

RACHEL PAGE

Smithsonian Tropical Research Institute • MRC 0580-12 • Apartado 0843-03092
Panamá, República de Panamá • PageR@si.edu

STRI website: stri.si.edu/scientist/rachel-page
Page Lab website: noseleaf.org

PROFESSIONAL APPOINTMENTS

Smithsonian Tropical Research Institute (11/2009–present), Panama

Staff Scientist

Vertebrate behavior, predator-prey interactions, sensory and cognitive ecology of foraging, effect of eavesdroppers on signal evolution

Max Planck Institute for Ornithology (10/2008–10/2009), Seewiesen, Germany

Humboldt Postdoctoral Research Fellow

Comparative cognition in bats: Ecological correlates of learning and novelty response; Host: Björn Siemers

AFFILIATE INSTITUTIONS

McGill University (1/2014–present), Montreal, Canada

Adjunct Professor, Department of Biology, Faculty of Science

Dartmouth College (8/2018–present), Hanover, New Hampshire, USA

Visiting Scholar, Department of Biological Sciences. Host: Hannah ter Hofstede

University of Auckland and University of Otago (1/2017–1/2018), New Zealand

Sabbatical Researcher. Hosts: Stuart Parsons and Mike Paulin

EDUCATION

University of Texas at Austin (2002–2008), Austin, Texas

Ph.D. in Ecology, Evolution & Behavior, Section of Integrative Biology, Advisor: Michael J. Ryan

- Foraging flexibility in the frog-eating bat, *Trachops cirrhosus*

Columbia University (1992–1996), New York, New York

B.A. East Asian Languages and Cultures, Concentration in Anthropology

PUBLICATIONS

2020

98. Brown BKG, Leffer L, Valverde Y, Toshkova N, Nystrom J, Page RA, Carter GG. 2020. Do bats use guano and urine stains to find new roosts? Tests with three group-living bats. *Royal Society Open Science* 7: 201055. doi: 10.1098/rsos.201055. 10.1098/rsos.201055.
97. Carter GG, Farine DR, Crisp RJ, Vrtillek JK, Ripperger SP, Page RA. 2020. Development of new food-sharing relationships in vampire bats. *Current Biology*. 30: 1275-1279. e1273. doi: 10.1016/j.cub.2020.01.055.
96. Flores V, Carter GG, Halczok TK, Kerth G, Page RA. 2020. Social structure and relatedness in the fringe-lipped bat (*Trachops cirrhosus*). *Royal Society Open Science*. 7: 192256. doi: 10.1098/rsos.192256.
95. Geipel I^{*}, Kernan CE^{*}, Litterer AS, Carter GG, Page RA[#], ter Hofstede HM[#]. ^{*}Co-first authors; [#]Co-last authors. 2020. Predation risks of signalling and searching: bats prefer moving katydids. *Biology Letters*. 16: 20190837. doi: 0.1098/rsbl.2019.0837.
94. Hemingway CT, Ryan MJ, Page RA. 2020. State-dependent learning influences foraging behaviour in an acoustic predator. *Animal Behaviour*. 163: 33-38.
93. Hermanns K, Marklewitz M, Zirkel F, Overheul GJ, Page RA, Loaiza JR, Drosten C, van Rij RP, Junglen S. 2020. Agua Salud alphavirus defines a novel lineage of insect-specific alphaviruses discovered in the New World. *Journal of General Virology*. 101: 96-104.
92. Hiller T, Brändel SD, Honner B, Page RA, Tschapka M. 2020. Parasitization of bats by bat flies (Streblidae) in fragmented habitats. *Biotropica* 00:1–14. doi: 10.1111/btp.12757.
91. Jones PL, Divoll TJ, Dixon MM, Aparicio D, Cohen G, Mueller U, Ryan MJ, Page RA. 2020. Sensory ecology of the frog-eating bat, *Trachops cirrhosus*, from DNA metabarcoding and behavior. *Behavioral Ecology*.
90. Kohles JE, Carter GG, Page RA, Dechmann DKN. 2020. Social foraging bats discriminate between group members based on search-phase echolocation calls. *Behavioral Ecology*. 10.1093/beheco/araa056.
89. Paraskevopoulou S, Pirzer F, Goldmann N, Schmid J, Corman VM, Gottula LT, Schroeder S, Rasche A, Muth D, Drexler JF, Heni AC, Eibner GJ, Page RA, Jones TC, Müller MA, Sommer S, Glebe D, Drosten C. 2020. Mammalian deltavirus without hepadnavirus coinfection in the neotropical rodent, *Proechimys semispinosus*. *Proceedings of the National Academy of Sciences* 117: 17977-17983. doi: 10.1073/pnas.2006750117.
88. Ripperger SP, Carter GG, Page RA, Duda N, Koelpin A, Weigel R, Hartmann M, Nowak T, Thielecke J, Schadhauer M, Robert J, Herbst S, Meyer-Wegener K, Wägemann P, Schröder-Preikschat W, Cassens B, Kapitza R, Dressler F, Mayer F. 2020. Thinking small: Next-generation sensor networks close the size gap in vertebrate biologging. *PLOS Biology*. 18: e3000655.

87. Stockmaier S, Bolnick DI, Page RA, Carter GG. 2020. Sickness effects on social interactions depend on the type of behaviour and relationship. *Journal of Animal Ecology*. 1-18. doi: 10.1111/1365-2656.13193.
86. Szczygieł H, Page RA. When the hunter becomes the hunted: foraging bat attacked by pit-viper at frog chorus. *Ecology*. e03111. doi: 10.1002/ecy.3111.
85. ter Hofstede HM, Symes LB, Martinson SJ, Robillard T, Faure P, Madhusudhana S, Page RA. 2020. Calling songs of Neotropical katydids (Orthoptera, Tettigoniidae) from Panama. *Journal of Orthoptera Research*.
84. Velilla E, Muñoz M, Quiroga N, Symes L, ter Hofstede HM, Page RA, Simon R, Ellers J, Halfwerk W. 2020. Gone with the wind: Is signal timing in a neotropical katydid an adaptive response to variation in wind-induced vibratory noise? *Behavioral Ecology and Sociobiology*. 74: 1-11. doi: 10.1007/s00265-020-02842-z.

