

CURRICULUM VITAE  
*Stephen Nowicki*

**Education:**

- Ph.D. 1985, Cornell University, Neurobiology and Behavior  
M.S. 1978, Tufts University, Behavioral Biology  
B.S. 1976, Tufts University, Biology and Music, *Summa Cum Laude*

**Professional Positions:**

- Dean of the Natural Sciences, Anne T. and Robert M. Bass Fellow, and Professor,  
Duke University (appointments in Biology and Psychology & Neuroscience  
in Trinity College, in Neurobiology, Duke Medical Center), 2004 – present  
Anne T. and Robert M. Bass Professorship, 1999 – 2004  
Gästforskare, Ekologiska Institutet, Lund University, Sweden, 1999  
Associate Professor, Duke University, 1994 – 2002  
Assistant Professor, Duke University, 1989 – 1994  
Assistant Professor, Rockefeller University, 1986 – 1989  
Postdoctoral Research Fellow, Rockefeller University, 1984 – 1986

**Honors:**

- Klaus Immelmann Lectureship, Bielefeld University, 2006  
Distinguished Scientist Lectureship, Trinity University, 2006  
Eminent Biologist Lectureship, Pittsburgh EcoForum, 2001  
John Simon Guggenheim Fellowship, 1999 – 2000  
Bass Society of Fellows, Duke University, 1999  
Elected Fellow, Animal Behavior Society, 1998  
Alfred P. Sloan Foundation Fellow, 1990 – 1992  
Kenneth Roeder Memorial Lectureship, Tufts University, 1990  
Mary Flagler Cary Charitable Trust Fellowship, 1987 – 1989  
U.S.P.H.S. Postdoctoral Research Fellowship, 1984 – 1986  
U.S.P.H.S. Predoctoral Research Fellowship, 1983 – 1984  
Henry Sage Graduate Fellowship, Cornell University, 1982 – 1983  
Andrew D. White Graduate Fellowship, Cornell University, 1977 – 1981  
Sigma Xi, Cornell University, 1980  
Phi Beta Kappa, Tufts University, 1975

**Grants and Awards:**

- National Science Foundation, “Developmental and receiver-dependent costs of avian  
signals” (IBN-0315377), 2003 – 2007  
National Science Foundation, “Sources of selection on song in white-crowned sparrows  
(*Zonotrichia leucophrys*)” (with E. Derryberry), 2005 – 2007  
P.H.S., National Institutes of Neurological Disorders and Stroke, “Single neuron correlates  
of learned song” P.I.: R. Mooney (R21 NS046583-01), 2003 – 2005  
National Science Foundation, “Implications of production constraints for the function of vocal  
performance in mate choice” (IBN-0407966, with B. Ballentine), 2004 – 2006  
National Science Foundation, “Fitness cost of nest defense in a passerine bird: A trade-off

with offspring care” (IBN-0407952, with R. Duckworth), 2004 – 2006  
National Science Foundation, "Complexity and information in avian signals"  
(IBN-9974743), 1999 – 2003  
National Science Foundation, “Function of multiple signals in avian vocal communication”  
(IBN-0104973, with M. Beebee), 2001 – 2003  
National Science Foundation, “Sound production in spiny lobsters (Paninuridae):  
morphological constraints and the evolution of signal diversity” (IBN-9972597,  
dissertation grant with S. Patek), 1999 – 2001  
John Simon Guggenheim Foundation, “Nutrition and song learning in birds” 1999 – 2000  
National Science Foundation, "Perception, function and development of complex vocal  
signals" (IBN-9408360), 1995 – 1999  
National Science Foundation, “Functional analysis of female reproductive coloration”  
(IBN-9623869, dissertation grant with S. Weiss), 1996 – 1999  
P.H.S., National Institutes of Deafness and Communicative Disorders, "Comparative  
study of mechanisms of vocal production" (R01 DC-00402-06), 1992 – 1996  
P.H.S., National Institutes of Deafness and Communicative Disorders, "Comparative  
study of mechanisms of vocal production" (“FIRST” award, R29 DC-00402-01),  
1987 – 1992  
National Science Foundation, "Undergraduate neurosciences summer program in  
mechanisms of behavior" Co-P.I. with W.G. Hall & M.M. Nijhout, 1993 – 1996; Co-P.I.  
with W. Meck (DBI-98320514), 1997 – 2001  
Alfred P. Sloan Foundation Fellowship Award, 1990 – 1992  
Duke University Research Council Awards, 1990, 1991, 1992, 1998  
Irma T. Hirschl Foundation Career Scientist Award, 1987 – 1989  
Whitehall Foundation Grant-in-Aid, 1986

***Professional Service:***

Animal Behavior Society, President, 2003-2007  
(4-year rotation: 2<sup>nd</sup> President-Elect, 1<sup>st</sup> President-Elect, President & Past-President)  
Animal Behavior Society, Executive Committee Member-at-Large, 2000 – 2003  
National Science Foundation, Animal Behavior Proposal Review Panel, 1999 – 2002, 2004  
National Science Foundation, IGERT Proposal Review Panel, 2001  
National Science Foundation, Graduate Fellowship Review Panel, 1999  
Leiden University, Institute of Biology, Department of Behavioral Biology,  
External Ph.D. Examiner, 2004  
Copenhagen University, Zoological Institute, Department of Animal Behaviour,  
External Ph.D. Examiner, 2001, 2002  
National Institute of Mental Health, Psychobiology, Behavior and Neuroscience Proposal  
Review Committee, 1994 – 1998  
Society for Integrative and Comparative Biology, Division of Animal Behavior,  
Chair, 1996 – 2000  
Project Kaleidoscope Consultant, 1997 – 1998  
Acoustical Society of America, Bioacoustics Technical Advisory Group, 1992 – 1998

