

## **CURRICULUM VITAE**

November 20, 2018

**Name:** Thomas E. Dowling

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### **Education:**

B.S. (Zoology), University of Michigan, Ann Arbor, 3 May 1980  
Ph.D. (Biology), Wayne State University, Detroit, Michigan, 3 May 1984  
Doctoral advisor: William S. Moore  
Postdoctoral: Wesley M. Brown, Division of Biological Sciences, University of Michigan  
Gerald R. Smith, Museum of Zoology, University of Michigan

### **Professional Experience:**

Instructor, Northwoods Biological Station, Wayne State University Summer Program,  
Ichthyology, 1984  
Research Fellow, Division of Biological Sciences and Museum of Zoology, The University  
of Michigan, December 1984 to September 1988  
Assistant Professor, Department of Zoology, Arizona State University, September 1988 to  
July 1994  
Associate Professor, Department of Biology (formerly Zoology), Arizona State University,  
August 1994 to August 1999  
Professor, School of Life Sciences (formerly Biology), Arizona State University, August  
1999 to July 2013  
Director, Graduate Programs, Department of Biology, Arizona State University, Fall 1998  
and August 2002 to August 2003  
Interim Museum Director, School of Life Sciences (formerly Biology), Arizona State  
University, November 2001 to August 2003,  
Museum Director, School of Life Sciences (formerly Biology), Arizona State University,  
September 2010 to July 2013  
Faculty Leader, School of Life Sciences, Genomics, Evolution, and Bioinformatics, Arizona  
State University, July 2009 to July 2013  
Professor Emeritus, School of Life Sciences, Genomics, Evolution, and Bioinformatics,  
Arizona State University, July 2013 to present  
Professor, Department of Biological Sciences, Wayne State University, August 2013 to  
present

### **Research related activities:**

#### **I. Grants, contracts, and awards:**

1. Marine Mammal Commission Postdoctoral Fellowship (with W. M. Brown, University of

- Michigan), 1984-1985, \$15,000, "Preliminary analysis of delphinid mitochondrial DNA, with special emphasis on population discreteness of *Tursiops truncatus* in the Gulf of Mexico."
2. Marine Mammal Commission contract (with W. M. Brown, University of Michigan), 1986-1987, \$4525, "Discreteness of Gulf of Mexico populations of *Tursiops truncatus* inferred from restriction endonuclease analysis of mitochondrial DNA."
  3. National Science Foundation, Population Biology and Physiological Ecology (with G. R. Smith, University of Michigan), 1986-1988, \$140,844, "Dynamics of reproductive isolation in cyprinid fishes."
  4. National Science Foundation, Population Biology and Physiological Ecology and Systematic Biology (jointly funded)(with G. R. Smith, University of Michigan), 1988-1992, \$141,599, "Dynamics of reproductive isolation in cyprinid fishes."
  5. National Science Foundation, Systematic Biology (subcontract with A. A. Echelle, Oklahoma State University), 1989-1992, \$4619, "Biochemical systematics of pupfishes."
  6. College Liberal Arts and Sciences, 1989, \$2500, "Biochemical genetics of trout hybridization."
  7. U.S. Fish and Wildlife Service contract (with W. L. Minckley), 1989-1990, \$2000, "Genetic survey of the Virgin chub."
  8. Bureau of Reclamation, Cooperative agreement (with W. L. Minckley), 1990-1993, \$111,720, "Genetic diversity in the razorback sucker (*Xyrauchen texanus*) as determined by restriction endonuclease analysis of mitochondrial DNA."
  9. U.S. Fish and Wildlife Service contract (with W. L. Minckley), 1990-1991, \$2000, "Genetic survey of wild and captive stocks of Virgin River chubs."
  10. U.S. Forest Service, 1992-1993, \$2550, "Population structure in the Little Colorado River spinedace, *Lepidomeda vittata*, as determined by analysis of mitochondrial DNA."
  11. National Science Foundation, Systematic Biology, 1993-1997, \$194,931, "Phylogenetic analysis of reproductive isolation in cyprinid fishes."
  12. Bureau of Reclamation, Cooperative agreement, 1994-1997, \$356,331, "*Gila* taxonomy: analysis of mitochondrial DNA."
  13. National Science Foundation (co-authored with members of several departments campus-wide), Instrumentation Panel, 1995-1997, \$93,711, "Automated DNA sequencer."
  14. Bureau of Reclamation (with Paul C. Marsh), 1997-1998, \$49,962, "Genetic monitoring of wild and repatriated populations of endangered bonytail and razorback sucker in Lake Mohave, Arizona-Nevada."
  15. Nevada Fish and Wildlife Department, 1997-2004, \$16,000, "Mitochondrial DNA variation in *Rhinichthys osculus* of Nevada."
  16. Bureau of Reclamation (with Paul C. Marsh), 1997-1999, \$58,809, "Population structure in the desert sucker, *Pantosteus discobolus*."
  17. Bureau of Reclamation, 1997-2003, \$238,405, "Conservation genetics of endangered suckers of the Klamath region: mitochondrial DNA."
  18. National Aeronautics and Space Administration, 2000-2003, \$749,685, "Evolution in microbe-based ecosystems: desert springs as analogues for the early development and stabilization of ecological systems." (With six other PIs)
  19. U.S. Fish and Wildlife Service, 2000-2005, \$9500, "Conservation genetics of Modoc sucker."
  20. Bureau of Reclamation, 2001-2006, \$15,000, "Population structure in the roundtail chub (*Gila robusta* complex) of the Gila River basin."