2019

83. Berrío-Martínez J, Kaiser S, Nowak M, Page RA, Carter GG. 2019. The role of past experience in development of feeding behavior in common vampire bats. *PeerJ*. 7:e7448.
82. Cronin AD, Ryan MJ, Page RA, Hunter KL, Taylor RC. 2019. Environmental heterogeneity alters mate choice behavior for multimodal signals. *Behavioral Ecology and Sociobiology*. 73:43.
81. Dixon MM, Hulgard K, Ratcliffe JM*, Page RA*. 2019. Habituation as an indicator of ecological relevance: Insights into the foraging ecology of a frog-eating bat. *Behavioral Ecology and Sociobiology*. *Ratcliffe and Page contributed equally to this work. 73:101. doi: 10.1007/s00265-019-2700-1.
80. Flores EE, Batista A, Rodríguez V, Page RA. 2019. Vicente's poison frog (*Oophaga vicentei*) in the wild: calling activity, bioacoustics and diet. *The Herpetological Bulletin*. 149: 11-17.
79. Flores E, Page RA, Aparicio D. 2019. *Pristimantis moro*. *Herpetological Review*. 50: 97-98.
78. Flores V, Mateo JM, Page RA. 2019. The role of male forearm crust odor in fringe-lipped bats (*Trachops cirrhosus*). *Behaviour*. 156: 1-24. doi: 10.1163/1568539X-00003573.
77. Geipel I*, Amin B*, Page RA†, Halfwerk W†. 2019. Does bat response to traffic noise support the misleading cue hypothesis? *Behavioral Ecology*. 30: 1775–1781. doi: 10.1093/beheco/arz148. *Joint first authors; †Joint senior authors.
76. Geipel I, Smeekes MJ, Halfwerk W, Page RA. 2019. Noise as an informational cue for decision-making: the sound of rain delays bat emergence. *The Journal of Experimental Biology*. jeb.192005.
75. Gessinger G*, Gonzalez-Terrazas T*, Page RA, Jung K, Tschapka M. 2019. Unusual echolocation behaviour of the common sword-nosed bat *Lonchorhina aurita*: an adaptation to aerial insectivory in a phyllostomid bat? *Royal Society Open Science*. *Gessinger and Gonzalez-Terrazas contributed equally to this work. doi: 0.1098/rsos.182165.

74. Halfwerk W, Blaas M, Kramer L, Hijner N, Trillo PA, Bernal XE, Page RA, Goutte S, Ryan MJ, Ellers J. 2019. Adaptive changes in sexual signaling in response to urbanization. *Nature Ecology & Evolution*. 3: 374-380. doi:10.1038/s41559-018-0751-8.
73. Hemingway CT, Lea AM, Page RA, Ryan MJ. 2019. Effects of information load on response times in frogs and bats: mate choice vs. prey choice. *Behavioral Ecology and Sociobiology*. 73: 111.
72. Hemingway CT, Ryan MJ, Page RA. 2019. Transitive foraging behaviour in frog-eating bats. *Animal Behaviour*. 154: 47-55. doi: 10.1016/j.anbehav.2019.05.005.
71. Legett HD, Page RA, Bernal XE. 2019. Synchronized mating signals in a communication network: the challenge of avoiding predators while attracting mates. *Proceedings of the Royal Society B*. 286. doi: 10.1098/rspb.2019.1067.
70. Marklewitz M, Dutari LC, Paraskevopoulou S, Page RA, Loaiza JR, Junglen S. 2019. Diverse novel phleboviruses in sandflies from the Panama Canal area, Central Panama. *Journal of General Virology*. 100: 938-949.
69. Page RA, Bernal XE. 2019. The challenge of detecting prey: Private and social information use in predatory bats. Invited review in 'The role of sensory ecology and cognition in social decisions' (eds. K Schneeberger, M Taborsky). *Functional Ecology*. 00: 1-20. doi: 10.1111/1365-2435.13439.
68. Ripperger SP, Carter GG, Duda N, Koelpin A, Cassens B, Kapitza R, Josic D, Berrío-Martínez J, Page RA, Mayer F. 2019. Vampire bats that cooperate in the lab maintain their social networks in the wild. *Current Biology*. 10.1016/j.cub.2019.10.024.
67. ter Hofstede HM, Symes LB, Martinson SJ, Robillard T, Faure P, Madhusudhana S, Page RA. 2019. Calling songs of Neotropical katydids (Orthoptera, Tettigoniidae) from Panama. *Journal of Orthoptera Research*.

2018

66. Carter GC, Forss S, Page RA, Ratcliffe JM. 2018. Younger vampire bats (*Desmodus rotundus*) are more likely to explore novel objects. *PLOS One*. 13(5): e0196889. doi: 10.1371/journal.pone.0196889.
65. Estrada-Villegas S, Halczok TK, Tschapka M, Page RA, Brändel SD, Hiller T. 2018. Updated survey of the bats of Coiba National Park, Panama and their associated ectoparasites. *Acta Chiropterologica*. 20: 161–176. doi: 10.3161/15081109ACC2018.20.1.012.
64. Haelewaters D, Page RA, Pfister, D. 2018. Parasites of parasites of bats: morphological and molecular diversity of Laboulbeniales fungi associated with ectoparasite bat flies (Diptera: Nycteribiidae, Streblidae). *Ecology and Evolution*. doi: 0.1002/ece3.4359.
63. Halczok TK, Flores V, Brändel SD, Puechmaille SJ, Tschapka M, Page RA, Kerth G. 2018. Male-biased dispersal and the potential impact of human-induced habitat modifications on the Neotropical bat *Trachops cirrhosus*. *Ecology and Evolution*. doi: 10.1002/ece3.4161.