***Invited Research Lectures (last 5 years):***

Clemson University, 2007  
Bielefeld University, Germany, 2006  
University of Miami, 2006  
Emory University, 2006  
Trinity University, San Antonio, TX, 2006  
Lund University, Sweden, 2005  
University of Western Ontario, Canada, 2005  
Princeton University, 2005  
Rutgers University, 2005  
Rockefeller University, 2004  
Leiden University, The Netherlands, 2004  
University of Maryland, College Park, 2004  
Pymatuning Laboratory of Ecology, 2004  
Freie Universität, Berlin, Germany, 2003  
Duke University Board of Trustees, 2003  
University of California, Davis, 2003  
University of California, Santa Barbara, 2003  
College of Charleston, Charleston, SC, 2002  
University of Maryland, College Park, 2002  
University of Massachusetts, Amherst, 2001  
North Carolina State University, 2001

***Teaching – Duke University Courses:***

Translating Science (Bio 93S), 2006 – present  
Foundations of Behavioral Ecology (Bio 277), 2004 – present  
Introductory Biology (Bio 25), 1996 – 2003, 2007  
Animal Communication and Social Behavior (Bio 276), 1992 – present  
Population, Community and Behavioral Ecology (UPE 301), 2000 – 2002  
Principles of Neurobiology (Bio 154), 1990 – 1995  
Integrative Biology: The View from the Organism (Bio 296), 1992  
Avian Behavioral Ecology (Bio 296), 1990 – 1991

***Teaching – Awards and Other Activities:***

Robert B. Cox Trinity College Distinguished Teaching Award, 1992 – 1993  
National Science Foundation Chautauqua Short Course for College Teachers:  
"Mechanisms of Animal Behavior," Organizer and Instructor, 1994  
Duke/Durham Fellows Seminar, 1993 – 1994  
Isle of Shoals Marine Laboratory: "Animal Behavior," Lecturer, 1985 – 1988, 1990  
Rocky Mountain Biological Laboratory: "Ecological Ornithology," Instructor, 1983, 1984

***Professional Affiliations:***

American Association for the Advancement of Science  
American Ornithologist's Union

Animal Behavior Society  
International Society for Behavioral Ecology  
Rocky Mountain Biological Laboratory  
Society for Integrative and Comparative Biology

***University Service:***

Campus Culture Initiative Task Force, 2006 – present  
Oak Ridge National Laboratory Liaison, 2004 – present  
Trombone Section, Duke University Basketball Pep Band, 2004 – 2006  
Information Science/Information Studies, Faculty Board Member, 2003 – 2005  
University Curriculum 2000 Review Committee, *Chair*, 2003 – 2004  
Bass Chair Selection Committee, 2002 – 2004  
Primate Center Internal Advisory Committee, 2002 – 2004  
University Union Board, 2002 – 2004  
Academic Council, 1991 – 1992, 1994 – 1995, 1998 – 2004  
*Member of Executive Committee*, 1998 - 2000  
Center for Cognitive Neuroscience Director Search Committee, 2002 – 2003  
Board of Trustees Student Affairs Committee, Faculty Representative, 1999 – 2002  
Vice President for Student Affairs Search Committee, *Vice Chair*, 2000 – 2001  
University Writing Program Task Force, 1998 – 1999  
Center for Teaching, Learning and Writing Director Search Committee, 1998 - 1999  
Undergraduate Neurosciences Program, *Co-Director*, 1992 – 2004  
Southern Association of Colleges and Schools Reaccreditation Self-Study Steering  
Committee, *Chair*, Undergraduate Education Subcommittee, 1996 – 1998  
University Task Force on Reorganization of the Biological Sciences, 1996 – 1997  
Faculty Associates Program (Pegram Dorm Associate), 1996 – 1997  
Executive Committee of the Graduate School, 1994 – 1996  
Institutional Animal Care and Use Committee, 1989 – 1994; *Vice Chair*, 1991 – 1994;  
AAALAC Subcommittee, 1992; DLAR Director Search Committee, 1993

***Departmental Service:***

Department of Biology (and former Department of Zoology)  
Director of Graduate Studies, 2002 – 2004  
Strategic Planning/Steering Committee, 2002 – 2004  
Faculty Review Committee, 2003  
Graduate Steering Committee, 1996 – 2002  
Department Merger Governance Committee, 2000  
Teaching Certificate in Biology Steering Committee, 2000 – 2004  
Animal Care and Use Officer, 1989 – present  
Search Committees: Biogeochemist, 2002 – 2003; Introductory Biology POP, *Chair*,  
2001; Evolutionary Biology, *Chair*, 1998; Animal Behavior, 1997; Integrative  
Biology, 1995; Physiology, 1992; Ecology, 1991; Physiology, 1990  
Department of Neurobiology  
Post-doctoral Fellowship Committee, 1996 – 2004  
Graduate Steering and Admissions Committees, 1990 – 1998