21. Bureau of Reclamation, 2001-2004, \$110,000, "Razorback sucker genetics."
22. US Forest Service, 2002-2005, \$10,000, "Population structure in the roundtail chub complex, Gila River basin, Arizona and New Mexico."
23. National Science Foundation, 2003-2006, \$357,162, "A capillary DNA sequencer and denaturing HPLC for molecular genetics, ecogenomics, and experimental bioinformatics." (PD with six other PIs).
24. U.S. Fish and Wildlife Service, 2004-2007, \$187,492, "Population structure in the roundtail chub (*Gila robusta* complex) of the Gila River basin as determined by microsatellites."
25. New Mexico Department of Game and Fish, Share with Wildlife Program, \$17,500, 2004-2007, "Levels and patterns of morphological and molecular variation in the Zuni bluehead sucker."
26. Bureau of Reclamation, 2004-2008, \$252,601, "Continuing studies of razorback sucker genetics."
27. AZ Game and Fish Department, 2008, \$22,539, "Molecular characterization of Verde River broodstock of roundtail chub, *Gila robusta*."
28. Bureau of Reclamation, 2008-2011, \$299,059, "Razorback sucker stock assessment."
29. Bureau of Reclamation, 2010-2014, \$579,798, "Genetic and demographic studies to guide conservation management of bonytail chub and razorback sucker in off-channel habitats."
30. Bureau of Reclamation, 2011-2013, \$251,699, "Razorback Sucker Stock Assessment."
31. Bureau of Reclamation, 2014-2019, \$515,636, "Genetic and demographic studies to guide conservation management of bonytail chub and razorback sucker in off-channel habitats."
32. Bureau of Reclamation, 2014-2019, \$685,425, "Razorback Sucker Genetic Diversity Assessment."
33. Great Lakes Fishery Commission, 2015, \$9,991, "Assessment of population genomics as a tool for discriminating among populations of Great Lakes Sea Lamprey."
34. Bureau of Reclamation, 2016-2019, \$343,863, "Development of SNP markers for sex determination, parentage assessment, and population genetics of razorback sucker."
35. Bureau of Reclamation (subcontract from the University of New Mexico), 2017-2019, \$142,582, "Next-generation Razorback Sucker (RBS) and Flannelmouth Sucker (FMS) larval fish genotyping: Grand Canyon Samples."
36. Great Lakes Fishery Commission, 2018-2021, \$287,000 (\$0 at WSU), "Functional genomics of Great Lakes ciscoes (*Coregonus* spp.): Identifying genetic markers consistent with morphological differences." Co-PI with T. Krabbenhoft, University of Buffalo.

## **II. Book chapters and invited review articles (peer-reviewed):**

1. Moritz, C., T. E. Dowling, and W. M. Brown. 1987. Evolution of animal mitochondrial DNA: Relevance for population biology and systematics. *Ann. Rev. Ecol. Syst.* 18:269-292.
2. Goddard, K. A., R. M. Dawley, and T. E. Dowling. 1989. Origin and genetic relationships of diploid, triploid, and diploid-triploid mosaic biotypes in the *Phoxinus eos-neogaeus* unisexual complex. Pp. 268-280 *in* Evolution and Ecology of Unisexual Vertebrates, R. M. Dawley and J. P. Bogart (eds.). New York State Museum, Albany.
3. Dowling, T. E., C. Moritz, and J. D. Palmer. 1990. Nucleic acids II: Restriction site analysis. Pp. 250-317 *in* Molecular Systematics, D. Hillis and C. Moritz (eds.), Sinauer Associates, Sunderland, Mass.
4. Buth, D. G., T. E. Dowling, and J. R. Gold. 1991. Molecular and cytological investigations.