62. Hemingway C*, Dixon MM*, Page RA. *In press*. The omnivore's dilemma: the paradox of the generalist predators. In: Phyllostomid Bats, a Unique Mammalian Radiation (editors: TH Fleming, L Davalos, M Mello). University of Chicago Press. *Hemingway and Dixon contributed equally to this work.
61. Hemingway CT, Ryan MJ, Page RA. 2018. Cognitive constraints on optimal foraging in frog-eating bats. *Animal Behaviour*. 143: 43-50. doi: 10.1016/j.anbehav.2018.07.007.
60. Hiller T, Honner B, Page RA, Tschapka M. 2018. Leg structure explains host site preference in bat flies (Diptera: Streblidae) parasitizing neotropical bats (Chiroptera: Phyllostomidae). *Parasitology*. 1–8. doi: 10.1017/S0031182018000318.
59. Hiller T, Rasche A, Brändel SD, König A, Jeworowski L, O'Mara MT, Cottontail V, Page RA, Glebe D, Drexler JF, Tschapka M. 2018. Host biology and anthropogenic factors affect hepadnavirus infection in a Neotropical bat. *EcoHealth*, 1-13. doi: 10.1007/s10393-018-1387-5.
58. Kohles JE, Page RA, Dechmann DKN, O'Mara MT (2018) Rapid behavioral changes during early development in Peters' tent-making bat (*Uroderma bilobatum*). *PLoS ONE* 13(10): e0205351. doi: 10.1371/journal.pone.0205351.
57. Miller AJ, Page RA, Bernal XE. 2018. Exploratory behavior of a native anuran species with high invasive potential. *Animal Cognition*. 21: 55-65. doi: 10.1007/s10071-017-1138-y.
56. Page RA. 2018. Leveling the playing field: Comparative cognition studies in bats. Box in book chapter by Yovel Y, Greif S. Bat cognition. In: Field and Laboratory Methods in Animal Cognition (editors: F Amici, N Bueno-Guerra). Cambridge University Press.
55. Patriquin KJ, Kohles J, Page RA, Ratcliffe JM. 2018. Bats without borders: predators learn novel prey cues from other predatory species. *Science Advances*. 4: eaaq0579.
54. Ryan MJ, Page RA, Hunter KL, Taylor RC. 2018. “Crazy love”—nonlinearity and irrationality in mate choice. Invited contribution to Cognitive Ecology issue of *Animal Behaviour* (eds JM Ratcliffe, R Dukas). 147: 189-198. doi: 10.1016/j.anbehav.2018.04.004.
53. Schmid J, Rasche A, Eibner G, Jeworowski L, Page RA, Corman VM, Drosten C, Sommer S. 2018. Ecological drivers of Hepacivirus infection in a neotropical rodent inhabiting landscapes with various degrees of human environmental change. *Oecologia*. doi: 10.1007/s00442-018-4210-7.
52. Stockmaier S, Bolnick DI, Page RA, Carter GG. 2018. An immune challenge reduces social grooming in vampire bats. *Animal Behaviour*. 140: 141-149. doi: 10.1016/j.anbehav.2018.04.021.
51. Symes L, Martinson S, Höger L-O, Page RA, ter Hofstede HM. 2018. Effects of predator cues on prey signaling behavior: bat echolocation and katydid calls in the Neotropical forest canopy. *Frontiers in Ecology and Evolution*. 6:227. doi: 10.3389/fevo.2018.00227.
50. Vrtilek J, Carter GG, Patriquin KJ, Page RA*, Ratcliffe JR*. 2018. New method for rapid testing of social learning in vampire bats. *Royal Society Open Science*. *Page and Ratcliffe contributed equally to this work. 5: 172483. doi: 10.1098/rsos.172483.

49. Wasimuddin, Brandel SD, Tschapka M, Page RA, Rasche A, Corman VM, Drosten C, Sommer S. 2018. Astrovirus infections induce age-dependent dysbiosis in gut microbiomes of bats. *ISME*. doi:10.1038/s41396-018-0239-1.

2017

48. Carter GG, Wilkinson GS, Page RA. 2017. Food-sharing vampire bats are more nepotistic under conditions of perceived risk. *Behavioral Ecology*. doi:10.1093/beheco/ax006.
47. Flores, EE, Page, RA, Cisneros, I, Rodriguez, S. 2017. *Oophaga vicentei* (Vicente's Poison Frog). Color change. *Herpetological Review*. 8: 166-167.
46. Flores V, Page RA. 2017. Novel odorous crust on the forearm of reproductive male fringe-lipped bats (*Trachops cirrhosus*). *Journal of Mammalogy*. 98: 1568-1577. doi:10.1093/jmammal/gyx137.
45. Gomes DGE, Halfwerk W, Taylor RC, Ryan MJ, Page RA. 2017. Multimodal weighting differences by bats and their prey: probing natural selection pressures on sexually selected traits. *Animal Behaviour*. <https://doi.org/10.1016/j.anbehav.2017.10.011>.
44. Hemingway C, Ryan MJ, Page RA. 2017. Rationality in decision-making in the fringe-lipped bat, *Trachops cirrhosus*. *Behavioral Ecology and Sociobiology*. 71: 94. doi:10.1007/s00265-017-2321-5.
43. Jones PL, Hämsch F, Page RA, Kalko EKV, O'Mara MT. 2017. Foraging and roosting behavior of the fringe-lipped, *Trachops cirrhosus*, on Barro Colorado Island, Panamá. *Acta Chiropterologica*. 19: 337-346. doi: 10.3161/15081109ACC2017.19.2.010.
42. Taylor RC, Page RA, Klein BA, Ryan MJ, Hunter KL. 2017. Perceived synchrony of frog multimodal signal components is influenced by content and order. *Integrative and Comparative Biology*. doi: <https://doi.org/10.1093/icb/ix027>.
41. ter Hofstede HM, Voigt-Heucke SL, Lang A, Römer H, Page RA, Faure PA, Dechmann DKN. 2017. Revisiting adaptations of Neotropical katydids (Orthoptera: Tettigoniidae) to gleaning bat predation. *Neotropical Biodiversity*. 3: 41-49. doi: 10.1080/23766808.2016.1272314.