***Ph.D. Dissertations and Postdocs Supervised:***

- Mark Westneat, postdoc 1991 – 1992; Present position: Associate Professor, Field Museum of Natural History & Adjunct Associate Professor, Organismal Biology and Anatomy, University of Chicago
- Melissa Hughes, postdoc 1994 – 1996; Present position: Assistant Professor, Department of Biology College of Charleston, Charleston, SC
- Bernard Lohr, Ph.D. 1995; Dissertation: Production and recognition of acoustic frequency cues in chickadees; Present position: Assistant Professor, Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY
- Jeffrey Podos, Ph.D. 1996; Dissertation: Performance limits on vocal evolution in songbirds (Passeriformes: Emberizidae); Present position: Associate Professor, Department of Biology, University of Massachusetts, Amherst, MA
- John Rowden, Ph.D. 1996; Dissertation: The evolution of display behavior in the parrot genus *Neophema* (Aves: Psittaciformes); Present position: Curator, Auckland Zoo; Auckland, New Zealand
- Tammy L. Windfelder, Ph.D. 1997; Dissertation: Polyspecific association and interspecific communication between two neotropical primates: saddle-back tamarins (*Saguinus fuscicollis*) and emperor tamarins (*Saguinus imperator*); Present position: Assistant Professor, Department of Biology, Drew University, Madison, NJ.
- William J. Hoese, Ph.D. 1998; Dissertation: Functional morphology and biomechanics of jaw operation in sparrows; Present position: Assistant Professor, Department of Biological Sciences, California State University, Fullerton, California
- Denise S. Pope, Ph.D. 1998; Dissertation: The fiddler crab claw waving display: function and evolution of a sexually selected signal; Present position: Assistant Professor, Department of Biology, Trinity College, San Antonio, Texas
- Stacey L. Weiss, Ph.D. 1999; Dissertation: The function and regulation of reproductive color of female striped plateau lizards (*Sceloporus virgatus*); Present position: Assistant Professor, Department of Biology, University of Puget Sound, Tacoma, Washington
- Sheila Patek, Ph.D. 2001; Dissertation: Signal producing morphology and the evolution of Palinurid lobster acoustic communication; Present position: Assistant Professor, Department of Integrative Biology, University of California, Berkeley
- Christopher Sturdy, postdoc 2000 – 2002; Functional analysis of brainstem activity during singing in songbirds (in collaboration with Richard Mooney, Neurobiology, DUMC); Present position: Assistant Professor, Department of Psychology, University of Alberta, Edmonton, Alberta
- Valerie B. Simon, Ph.D., 2002; Dissertation: Predation, risk assessment and signaling behavior in *Anolis* lizards
- Martin D. Beebee, Ph.D., 2003; Song complexity and avian communication
- Silke Kipper, postdoc 2004 – 2005; Categorical perception and mechanisms of mate choice in birds; Present position: Akademische Mitarbeiter, Free University, Berlin, Germany
- Barbara E. Ballentine, Ph.D., 2006; Production constraints in assessment signaling and the evolution of birdsong; Present position: Postdoctoral associate, Smithsonian Institution, Washington, DC.

Jeremy D. Hyman, postdoc 2002 – 2006; Intrasexual signaling and territoriality; Present position: Assistant professor, Department of Biology, Western Carolina University  
Renée Duckworth, Ph.D., 2006; Ecological determinants of population-level variation in aggression in bluebirds; Present position: Postdoctoral associate, Institute of Evolutionary Biology, University of Edinburgh, Scotland.

***Current Students and Postdocs:***

Elizabeth Derryberry, Ph.D. expected 2007.

Kimberly Rosvall, Ph.D. expected 2008.

Jonathan Prather, postdoc 2003 – present (with Dr. Richard Mooney).

Rindy Anderson, postdoc 2006 – present

Rob Lachlan, postdoc 2007 – present

**PUBLICATIONS:**

***Books:***

Searcy, W. A. & S. Nowicki. 2005. *The Evolution of Animal Communication: Reliability and Deception in Signaling Systems*. Princeton University Press: Princeton.

Nowicki, S. 2007. *Biology*. McDougal-Littell: Evanston, IL.

[An introductory text book for secondary school students at the 9<sup>th</sup> & 10<sup>th</sup> grade levels.]

***Video Course:***

Nowicki, S. 2004. *Biology: The Science of Life*. The Teaching Company: Chantilly, VA.

[An introductory biology course in the “Great Professors” series, in 72 half-hour lectures.]

***Journal Articles and Book Chapters:***

Hughes, M., Anderson, R. C., Searcy, W. A., Bottensek, L. M., Nowicki, S. Song type sharing and territory tenure in eastern song sparrows: implications for the evolution of song repertoires. *Anim. Behav.*, in press.

Anderson, R., S. Nowicki & W. A. Searcy. Soft song in song sparrows: response of males and females to an enigmatic signal. *Behav. Ecol. Sociobiol.*, in press.

Searcy, W. A. & S. Nowicki. Sexual selection and the evolution of animal signals. *New Encyclopedia of Neuroscience*, ed. Larry R. Squire, Elsevier Publishers, in press.

