)	2017
Field Work Training	14 undergraduates trained in field work and data analysis for behavioral ecology research. At least 4 of these students have started graduate studies (UC Davis, Universidad de Costa Rica (2), Universidad Autónoma de Campeche (Mexico)).	2010-2015

Professional service

Invited Participant	Interdisciplinary multi-species bioacoustics workshop. Heidelberg Academy of Sciences, Heidelberg, Germany	2019
Instructor	Acoustic Analysis in R Course, Statistics Workshop, Organization for Tropical Studies (course website)	2022 2020-2022
	Bioacoustic Analysis in R, Organization for Tropical Studies, (course website)	
	Workshop on Bioacoustic Approaches in Ecology and Animal Behavior. National Autonomous University of Mexico (UNAM), Mexico City, Mexico	2019
	Workshop on Bioacoustic Analysis in R. University of Gdańsk, Gdańsk, Poland	
	Workshop on Bioacoustic Analysis in R. Universidad Nacional de San Agustín, Arequipa Peru	2016
	Workshop on Bioacoustic Analysis in R. American Ornithological Society meeting. Arizona, US	
	Workshop on Bioacoustic Analysis in R. National Autonomous University of Nicaragua, Managua, Nicaragua	
	Workshop on Bioacoustic Analysis in R. International Bioacoustics Congress, Murnau, Germany	2015
	Workshop on Bioacoustic Analysis in R. National University. OTS Station, Palo Verde, Costa Rica	2015
	Bioacoustics Workshop. II & III Costa Rican Conference of Ornithology. Costa Rican Ornithologist Union. San José, Costa Rica	2010 2012
	Ornithology Workshop. Costa Rican Association of Ornithology (AOCR).	2009
Invited Professor	Neotropical Ornithology. Neurobiology and Behavior, Cornell University, Punta Cana, Dominican Republic . Coordinator: Dr André Dhondt	2018
	Undergraduate Abroad Experience Program (CHANCE), Penn State University. La Selva Biological Station, Costa Rica . Coordinator: Dr. J. McLaughlin	2014-2017
	Tropical Ecology and Conservation Course. Graduate Program, Organization for Tropical Studies. Costa Rica . Coordinators: Dr. F. Soley and MSc. F. Chinchilla.	2014-2017 2019-2021
Assistant instructor	Phylogenetic Approaches to the Study of Acoustic Signals. International Bioacoustics Congress, Pirenópolis, Brazil	2013
Reviewer	<i>Evolution, American Naturalist, Behavioral Ecology and Sociobiology Animal Behaviour, Methods in Ecology and Evolution, Journal of Experimental Biology, Bioscience, Plos One, Revista de Biología Tropical</i>	2013-present

Training

Phylogenetic data analysis using R	PR Statistics. Dr Emmanuel Paradis. Glasgow. Scotland	2016
Current Issues in Statistical Ecology	National Institute for Mathematical and Biological Synthesis (NIMBioS), Knoxville, Tennessee, USA	2015
Phylogenetic Comparative Methods	Universidad de los Andes, Colombia. Coordinators: Dr. L. Harmon and Dr. L. Revell	2014
Ecology and Conservation of Neotropical Birds	Graduate Program, Organization for Tropical Studies. Coordinators: Dr. J. Blake and Dr. B. Loiselle. Costa Rica.	2009
Bioacoustics Workshop	Montecristo, El Salvador. Animal Ecology and Biodiversity Department, Xalapa Ecology Institute. Coordinator: MS. F. González-García.	2009
Tropical Ecology and Conservation	Graduate Program, Organization for Tropical Studies. Costa Rica. Coordinators: Dr. A. Farji-Brener and MS. F. Chinchilla.	2008

Fellowships

Postdoctoral Fellowship	University of Costa Rica	2018
Edward W. Rose Postdoctoral Fellowship	Laboratory of Ornithology, Cornell University	2016
Outstanding OSNA Society Membership	Ornithological Societies of North America	2011
Training in analysis and interpretation of animal vocalizations	Institute of Experimental Ecology, Biology Department, University of Ulm. Germany. Advisors: Dr. E. Kalko and Dr. M. Schapka.	2008
Partners in Flight Bird Monitoring Program-Latin American Fellowship	Field Research Assistant and Environmental Education and Outreach. Klamath Bird Observatory, Oregon, USA.	2007