2016

40. Gomes DGE, Page RA, Geipel I, Taylor RC, Ryan MJ, Halfwerk W. 2016. Bats perceptually weight prey cues across sensory systems when hunting in noise. *Science*. 353: 1277-1280. doi: 10.1126/science.aaf7934.
39. Halfwerk W, Guerra MA, Lea AM, Page RA, Ryan MJ. 2016. Amplitude regulation in frogs reveals the ancestral state of the Lombard effect. *Behavioral Ecology*. 27: 669-676. doi:10.1093/beheco/arv204.
38. Jones PL, Page RA, Ratcliffe JM. 2016. To scream or to listen? Prey detection and discrimination in animal-eating bats. In: *Bat Bioacoustics* (volume editors: B. Fenton and A. Grinnell; series editor: A. Popper). New York: Springer. pp. 93-116.

37. Page RA, Jones PL. 2016. Overcoming sensory uncertainty: factors affecting foraging decisions in frog-eating bats. In: Perception and Cognition in Animal Communication (volume editors, MA Bee and CT Miller), in the book series Animal Signals and Communication (series editors: PK McGregor and VM Janik). New York: Springer. pp 285-312. DOI 10.1007/978-3-319-48690-1_11.
36. Ramakers JJC, Dechmann DKN, Page RA, O'Mara MT. 2016. Frugivorous bats prefer information from novel social partners. *Animal Behaviour*. 116: 83-87.
35. Ripperger S, Josic D, Hierold M, Koelpin A, Weigel R, Hartmann M, Page RA, Mayer F. 2016. Automated proximity sensing in small vertebrates: design of miniaturized sensor nodes and first field tests in bats. *Ecology and Evolution*. 6: 2179–2189.
34. Stange N, Page RA, Ryan MJ, Taylor RC. 2016. Interactions between complex multisensory signal components result in unexpected mate choice responses. *Animal Behaviour*. DOI: 10.1016/j.anbehav.2016.07.005.
33. Symes LB, Page RA, ter Hofstede HM. 2016. Effects of acoustic environment on male calling activity and timing in Neotropical forest katydids. *Behavioral Ecology and Sociobiology*. 70: 1485-1495. doi:10.1007/s00265-016-2157-4.
32. Trillo PA, Bernal XE, Caldwell M, Halfwerk W, Owens M, Page RA. 2016. Collateral damage or a shadow of safety? The effects of signaling neighbors on the risks of parasitism and predation. *Proceedings of the Royal Society Series B*. 283: 20160343. <http://dx.doi.org/10.1098/rspb.2016.0343>.
31. VencI FV, Ottens K, Dixon MM, Candler S, Bernal XE, Estrada C, Page RA. 2016. Pyrazine emission by a tropical firefly: an example of chemical aposematism? *Biotropica*. 48: 645–655. doi:10.1111/btp.12336.

2015

30. Bader E, Jung K, Kalko EKV, Page RA, Rodriguez R, Sattler T. 2015. Mobility explains the response of aerial insectivorous bats to anthropogenic habitat change in the Neotropics. *Biological Conservation*. 186: 97–106.
29. Bulbert MW, Page RA, Bernal XE. 2015. Danger comes from all fronts: predator-dependent escape tactics of túngara frogs. *PLOS ONE*: 10(4): e0120546. doi:10.1371/journal.pone.0120546.
28. Falk JJ*, ter Hofstede HM*, Jones PL, Dixon MM, Faure PA, Kalko EKV, Page RA. 2015. Sensory-based niche partitioning in a multiple predator-multiple prey community. *Proceedings of the Royal Society Series B*. 282: 20150520. <http://dx.doi.org/10.1098/rspb.2015.0520>. *Falk and ter Hofstede contributed equally to this work.
27. Fugère V, O'Mara MT, Page RA. 2015. Perceptual bias does not explain preference for prey call adornment in the frog-eating bat. *Behavioral Ecology and Sociobiology*. DOI 10.1007/s00265-015-1949-2.

26. Rhebergen F, Taylor RC, Ryan MJ, Page RA, Halfwerk W. 2015. Multimodal cues improve prey localisation under complex environmental conditions. *Proceedings of the Royal Society Series B*. 282: 20151403. <http://dx.doi.org/10.1098/rspb.2015.1403>.
25. Stockmaier S, Dechmann DKN, Page RA, O'Mara MT. 2015. No fever and leukocytosis in response to a lipopolysaccharide challenge in an insectivorous bat. *Biology Letters*. 11: 20150576. <http://dx.doi.org/10.1098/rsbl.2015.0576>.