Searcy, W. A. & S. Nowicki. 2006. Signal interception and the use of soft song in aggressive interactions. *Ethology* 112: 865-872.

Searcy, W. A., R. Anderson & S. Nowicki. 2006. Bird song as a signal of aggressive intent. *Behav. Ecol. Sociobiol.* 160: 234-241.

- Nowicki, S. & W. A. Searcy. 2005. Adaptive priorities in brain development: Theoretical comment on Pravosudov (2005). *Behav. Neurosci.*, 119: 1415-1418.
- Anderson, R. C., W. A. Searcy & S. Nowicki. 2005. Partial song matching in an eastern population of song sparrows (*Melospiza melodia*). *Anim. Behav.*, 69: 189-196.
- Nowicki, S. & W. A. Searcy. 2005. Song and mate choice in birds: How the development of behavior helps us understand function. *Auk*, 122: 1-14.
- Ballentine, B., J. Hyman & S. Nowicki. 2004. Singing performance influences female response to male bird song: an experimental test. *Behav. Ecol.*, 15: 163-168.
- Hyman, J., M. Hughes, W. A. Searcy & S. Nowicki. 2004. Individual variation in the strength of territory defense in song sparrows: correlates of age, territory tenure, and neighbor aggressiveness. *Behaviour*, 141: 15-27.
- Nowicki, S. & W. A. Searcy. 2004. Song function and the evolution of female preferences: Why birds sing and why brains matter. *Ann. N.Y. Acad. Sci.*, 1016: 704-723.
- Podos, J. & S. Nowicki. 2004. Beaks, adaptation, and vocal evolution in Darwin's finches. *BioScience* 54: 501-510.
- Podos, J. & S. Nowicki. 2004. Performance limits on birdsong production. In: Marler, P & H. Slabbekoorn (Eds.) *Nature's Music: The Science of Birdsong*, pp. 318-341. Elsevier/Academic Press: New York.
- Podos, J., S. Peters & S. Nowicki. 2004. Calibration of song learning targets during vocal ontogeny in swamp sparrows (*Melospiza georgiana*). *Anim. Behav.* 68: 929-940.
- Searcy, W. A., S. Peters & S. Nowicki. 2004. Effects of early nutrition on growth rate and adult size in song sparrows. *J. Avian Biol.*, 35: 269-279.
- Searcy, W.A., S. Nowicki & S. Peters. 2003. Phonology and dialect discrimination in song sparrows (*Melospiza melodia*). *Ethology* 109: 23-35.
- Nowicki, S., W. A. Searcy & S. Peters. 2002. Brain development, song learning and mate choice in birds: a review and experimental test of the "nutritional stress hypothesis." *J. Comp. Physiol. A* 188: 1003-1014.
- Nowicki, S., W. A. Searcy & S. Peters. 2002. Quality of song learning affects female response to male bird song. *Proc. Roy. Soc. Lond. B* 269: 1949-1954.
- Nowicki, S, W.A. Searcy, T. Krueger & M. Hughes. 2002. Individual variation in response to simulated territorial challenge among territory-holding song sparrows. *J. Avian Biol.* 33: 253-259.

- Searcy, W.A., S. Nowicki, M. Hughes & S. Peters. 2002. Geographic song discrimination in relation to dispersal distances in song sparrows. *Amer. Natur.* 159: 221-230.
- Hoese, W.J. & S. Nowicki. 2001. Using "the organism" as a conceptual focus in an introductory biology course. *Amer. Biol. Teacher* 63: 176-182.
- Mooney, R., W.J. Hoese & S. Nowicki. 2001. Auditory representation of the vocal repertoire in a songbird with multiple song types. *Proc. Natl. Acad. Sci. USA* 98: 12798-12783.
- Nowicki, S., W. A. Searcy, M. Hughes & J. Podos. 2001. The evolution of bird song: male and female response to song innovation in swamp sparrows. *Anim. Behav.* 62: 1189-1195.
- Hoese, W.J., J. Podos, N.C. Boetticher & S. Nowicki. 2000. Vocal tract function in birdsong production: experimental manipulation of beak movements. *J. Exp. Biol.* 203: 1845-1855.
- Nowicki, S., D. Hasselquist, S. Bensch & S. Peters. 2000. Nestling growth and song repertoire size in great reed warblers: evidence for song learning as an indicator mechanism in mate choice. *Proc. Roy. Soc. Lond. B* 267: 2419-2424.
- Peters, S., W.A. Searcy, M.D. Beecher & S. Nowicki. 2000. Geographic variation in the organization of song sparrow repertoires. *Auk* 117: 936-942.
- Podos, J. & S. Nowicki. 2000. Mechanical limits and the evolution of vocalizations in birds. In: Maria Alice dos Santos Alves, et al. (Eds.) *A Ornithologia no Brasil: Pesquisa Atual e Perspectivas*, do Congresso Brasileiro de Ornitologia, pp. 251-271. EdUERJ: Rio de Janeiro.
- Searcy, W.A. & S. Nowicki. 2000. Male-male competition and female choice in the evolution of vocal signaling. In: Y. Espmark, T. Amundsen & G. Rosenqvist (Eds.) *Animal Signals: Signalling and Signal Design in Animal Communication*, pp. 301-315. Tapir Academic Press: Trondheim.
- Searcy, W.A., S. Nowicki & C. Hogan. 2000. Song type variants and aggressive signaling. *Behav. Ecol. Sociobiol.* 48: 358-363.
- Nowicki, S., S. Peters, W.A. Searcy & C. Clayton. 1999. The development of song variation in song sparrows. *Anim. Behav.* 57: 1257-1264.
- Podos, J., S. Nowicki & S. Peters. 1999. Permissiveness in vocal syntax learning in the swamp sparrow. *Anim. Behav.* 58: 93-103.