Conference Participation and Talks

“Social learning and the (cultural) evolution of song in hummingbirds”, talk at National Museum of Natural Sciences, CSIC, Madrid, Spain		2019
Presentation at Forum: "Agentes de investigación e innovación", University of Costa Rica		2019
“Song cultural evolution over five decades in a lekking hummingbird”. Behavior Conference. Chicago, USA. First prize Founders award for overall outstanding poster.		2019
“Evolutionary dynamics of vocal complexity in a vocal learning clade”. Polish Evolution Conference, Gdansk, Poland		2019
“Brain or brawn: spatial memory is more important than weapon or body size in predicting territory ownership in wild lekking hummingbirds”. International Bioacoustics Conference, Haridwar, India		2017
“Evolution and diversification of learned vocal signals in Parrots”. Bioacoustics research in Latin America special session. Conference of the Acoustic Society of America. Oral presentation.		2015
“Vocal learning and the diversification of Parrot contact calls”. Modern Phylogenetic Comparative Methods Conference. Seville, Spain. Oral presentation.		2014
“Bills as daggers? A test for sexually dimorphic weapons in a lekking hummingbird”. VI Costa Rican Conference of Ornithology. Costa Rican Ornithologist Union. San José, Costa Rica. Oral presentation.		2014
“Ecological and anatomical conservatism and the evolution of learned contact calls in Neotropical parrots”. Association for Tropical Biology and Conservation 50th Conference. San José, Costa Rica. Oral presentation.		2013
“Bills as daggers? A test for sexually dimorphic weapons in a lekking hummingbird”. Animal Behaviour Society Conference. Boulder, Colorado, Poster.		2013
“Evidence suggests heterospecific vocal imitation in scaly-breasted hummingbirds”. Pirenopolis, Brazil, Oral presentation.		2013

“Open-ended song learning in a hummingbird. International Bioacoustics Congress. Pirenopolis, Brazil, Oral presentation.	2013
Is bird song music? Evaluating harmonic intervals in songs of a Neotropical songbird. III Costa Rican Conference of Ornithology. Costa Rican Ornithologist Union. San José, Costa Rica. Oral presentation.	2012
“Identifying stopover hotspots and their conservation status for Nearctic migratory land birds in Costa Rica”. XIV Conference of the Sociedad Mesoamericana para la Biología y la Conservación. San José, Costa Rica. Oral presentation.	2010

Funding and Awards

NLBIF grant for developing and open-access online repository for bat vocalizations, in collaboration with Dr. Gloriana Chaverri and Dr. Williem-Pier Velinga	Netherlands Biodiversity Information Facility (NLBIF) € 11 440	2021
Internal UCR grant for the development of automatic behavioral monitoring devices for small vertebrates	University of Costa Rica. \$14 000	2021
UCREA-UCR grant for Advances Studies, in collaboration with Dr. Veronica García-Castro	University of Costa Rica. \$15 000	2020
First prize Founders award for overall outstanding poster	Animal Behaviour Conference	2019
Outstanding Graduate Assistantship	Graduate School, New Mexico State University. \$2000	2015
Research Grant	British Ornithologist’s Union. Co-PI. \$1500	2015
Award for Graduate Excellence in Research	Biology Department, New Mexico State University. \$1000	2015
Interdisciplinary Research Grant	New Mexico State University. Collaborator. PI: Timothy Wright (NMSU). \$29 000	2013
Merit-based Enhancement Award	Graduate School New Mexico State University. \$4000	2013
National Geographic Society Research Grant	PI Timothy Wright, New Mexico State University. Collaborator. \$19,212	2012
Animal Behavior Society Research Grant	Dissertation Research Project. \$1250	2012
Organization for Tropical Studies Research Grant	Doctoral thesis research project. \$3420	2011
Research Grant	Costa Rican Association of Ornithology (AOCR). Licentiate thesis research project. \$500	2009

Press Coverage

Nature News and Views	Hummingbirds look and learn	2019
Scientific American Podcast	How baby birds learn duets (co-author Karla Rivera-Caceres)	2018
La Nación	La inteligencia es más importante que el físico en los colibríes al conseguir pareja	2018
Cornell Chronicles	Spatial memory allows hummingbirds to rule the roost	2018
AAS Eurekalert!	Brainpower wins over brawn when male hummingbirds display for mates	2018
The Pulse Podcast (why.org)	A biological debate: is bird song music?	2018
Phys.org	Songbirds in Costa Rica learn new duets when paired with new mate	2017
PBS Nature Series	Super Hummingbirds (~1 h documentary)	2016
Nature World News	Fencing hummingbirds stab	2014
La Vanguardia	Pico como arma de combate	2014
Time	Hummers stab with beaks	2014
Discovery News	Beaks as weapons	2014
IFL Science	Beaks as daggers	2014

Uconn Today	Fighting for females	2014
Science News	Hummers stab rivals with beaks	2014
NMSU News Center	Smart feeders	2014
Techietonics.com	Hummingbirds too can create new tunes	2013
Redorbit	Open-ended song learning in a hummingbird	2013
National Geographic	Hummingbirds May Change Their Tunes to Seduce Mates	2013
Earthtimes	Hummingbirds change their tunes	2013
Music cognition	Is bird song music?	2012
The Catholic Thing	Beauty and bird song	2012
ScienceNow	Bird song not music, after all	2012
La Nación	Cantos de aves difieren de frecuencias musicales	2012