2014

24. Clarin TMA, Borissov I, Page RA, Ratcliffe JM, Siemers BM. 2014. Social learning within and across species: information transfer in mouse-eared bats. *Canadian Journal of Zoology*. 129-139. DOI 10.1139/cjz-2013-0211.
23. Halfwerk W, Dixon MM, Ottens K, Taylor RC, Ryan MJ, Page RA, Jones PL. 2014. Risks of multimodal signaling: bat predators attend to dynamic motion in frog sexual displays. *Journal of Experimental Biology*. 217: 3038-3044. DOI 10.1242/jeb.107482.
22. Halfwerk W, Jones PL, Taylor RC, Ryan MJ, Page RA. 2014. Risky ripples allow bats and frogs to eavesdrop on a multisensory sexual display. *Science*. 342: 413-416, DOI 10.1126/science.1244812.
21. Halfwerk W, Page RA, Taylor RC, Wilson PS, Ryan MJ. 2014. Cross-modal comparisons of signal components allow for relative distance assessment. *Current Biology*: <http://dx.doi.org/10.1016/j.cub.2014.05.068>.
20. Jones PL, Ryan MJ, Page RA. 2014. Population and seasonal variation in response to prey calls by an eavesdropping bat. *Behavioral Ecology and Sociobiology*. 68: 605-615. DOI 10.1007/s00265-013-1675-6.
19. O'Mara MT, Dechmann DKN, Page RA. 2014. Frugivorous bats evaluate the quality of social information when choosing novel foods. *Behavioral Ecology*: 1-7. doi:10.1093/beheco/aru120.
18. Page, RA, Ryan, MJ, Bernal, XE. 2014. Be loved, be prey, be eaten. In: Animal Behavior, vol 3. Case Studies: Integration and Application of Animal Behavior (ed., K. Yasukawa), New York: Praeger. pp. 123-154.

2013

17. Clarin TMA, Ruczyński I, Page RA, Siemers BM. 2013. Foraging ecology predicts learning performance in insectivorous bats. *PLoS ONE*. 8: e64823.
16. Jones PL, Farris HE, Ryan MJ, Page RA. 2013. Do frog-eating bats perceptually bind the complex components of frog calls? *Journal of Comparative Physiology A*. 199: 279-283.
15. Jones PL, Ryan MJ, Flores V, Page RA. 2013. When to approach novel prey cues? Social learning strategies in frog-eating bats. *Proceedings of the Royal Society Series B*. 280: 20132330, <http://dx.doi.org/10.1098/rspb.2013.2330>.

14. Surlykke A, Jakobsen L, Kalko EKV, Page RA. 2013. Echolocation intensity and directionality of perching and flying fringe-lipped bats, *Trachops cirrhosus* (Phyllostomidae). *Frontiers in Physiology*. 4:143, doi: 10.3389/fphys. 2013.00143.

2012 and earlier

13. Page RA, Schnelle T, Kalko EKV, Bunge T, Bernal XE. 2012. Reassessment of prey through sequential use of multiple sensory cues by an eavesdropping bat. *Naturwissenschaften* 99: 505-509.
12. Page RA*, von Merten S*, Siemers BM. 2012. Associative memory or algorithmic search: a comparative study on learning strategies of bats and shrews. *Animal Cognition* 15: 495-504.
*Equal contribution.
11. Akre, KL, Farris, HE, Lea, AM, Page, RA, Ryan, MJ. 2011. Signal perception in frogs and bats and the evolution of mating signals. *Science* 333: 751-752.
10. Jones, PL, Page, RA, Hartbauer, M, Siemers, BM. 2011. Behavioral evidence for eavesdropping on prey song in two Palearctic sibling bat species. *Behavioral Ecology and Sociobiology* 65: 333-340.
9. Bernal, XE, Page, RA, Ryan, MJ, Argo, TF, Wilson, PS. 2009. Acoustic radiation patterns of mating calls of the túngara frog (*Physalaemus pustulosus*): implications for multiple receivers. *Journal of the Acoustical Society of America* 126: 2757-2767.
8. Siemers, BM, Page, RA. 2009. Behavioral studies of bats in captivity: methodology, training, and experimental design. In: Ecological and Behavioral Methods for the Study of Bats (ed. TH Kunz & S. Parsons), Baltimore: Johns Hopkins University Press. pp. 373-392.
7. Page, RA, Ryan, MJ. 2008. The effect of signal complexity on localization performance in bats that localize frog calls. *Animal Behaviour* 76: 761-769.
6. Bernal, XE, Page, RA, Rand, AS, Ryan, MJ. 2007. Cues for eavesdroppers: do frog calls indicate prey density and quality? *American Naturalist* 169: 409-415.
5. Page, RA. 2007. Prey-predator communication: for your sensors only. Dispatch for *Current Biology* 17: R965-R966.
4. Page, RA, MJ. Ryan. 2006. Social transmission of novel foraging behavior in bats: frog calls and their referents. *Current Biology* 16: 1201-1205.
3. Page, RA, Bernal, XE. 2006. Túngara frogs. Quick guide for *Current Biology* 16: R979-980.
2. Page, RA, Ryan, MJ. 2005. Flexibility in assessment of prey cues: frog-eating bats and frog calls. *Proceedings of the Royal Society Series B* 272: 841-847.
1. Gabor, CR, Page, RA. 2003. Female preference for large males in sailfin mollies, *Poecilia latipinna*: the importance of predation pressure and reproductive status. *Acta Ethologica* 6: 7-12.

RESEARCH GRANTS AND FELLOWSHIPS

National Science Foundation, IOS: Collaborative Research: Trimodal communication: Cognitive overload versus enhanced performance. PI: Ryan Taylor (Salisbury University). Co-PIs: Michael J.

Ryan (University of Texas at Austin), Kimberly Hunter (Salisbury University). Co-I: Rachel Page (STRI). Four years (May 2019- April 2023). Total: \$1,855,813.