- Searcy, W.A. & S. Nowicki. 1999. Functions of song variation in song sparrows. In: M. Konishi & M. Hauser (eds.) *The Design of Animal Communication*, pp. 577-595. MIT Press: New York.
- Searcy, W.A., S. Nowicki & S. Peters. 1999. Song types as fundamental units in vocal repertoires. *Anim. Behav.* 58: 37-44.
- Nowicki, S, S. Peters & J. Podos. 1998. Song learning, early nutrition and sexual selection in songbirds. *Amer. Zool.* 38: 179-190.
- Nowicki, S., W.A. Searcy & M. Hughes. 1998. The territory defense function of song in song sparrows: a test with the speaker occupation design. *Behaviour* 135: 615-628.
- Hughes, M., S. Nowicki, W.A. Searcy & S. Peters. 1998. Song type sharing in song sparrows: Implications for repertoire function and song learning. *Behav. Ecol. Sociobiol.* 42: 437-446.
- Hughes, M., S. Nowicki & B. Lohr. 1998. Call learning in black-capped chickadees (*Parus atricapillus*): The role of experience in the development of “chick-a-dee” calls. *Ethology* 104: 232-249.
- Erickson, C. J., S. Nowicki, L. Dollar & N. Goehring. 1998. Percussive foraging: Stimuli for prey location by aye-ayes (*Daubentonia madagascariensis*). *Int. J. Primatol.* 19: 111-122.
- Gaunt, A.S. & S. Nowicki. 1998. Birdsong: acoustics and physiology revisited. In: Hopp, S. L. M. J. Owren & C. S. Evans (eds.), *Animal Acoustic Communication*. Springer-Verlag, Heidelberg, pp. 291-321.
- Searcy, W.A., M. Hughes & S. Nowicki. 1997. The response of male and female song sparrows to geographic variation in song. *Condor* 99: 651-657.
- Nowicki, S. 1997. Bird acoustics. In: M. J. Crocker (ed.) *Encyclopedia of Acoustics*. John Wiley & Sons, New York, Chapter 150, pp. 1813-1817.
- Peters, S. & S. Nowicki. 1996. Development of tonal quality in birdsong: Further evidence from song sparrows. *Ethology* 102: 323-335.
- Strote, J. & S. Nowicki. 1996. Responses to songs with altered tonal quality by adult song sparrows (*Melospiza melodia*). *Behaviour* 130: 1-15.
- Podos, J., J. K. Shearer, S. Peters & S. Nowicki. 1995. Ontogeny of vocal tract movements during song production in song sparrows. *Anim. Behav.* 50: 1287-1296.

- Searcy, W.A., J. Podos, S. Peters & S. Nowicki. 1995. Discrimination of song types and variants in song sparrows. *Anim. Behav.* 49: 1219-1226.
- Lohr, B., R. Weisman & S. Nowicki. 1994. The role of pitch cues in song recognition by Carolina chickadees (*Parus carolinensis*). *Behaviour* 130: 1-15.
- Nowicki, S., J. Podos & F. Valdés. 1994. Temporal patterning of within-song type and between-song type variation in song repertoires. *Behav. Ecol. Sociobiol.* 34: 329-335.
- Nowicki, S. & J. Podos. 1993. Complexity, coupling and contingency in birdsong. In: *Perspectives in Ethology*, vol.10 (P.P.G. Bateson, P. Klopfer & N. Thompson, eds.), pp. 159-186, Plenum Press, New York.
- Westneat, M.W., J.H. Long, Jr., W. Hoese & S. Nowicki. 1993. Kinematics of birdsong: Functional correlation of cranial movements and acoustic features in sparrows. *J. Exp. Biol.* 182: 147-171.
- Jacobs, M., D.P. Nowacek, G. Cannon, S. Nowicki & R.B. Forward. 1993. Seasonal changes in vocalizations during behavior of the Atlantic bottlenose dolphin. *Estuaries* 16: 241-246.
- Nowicki, S., M. Westneat & W. Hoese. 1992. Birdsong: Motor function and the evolution of communication. *Seminars in Neurosci.* 4: 385-390.
- Nowicki, S., P. Marler, A. Maynard & S. Peters. 1992. Is the tonal quality of birdsong learned? Evidence from song sparrows. *Ethology* 90: 225-235.
- Peters, S, P. Marler & S. Nowicki. 1992. Song sparrows learn from limited exposure to song models. *Condor* 94: 1016-1019.
- Podos, J., S. Peters, T. Rudnický, P. Marler & S. Nowicki. 1992. The organization of song repertoires in song sparrows: Themes and variations. *Ethology* 90: 89-106.
- Nowicki, S., M. Hughes & P. Marler. 1991. Flight songs of swamp sparrows: Alternative phonology of an alternative song category. *Condor* 93: 1-11.
- Lohr, B., S. Nowicki & R. Weisman. 1991. Pitch production in Carolina chickadee songs. *Condor* 93: 197-199.
- Nowicki, S. & D.A. Nelson. 1990. Defining natural categories in acoustic signals: Comparison of three methods applied to 'chick-a-dee' call notes. *Ethology* 86: 89-101.
- Ball, G.F. & S. Nowicki. 1990. Assessment of song quality in photorefractory and photosensitive song sparrows. *Anim. Behav.* 40: 986-987.

- Nowicki, S. & G.F. Ball. 1989. Testosterone induction of song in photosensitive and photorefractory male sparrows. *Horm. and Behav.* 23: 514-525.
- Nowicki, S. J.C. Mitani, D.A. Nelson & P. Marler. 1989. The communicative significance of tonality in birdsong: Responses to songs produced in helium. *Bioacoustics* 2: 35-46.
- Nowicki, S. 1989. Vocal plasticity in captive black-capped chickadees: The acoustic basis and rate of call convergence. *Anim. Behav.* 37: 64-73.
- Nowicki, S. & P. Marler. 1988. How do birds sing? *Music Perception* 5: 391-426.
- Nowicki, S. 1987. Vocal tract resonances in oscine bird sound production: evidence from birdsongs in a helium atmosphere. *Nature* 325: 53-55.
- Nowicki, S. & R.R. Capranica. 1986. Bilateral syringeal coupling during phonation of a songbird. *J. Neuroscience* 6: 3595-3610.
- Nowicki, S. & R.R. Capranica. 1986. Bilateral syringeal interaction in the vocal production of an oscine bird sound. *Science* 231: 1297-1299.
- Nowicki, S. 1985. Spider. In: *McGraw-Hill Yearbook of Science and Technology* (S.P. Parker, editor-in-chief), pp. 410-412, New York: McGraw-Hill Inc.
- Nowicki, S. 1984. A question of identity: the call of the black-capped chickadee. *Living Bird Quart.* 3(1): 30.
- Nowicki, S. 1983. Flock-specific recognition of chickadee calls. *Behav. Ecol. Sociobiol.* 12: 317-320.
- Eisner, T. & S. Nowicki. 1983. Spider web protection through visual advertisement: The role of the "stabilimentum." *Science* 219: 185-187.
- Nowicki, S. & T. Eisner. 1983. Predatory capture of bombardier beetles by a tabanid fly larva. *Psyche* 90: 119-122.
- Jackman, R., S. Nowicki, D.J. Aneshansley & T. Eisner. 1983. Predatory capture of toads by fly larvae. *Science* 222: 515-516.
- Jefson, M., J. Meinwald, S. Nowicki, K. Hicks & T. Eisner. 1983. Chemical defense of a rove beetle (*Creophilus maxillosus*). *J. Chem. Ecol.* 9: 159-180.
- Jain, S.C., S. Nowicki, T. Eisner & J. Meinwald. 1982. Insect repellents for vetiver oil: Zizanal and epizizanal. *Tetr. Letters* 23: 4639-4642.

Mammen, D.L. & S. Nowicki. 1981. Individual differences and within-flock convergence in chickadee calls. *Behav. Ecol. Sociobiol.* 9: 179-186.

Eisner, T., S. Nowicki, M. Goetz & J. Meinwald. 1980. Red cochineal dye (Carminic acid): Its role in nature. *Science* 208: 1038-1040.

Nowicki, S. & K.B. Armitage. 1979. Behavior of juvenile yellow-bellied marmots: Play and social integration. *Z. Tierpsychol.* 51: 85-105.

***Abstracts and Conference Presentations (last 5 years & selected earlier):***

Nowicki, S. 2005. Priorities in brain development: Lessons from wild birds. Brain Plasticity: Change and Control Workshop. Lund University, Lund, Sweden.

Anderson, R., W. A. Searcy & S. Nowicki. 2005. Costs and benefits of soft song as an aggressive signal in song sparrows: male response. Animal Behavior Society Annual Meeting, Snowbird, Utah.

Nowicki, S., R. Anderson & W. A. Searcy. 2005. Costs and benefits of soft song as an aggressive signal in song sparrows: female response. Animal Behavior Society Annual Meeting, Snowbird, Utah.

Kipper, S., S. Peters, W. A. Searcy & S. Nowicki. 2005. Effects of early nutritional stress on female swamp sparrows. Animal Behavior Society Annual Meeting, Snowbird, Utah.

Anderson, R., W. A. Searcy & S. Nowicki. 2003. Partial song matching in an eastern population of song sparrows. Animal Behavior Society Annual Meeting, Boise, ID.

Ballentine, B., J. Hyman & S. Nowicki. 2003. Vocal performance influences female response to male bird song: an experimental test. Animal Behavior Society Annual Meeting, Boise, ID.

Hyman, J., M. Hughes, W. A. Searcy & S. Nowicki. 2003. Individual variation in the strength of territory defense in song sparrows. Animal Behavior Society Annual Meeting, Boise, ID.

Podos, J. & S. Nowicki. 2003. Calibration of song learning targets during vocal ontogeny in swamp sparrows. Animal Behavior Society Annual Meeting, Boise, ID.