Scholarly Studies Grant, Smithsonian Institution. The evolutionary dance between eavesdropping predators and their sexually signaling prey: Testing the role of predator sensory limitations in the evolution of ‘private’ channels in prey communication. PI: Rachel Page. Co-PIs: Hannah ter Hofstede (Dartmouth College), Inga Geipel (STRI), Ciara Kernan (Dartmouth College). One year: Jan 2020 to Jan 2021. \$37,220.

American Women’s History Initiative Programming and Education Fund Award, Smithsonian Institution. How to Be a Scientist: Smithsonian Women as Career Role Models. PI: Darren Milligan. Co-PIs: Cody Coltharp, Pino Monaco, Michelle K. Smith, Rachel Page. One year: Jan 2019 to Dec 2020. \$18,300.

Scholarly Studies Grant, Smithsonian Institution: Multimodal signal evolution: Is more information always better? PI: Rachel Page (STRI). Co-PIs: Ryan Taylor (Salisbury University), Kim Hunter (Salisbury University), Mike Ryan (University of Texas at Austin). One year: 2017-2018. \$46,240.

Wildlife Acoustics Scientific Product Grant: Effectiveness of artificial roosts for Neotropical bat species. PI: Michael Schöner (University of Greifswald). Co-PIs: Gloriana Chaverri (University of Costa Rica), Rachel Page (STRI). Two years: Oct 2017-Aug 2019. \$4921.

U.S.–Israel Binational Science Foundation (BSF): The benefits of social sleeping: behavior and neuroimaging of sleep within a group. PIs: Yossi Yovel (Tel-Aviv University), Rachel Page (STRI), Barrett Klein (University of Wisconsin, La Crosse). Four years: Sept 2017-Sept 2021. \$220,000.

National Geographic Society Research Grant (WW-057R-17): Food-sharing vampire bats: manipulating and tracking cooperative relationships in the lab and field. PI: Gerry Carter. Co-PIs: Simon Ripperger, Rachel Page, Frieder Mayer. One year: 2017-2018. \$19,275.

Scholarly Studies Grant, Smithsonian Institution: Tracking and manipulating cooperative relationships in vampire bats. PI: Rachel Page, Co-PIs: Gerry Carter, Simon Ripperger, Frieder Mayer. One year: 2016-2017. \$54,200.

Smithsonian Competitive Grants Program for Science, Pell Grant: Improved learning as a shared functional benefit of sleep. PI: Rachel Page. Co-PIs: Bill Wcislo, Barrett Klein. One year: 2014-2016. \$26,043.

Human Frontier Science Program: Multimodal sensing in the natural environment. PI: Cindy Moss. Co-PIs: Yossi Yovel, John Hallam, Annemarie Surlykke, Rachel Page. Three years: 2013-2016. \$1,350,000.

National Science Foundation: Multimodal communication, mate choice and predation risk. PIs: Mike Ryan, Ryan Taylor. Co-PI: Rachel Page. Five years: 2011-2016. \$1,174,954.

National Geographic Society Research Grant (9794-15): Acoustic-GPS tracking of frog-eating bats to reveal foraging flexibility in a changing world. PI: Yossi Yovel. Co-PIs: Rachel Page and Gerry Carter. One year: April 2016-April 2017. \$25,000.

Smithsonian Institution Barcode Network Opportunity: Barcoding Central American bats and their ectoparasites including a new type of acoustic voucher. PI: Rachel Page. Co-PIs: Matt Miller,

Thomas Sattler, Marco Tschapka, Thomas Hiller, Jose Loaiza Rodriguez. One year: 2013-2014. \$14,283.

Alexander von Humboldt Postdoctoral Research Fellowship: 2008-2009

Smithsonian Institute Postdoctoral Fellowship: 2008-2010 (declined)

Smithsonian Institute Predoctoral Fellowship: 2007-2008

P.E.O. Scholar Award: 2007-2008

National Science Foundation Doctoral Dissertation Improvement Grant: 2006-2008

American Association of University Women Dissertation Fellowship: 2006-2007

National Science Foundation Graduate Research Fellowship: 2003-2006.

American Society of Mammalogists, Elisabeth Horner Award for best research proposal: 2005.

Zoology Scholarship Endowment for Excellence, UT Austin: 2004.

Center for Perceptual Systems Travel Grant, UT Austin: Summer 2007, 2004, 2003.

Dorothea Bennett Memorial Graduate Fellowship, UT Austin: 2003.

American Museum of Natural History, Theodore Roosevelt Memorial Fund: 2003.

Smithsonian Tropical Research Institute Short-Term Fellowship: Spring 2003; Spring 2002.

Terrell H. Hamilton Endowed Graduate Fellowship Fund: 2002.

Dean's Excellence Award, UT Austin: 2002.

CONFERENCES AND INVITED TALKS

Page RA. Efficient eavesdroppers, evasive advertisers, and multimodal cocktails: The sensory and cognitive ecology of a frog-eating bat. Tupper talk, Smithsonian Tropical Research Institute, Panamá. June 5, 2020.

Page RA. Ecology and behavior of bats: the link between bats' amazing immune systems, their extraordinary longevity and the transmission of zoonotic disease. STRI Zoom Seminar Series. May 20, 2020.

Page RA. Some thoughts about sleep in bats: Moving to the tropics. Invited talk in the symposium: Sleep Across Taxa: Birds, Bats, Bees and Beyond! University of Tel Aviv, Israel. May 23-25, 2019.

Page RA. The sensory and cognitive ecology of bat foraging behavior: A tribute to Alexander von Humboldt. 2019 Von Humboldt Kolleg. Universidad del Norte, Barranquilla, Colombia. March 19, 2019.

Page RA, Bernal XE. The ecology and evolution of information acquisition by predatory bats. 48th North American Symposium for Bat Research. Puerto Vallarta, Mexico. Oct 24-27, 2018.