Searcy, W. A., S. Nowicki & R. Anderson. 2003. Singing behaviors as predictors of attack in song sparrows. Animal Behavior Society Annual Meeting, Boise, ID.

- Nowicki, S. & P. K. Stoddard (co-organizers) 2002. "New Perspectives on Mechanisms of Evolution in Communication Systems," Symposium, Animal Behavior Society Annual Meeting, Indiana University, Bloomington, IN.
- Ballentine, B., S. Nowicki & J. Hyman. 2002. Variation in vocal performance influences female choice in swamp sparrows (*Melospiza georgiana*). 9th Biennial Congress of the International Society for Behavioral Ecology, Montréal, Canada.
- Nowicki, S. & W. A. Searcy. 2001. Developmental stress, song learning, and mate choice in birds. Invited symposium presentation, Animal Behavior Society Annual Meeting, Corvallis, OR.
- Nowicki, S., D. Hasselquist, S. Bensch & S. Peters. 2000. Nestling growth and song repertoire size in great reed warblers: evidence for song learning as an indicator mechanism in mate choice. 8th Biennial Congress of the International Society for Behavioral Ecology, Zurich, Switzerland.
- Hoese, W. J., S. Nowicki & R. Mooney. 2000. Auditory encoding of multiple song types in the swamp sparrow. Soc. Neurosci. Abstracts 26: 2030.
- Nowicki, S. 1999. On the function and evolution of bird song: new questions to old answers. Invited Fellows Lecture, Animal Behavior Society Annual Meeting, Lewisburg, PA.
- Hughes, M., S. Nowicki, J. Hailman & B. Lohr. 1999. The role of development in the evolution of vocalizations: call notes in black-capped, Carolina and mountain chickadees. Animal Behavior Society Annual Meeting, Lewisburg, PA.
- Searcy, W. A., S. Nowicki, S., M. Hughes & J. Podos. 1999. Sexual selection limits evolutionary innovation in bird song. Animal Behavior Society Annual Meeting, Lewisburg, PA.
- Nowicki, S. 1997. Song learning, song variation and sexual selection. Invited paper at the 1st International Workshop on "Signal Sequence and Sense," Freie Universität, Berlin, Germany.
- Nowicki, S. 1997. Process of changing an introductory course at a major research university. Invited workshop presentation, Project Kaleidoscope Workshop "Enhancing learning-centered environments," University of Wisconsin, Madison, WI.
- Nowicki, S. and S. Peters. 1996. Song learning, early nutrition and sexual selection. Invited paper in the symposium: "Animal Behavior: Integration of Proximate and Ultimate Causation" Society for Integrative and Comparative Biology Annual Meeting, Albuquerque, NM.

Hauser, M.D., J. Locke & S. Nowicki (co-organizers) 1993. "Human and Nonhuman Vocal Communication: Sources of Convergence and Divergence," Symposium, Animal Behavior Society 30th Annual Meeting, University of California, Davis.

## **Stephen Nowicki – Research Interests**

My research addresses the broad question of how information is encoded in signals on the organismal level. I approach this question both from a proximate perspective, with studies of how communication signals are produced and perceived, and from an ultimate perspective, with studies of how signals function and how they have evolved. Birdsong provides an apt model system for this work, because the behavior can be analyzed and manipulated easily and because song shares many parallels with human speech in how it is learned, how it develops, and in the sensory- motor mechanisms that underlie it.

One current focus of our work involves testing the “developmental stress hypothesis,” an idea we proposed for how a male bird’s song can serve as a reliable indicator of its phenotypic or genotypic quality used by females in mate choice, based on the relationship between early developmental stress, brain growth, and subsequent song learning abilities. We now have supported several key predictions of this hypothesis through both laboratory and field studies, and we began a new NSF grant this year that will expand this work in three ways. First, we will test whether early stress affects a male’s “vocal performance” capabilities – that is, his ability to sing songs that are physically challenging to produce – thus extending our work from the brain to the motor periphery. Second, we will test whether early stress affects the development of immune function, a trait that is of special interest to females in mate choice. Third, we will ask whether early stress independently affects the development of song preferences in females. Another current focus of our work, also funded by the NSF, is to test whether “receiver-dependent” costs can maintain signal reliability in aggressive interactions. Here, we are asking whether particular patterns of signal production (e.g., song type matching, amplitude changes, and so forth) convey information about aggressive intention or probability of attack. This work involves field experiments in which the signaling of male subjects is provoked by a generic stimulus and then a subsequent aggressive encounter is staged, allowing us to determine the predictive value of signaling.

A newer focus of our work involves a collaboration with Rich Mooney in the Department of Neurobiology on the neural mechanisms underlying categorical processing of song. This work, supported by an NIH grant Mooney and I received this year, involves implementing new technology for obtaining neurophysiological data from awake, behaving birds, through the use of a permanently implanted electrode microdrive attached to the bird’s skull. There are several long-term goals of this work, but our immediate interest is to understand how neurons parse continuously variable acoustic elements into discrete functional categories, a process referred to as “categorical perception.” Categorical perception is a fundamental aspect of human speech processing and has been demonstrated in birds through field behavioral testing. Our work combines neurophysiological data with behavioral data obtained by operant conditioning techniques, and we hope it will establish the song system as a new model for understanding the brain mechanisms that underlie categorical perception in general.