Page RA, Bernal XE (equal contributors / co-speakers). How enemies shape communication systems. Introductory symposium talk at the 55th Annual Conference of the Animal Behavior Society. University of Wisconsin, Milwaukee, Wisconsin. Aug 2-6, 2018.

Page RA, Bernal XE (equal contributors / co-speakers). Sensory strategies of prey to avoid eavesdropping predators and parasites. Behavior Seminar Series. Tupper Center, Smithsonian Tropical Research Institute. July 3, 2018.

Page RA. The cognitive ecology of predator eavesdropping behavior: Learning and memory in a frog-eating bat. Invited seminar in the Department of Ecology, Environment and Evolution, School of Life Sciences, La Trobe University, Melbourne, Australia. September 20, 2017.

Page RA. Learning, flexibility and memory: Cognitive ecology of an eavesdropping bat. Zoology Department, University of Otago. Dunedin, New Zealand. August 11, 2017.

Page RA. The costs and benefits of sexual signaling: Learning, memory and signal detection in an eavesdropping bat. Invited seminar, Head of School Seminar Series, Queensland University of Technology (QUT). Brisbane, Australia. July 24, 2017.

Page RA, Ryan MJ, Jones PL. Social eavesdropping in bats: When, where, why and how? 45th Meeting of the Australasian Society for the Study of Animal Behaviour. Mooroolbark, Victoria, Australia. July 19-22, 2017.

Page RA. Efficient eavesdroppers, evasive advertisers, and multimodal cocktails: The sensory and cognitive ecology of a frog-eating bat. Invited seminar, School of Biological Sciences, University of Auckland. Auckland, New Zealand. May 15, 2017.

Page RA, Bernal XE, Caldwell MS, Halfwerk WH, Wessel MO, Trillo PA. Collateral damage or shadow of safety? Effect of predatory bats and parasitic midges on frog calling. North American Symposium for Bat Research. San Antonio, TX. Oct 12-15, 2016.

Page, RA. Eavesdropping predators and sexual signals: Bat exploitation of frog calls. Harvard Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. August 1, 2016.

Page, RA. Conservation in the Neotropics: Challenges and triumphs. Invited lecture in International Conservation course at the University of Greifswald, Germany. November 23, 2015.

Page, RA. Foraging flexibility in the Neotropical frog-eating bat, *Trachops cirrhosus*: Behavioral metrics for genetic correlation. Invited talk at the University of Greifswald, Germany. November 18, 2015.

Page, RA, Taylor, R, Ryan, MJ, Halfwerk, W. Water-borne vibrations and dynamically inflating vocal sacs: a multimodal cocktail for frog-eating bats. North American Symposium for Bat Research. Monterey, California. October 28-31, 2015.

Page, RA, Taylor, R, Ryan, MJ, Halfwerk, W. Costs and benefits of multimodal signaling in environmental complexity. 52nd Annual Conference of the Animal Behavior Society. Anchorage, Alaska. June 10-14, 2015.

Page, RA. La flexibilidad, el aprendizaje y la memoria: Cuentos de un murciélago que come ranas. Smithsonian Tropical Research Institute, Panama. Charla Pública (public outreach talk in Spanish). May 2014.

Page, RA. The dark side of the túngara frog call: 30 years of research on frog-eating bats. Invited speaker for symposium: Brain, behavior and evolution: three decades of scientific exploration. University of Texas at Austin. January 17, 2014.

Page, RA. Predator use of prey cues: Sensory and cognitive ecology of a frog-eating bat. Invited departmental seminar for consideration as adjunct faculty. McGill University, Montreal, Canada. December 5, 2013.

Page, RA. Of bats, frogs and flies: Cognitive and sensory insights from a communication network. Gamboa Seminar, Smithsonian Tropical Research Institute. December 2, 2013.

Page, RA, Falk, J, Jones, PL, ter Hofstede, H, Dixon, M, Faure, PA, Kalko, EKV. Neotropical mosaic: an Eli Kalko approach to understanding sensory niche partitioning, species coexistence, and eavesdropping in Phyllostomid bats. Invited talk in the Memorial Symposium, Two curious explorers: the work of Elisabeth Kalko and Björn Siemers. 16th International Bat Research Conference, San Jose, Costa Rica, August 11-15, 2013.

Page, RA, O'Mara, MT, Jones, PL. Learning, decision-making, and flexibility in the fringe-lipped bat, *Trachops cirrhosus*. Invited talk in the Behavioral Ecology Symposium. 16th International Bat Research Conference, San Jose, Costa Rica, August 11-15, 2013.

Page, RA. Sensory perception in frog-eating bats – and other recent projects with Elisabeth Kalko. Elisabeth Kalko Memorial Symposium, Tupper Auditorium, Smithsonian Tropical Research Institute, August 20-21, 2012.

Page, RA, Akre, KL, Farris, HE, Lea, AM, Ryan, MJ. Psychoacoustics, ratio-comparisons, sex and dinner: stimulus perception in frogs and bats. 41st North American Symposium on Bat Research, Toronto, Canada, October 26-29, 2011.

Page, RA, Ryan, MJ. The acoustic universe of a frog-eating bat. 13th International Society for Behavioral Ecology, Perth, Australia, September 26-October 1, 2010.

Page, RA. Bat-frog interactions: Learning, categorization and memory. Invited talk in the Adaptations and Evolutionary Ecology Symposium. 15th International Bat Research Conference, Prague, Czech Republic, August 22-27, 2010.

Page, RA. Social transmission of novel foraging behavior in bats: Frog calls and their referents. Invited talk for Interdisciplinary Symposium and Workshop on Copying, Zurich, Switzerland. Host: Dr. Gerald Kerth. February 5-7, 2009.

Page, RA. Flexibility, learning and memory in foraging behavior. German Bat Research Conference (Treffen der Fledermausforscher). Frauenchiemsee, Germany. January 22-24, 2009.