Mooney and I have jointly sponsored a post- doc, Dr. Jon Prather, funded by an NIH NSRA, to take the lead on developing the neurophysiological component of this project. We have just learned that the Alexander von Humboldt Foundation will fund Dr. Silke Kipper to join my lab as a post-doc and take the lead on the operant conditioning work.

Another research direction we are just beginning to explore is to look at variation in gene expression among individual birds in a population, as a molecular measure of individual quality. We have shown that female songbirds prefer males who sing well-learned songs, and that nutritionally stressed birds suffer developmental costs that interfere with their ability to learn songs properly. These nutritionally stressed nestlings allocate resources for immediate survival, but the ensuing physiological consequences may make them less suited for long-term success (i.e. “survive now, pay later”), as evidenced by our preliminary finding that developmental stress leads to lasting depression of immunocompetance. To gain a more integrated perspective on how developmental stress negatively impacts aspects of male phenotype relevant to mate choice, we are beginning to use quantitative reverse transcription PCR to measure differences in the expression of key metabolic enzymes between developmentally stressed and unstressed individuals.

**Stephen Nowicki – External Research Support (previous 5 years)**

NSF, “Developmental and receiver-dependent costs of avian signals” \$324,874  
IBN-0315377, 09/01/03–08/31/06 (Nowicki, PI)

NIH-NINDS, “Single neuron correlates of learned song” \$382,300  
R21 NS046583-01, 07/01/03–06/30/05 (Mooney, PI; Nowicki, Co-PI)

NSF, “Complexity and information in avian signals” \$212,868  
IBN-9974743, 09/01/99–08/31/03 (Nowicki, PI)

NSF, “Function of multiple signals in avian vocal communication” \$9,691  
IBN-0104973, 05/01/01–04/30/03 (Nowicki, PI; Beebee, Co-PI; *NSF Dissertation  
Improvement Grant*)

NSF, “Sound production in spiny lobsters (Paninuridae): morphological constraints and the  
evolution of signal diversity” \$9,812  
IBN-9972597, 07/01/99–06/30/01 (Nowicki, PI; Patek, Co-PI; *NSF Dissertation  
Improvement Grant*)

John Simon Guggenheim Foundation, “Nutrition and song learning in birds” \$33,000  
07/01/99–06/30/00

### Stephen Nowicki – Dissertations Supervised

Melissa Hughes, Ph.D. 1994 (co-advised with P. Klopfer)

“Communication in snapping shrimp (*Alpheus heterochaelis*): Signals, signaling behavior, and the responses of receivers”

Bernard Lohr, Ph.D. 1995

“Production and recognition of acoustic frequency cues in chickadees”

Jeffrey Podos, Ph.D. 1996

“Performance limits on vocal evolution in songbirds (Passeriformes: Emberizidae)”

John Rowden, Ph.D. 1996

“The evolution of display behavior in the parrot genus *Neophema* (Aves: Psittaciformes)”

Tammy L. Windfelder, Ph.D. 1997

“Polyspecific association and interspecific communication between two neotropical primates: saddle-back tamarins (*Saguinus fuscicollis*) and emperor tamarins (*Saguinus imperator*)”

William J. Hoese, Ph.D. 1998

“Functional morphology and biomechanics of jaw operation in sparrows”

Denise S. Pope, Ph.D. 1998

“The fiddler crab claw waving display: function and evolution of a sexually selected signal”

Stacey L. Weiss, Ph.D. 1999

“The function and regulation of reproductive color of female striped plateau lizards (*Sceloporus virgatus*)”

Sheila Patek, Ph.D. 2001

Signal producing morphology and the evolution of Palinurid lobster acoustic communication”

Valerie B. Simon, Ph.D., 2002

“Predation, risk assessment and signaling behavior in *Anolis* lizards”

Martin D. Beebe, Ph.D., 2003

“Song modes in yellow warblers and the function of multiple signal strategies in avian communication”

Barbara E. Ballentine, Ph.D. expected 2005

Role of production constraints in assessment signaling and the evolution of birdsong

Renée Duckworth, Ph.D. expected 2005

Ecological determinants of population-level variation in aggression in bluebirds

Elizabeth Derryberry, Ph.D. expected 2006

Drift and selection on continuous vocal characteristics in bird song across time and space

Kimberly Rosvall, Ph.D. expected 2007

Effects of female condition on mate sampling tactics in birds

**Stephen Nowicki – Current Teaching Load/Schedule**

*Fall semester:*

Bio 25L “Principles of Biology”  
currently co-taught with Paula Lemons

*Spring semester:*

Bio 277S “Foundations of Behavioral Ecology”  
co-taught with Susan Alberts, Spring 2004  
(we anticipate teaching this course in alternating years)

Bio 276S “Animal Communication and Social Behavior”  
(course taught in alternating years)

Bio 295.22S “Mechanisms of Animal Communication”  
course taught in Spring 2003  
(this course may or may not be repeated, depending on student interest)

*Other miscellaneous teaching activities:*

Participant in UPE 301 and UPE 302, the core courses for 1<sup>st</sup>-year graduate students in the  
University Program in Ecology

Participant in PSY 363S, the 1<sup>st</sup>-year seminar for graduate students in Psychological and Brain  
Sciences

Organizer of Bio 322S, “Behavioral, Population, and Community Ecology Discussion Group”