Page, RA. Learning and flexibility in foraging: Bats, frogs and shrews. Max Planck Institute for Ornithology, Seewiesen, Germany. November 25, 2008.

Page, RA, Kalko, EKV, Ryan, MJ. Flexibility in sensory strategy use during foraging in the fringe-lipped bat, *Trachops cirrhosus*. Invited talk in the Adaptability and Functional Significance of Echolocation Symposium. 14th International Bat Research Conference, Mérida, Mexico, August 19-23, 2007.

Page, RA. Foraging flexibility in the frog-eating bat, *Trachops cirrhosus*. Allee Competition. Animal Behavior Society Meeting, Burlington, VT, July 21-25, 2007.

Page, RA. Predator use of prey cues: Learning and flexibility in a frog-eating bat. Invited talk at the Max Planck Institute for Ornithology, Seewiesen, Germany. Host: Dr. Björn Siemers. March 16, 2007.

Page, RA. Predator use of prey cues: Frog-eating bats and frog calls. Invited talk for the Acoustics Seminar Series, Engineering Department, University of Texas at Austin. Host: Dr. Preston Wilson. November 10, 2006.

Page, RA. Predator use of prey cues: Frog-eating bats and frog calls. Biology Department, Texas A&M University. Host: Dr. Michael Smotherman. November 6, 2006.

Page, RA. Sensory mode switching in prey detection by the frog-eating bat, *Trachops cirrhosus*. 35th Annual North American Symposium on Bat Research, Wilmington, NC, October 18-21, 2006.

Page, RA. Predator use of prey cues: Frog-eating bats and frog calls. Invited talk at the University of Tübingen, Germany. Host: Dr. Björn Siemers and Dr. Hans-Ulrich Schnitzler. February 2, 2006.

Page, RA. Whisper in my pinna: Social learning, persistence, and memory in the frog-eating bat, *Trachops cirrhosus*. 35th Annual North American Symposium on Bat Research, Sacramento, CA, October 19-22, 2005.

Page, RA. Flexibility in foraging: Tales of a frog-eating bat. Bambi seminar, Smithsonian Tropical Research Institute, Barro Colorado Island, Panama, May 5, 2005.

Page, RA. Frogs, toads, or Bob Marley? Flexibility and learning in the frog-eating bat, *Trachops cirrhosus*. 34th Annual North American Symposium on Bat Research, Salt Lake City, UT, October 27-30, 2004.

Page, RA. Behavioral flexibility in the frog-eating bat, *Trachops cirrhosus*. Invited talk at the University of Ulm, Germany. Host: Dr. Elisabeth Kalko. August 31, 2004.

Page, RA, Ryan, MJ. Foraging flexibility and response to prey mating calls in the frog-eating bat, *Trachops cirrhosus*. Invited talk in Sensory Ecology in Bat Foraging Behaviour Symposium, 13th International Bat Research Conference, Mikolajki, Poland, August 23-27, 2004.

Page, RA. Behavioral flexibility in the frog-eating bat, *Trachops cirrhosus*. Smithsonian Tropical Research Institute Science Symposium, Panama City, Panama, July 8-9, 2004.

Page, RA, Bernal, XE. Eavesdroppers are listening: Convergent acoustic preferences in frogs, bats, and flies. Invited talk in Sexual Communication in Túngara Frogs Symposium, 41st Animal Behavior Society Meeting, Oaxaca, Mexico, June 13-16, 2004.

Page, RA. Prey preferences and localization performance: Behavioral flexibility in a frog-eating bat. Tupper talk, Smithsonian Tropical Research Institute, Panama, June 2003.

TEACHING, MENTORSHIP AND CONSERVATION

Masters and PhD advisor (2009 to present) Smithsonian Tropical Research Institute, Panamá. Since my start as a staff scientist at STRI, I have co-advised thesis research for numerous Masters and PhD students. Duties range from hosting students in the field; participating in committee meetings and evaluating in thesis defenses; advising on experimental design, data analysis and manuscript writing. Institutes I have partnered with include:

- *University of Texas at Austin, McGill University, Purdue University, University of Chicago, Max Plank Institute for Ornithology, Max Planck Institute for Animal Behavior.*

Field course teacher (2010 to present) Smithsonian Tropical Research Institute, Panama. Lecturer and field leader for numerous courses that come through STRI. For example:

- *McGill-STRI Neotropical Environment Option (NEO)* field course: Led guest lecture and field excursion, demonstration of bat mistnetting, bioacoustic monitoring, and ongoing experimental work.
- *STRI's Gigante Course*, a course designed for Latin American students to get experience with tropical research; I give a lecture and teach small, group-based nocturnal research projects.

Intern mentor (2009-present) Smithsonian Tropical Research Institute, Panama. I host numerous interns in my lab, guiding them through the basics of tropical field biology, often mentoring through the publication of their first manuscript and their application to graduate school.

Bat Conservation (2014-present). I am on the board of directors for Merlin Tuttle's Bat Conservation, an organization dedicated to bat conservation worldwide.

REVIEWER FOR

- | | |
|---------------------------------------|--|
| • Acta Chiropterologica | • Functional Ecology |
| • Animal Behaviour | • Journal of Experimental Biology |
| • Behavioral Ecology | • Journal of Mammalogy |
| • Behavioral Ecology and Sociobiology | • Journal of the Acoustical Society of America |
| • Behavioural Processes | • Mammalia |
| • Biology Letters | • PLOS One |
| • Biotropica | • PNAS |
| • Current Biology | • Proceedings of the Royal Society, Series B |
| • Ecology | • Science |
| • Ethology | • Science Advances |
| • Evolutionary Ecology | • The American Naturalist |
| • Frontiers in Ecology and Evolution | |