- Pp. 83-126 in *The Biology of Cyprinid Fishes*, I. Winfield and J. Nelson (eds.), Chapman and Hall, London.
5. Hofman, R. J., P. D. Shaughnessy, T. E. Dowling, and W. M. Brown. 1993. Genetic-based studies for stock separation. Pp. 172-193 in *Antarctic seals: Research methods and techniques*, R. Laws (ed.), Cambridge University Press, Cambridge.
  6. Dowling, T. E., C. Moritz, J. D. Palmer, and L. H. Rieseberg. 1996. Nucleic acids IV: Analysis of fragments and restriction sites. Pp. 249-320 in *Molecular Systematics*, D. M. Hillis, C. Moritz, and B. K. Mable (eds.), Sinauer Associates, Sunderland, Mass.
  7. Dowling, T. E., and C. L. Secor. 1997. The role of hybridization in the evolutionary diversification of animals. *Ann. Rev. Ecol. Syst.* 28:593-619.
  8. Gerber, A. S., R. Loggins, S. Kumar, and T. E. Dowling. 2001. Does non-neutral evolution shape observed patterns of DNA variation in animal mitochondrial genomes? *Ann. Rev. Genet.* 35:539-566.
  9. Collins, J. P., J. Deacon, T. Dowling, and P. C. Marsh. 2002. Wendell Lee Minckley: 1935-2001. *Copeia* 2002: 258-262.
  10. Smith, G. R., T. E. Dowling, K. Gobalet, T. Lugaski, D. Shiozawa, and P. Evans. 2002. Biogeography and rates of evolution of Great Basin fishes. Pp. 175-234 in *Great Basin Aquatic Systems History*, R. Hershler, D. B. Madsen, and D. R. Curry (eds.), Contributions to the Earth Sciences, number 33. Smithsonian Institution, Washington, DC. Smithsonian.
  11. Smith, G. R. and T. E. Dowling. 2008. Correlating hydrographic events and divergence times of speckled dace (*Rhinichthys*: Teleostei: Cyprinidae) in the Colorado River basin. Reheis M., and Hershler, R. (eds.). *Late Cenozoic Drainage History of the Southwestern Great Basin and Lower Colorado River Region: Geologic and Biotic Perspectives*. Geological Society of America Special Paper 439:301-317.
  12. Spencer, J. E., G. R. Smith, and T. E. Dowling. 2008. Middle to Late Cenozoic geology, hydrography, and fish evolution in the American Southwest. Reheis M., and Hershler, R. (eds.). *Late Cenozoic Drainage History of the Southwestern Great Basin and Lower Colorado River Region: Geologic and Biotic Perspectives*. Geological Society of America Special Paper 439:279-299.
  13. Smith, G. R., J. Chow, P. J. Unmack, D. F. Markle, and T. E. Dowling, 2017. Evolution of the *Rhinichthys osculus* complex (Teleostei: Cyprinidae) in western North America, pp. 45-84, 17 figs., 5 tables, 5 maps and supplementary material. In: *Fishes of the Mio-Pliocene Western Snake River Plain and Vicinity. Misc. Publ. Mus. Zool., Univ. Michigan*, No. 204 no.2.
  14. Smith, G. R., D. W. Zaroban, B. High, J. W. Sigler, J. Schilling, T. J. Krabbenhoft, and T. E. Dowling. 2018. Introgressive mtDNA transfer in hybrid lake suckers (Teleostei, Catostomidae) in western United States, pp. 87-117, 14 figs. and 7 tables. In: *Fishes of the Mio-Pliocene Western Snake River Plain and Vicinity. Misc. Publ. Mus. Zool., Univ. Michigan*, No. 204 no.3.
  15. Bestgen, K. R., T. E. Dowling, B. Albrecht, and K. A. Zelasko. 2018. Large-river fish conservation in the Colorado River basin: progress and challenges with endangered razorback sucker. In press.
  16. Turner, T. F., T. E. Dowling, T. J. Krabbenhoft, M. J. Osborne, and T. J. Pilger. 2018. Conservation genetics of fishes in the genomic age. In press.

### III. Articles (peer-reviewed):

1. Dowling, T. E., and W. S. Moore. 1984. The level of reproductive isolation between two cyprinid fishes, *Notropis cornutus* and *N. chrysocephalus*. *Copeia* 1984:617-628.
2. Dowling, T. E., and W. S. Moore. 1984. A program for estimating genetic variability within and between populations. *J. Hered.* 75:416.
3. Dowling, T. E., and W. S. Moore. 1985. Evidence for selection against hybrids in the family Cyprinidae (genus *Notropis*). *Evolution* 39:152-158.
4. Dowling, T. E., and W. S. Moore. 1985. Genetic variation and divergence of the sibling pair of cyprinid fishes, *Notropis cornutus* and *N. chrysocephalus*. *Biochem. Syst. Ecol.* 13:471-476.
5. Dowling, T. E., and W. S. Moore. 1986. Absence of population subdivision in the common shiner, *Notropis cornutus* (family Cyprinidae). *Env. Biol. Fishes* 15:151-155.
6. Dowling, T. E., and W. M. Brown. 1989. Allozymes, mitochondrial DNA, and levels of phylogenetic resolution among four minnow species (*Notropis*: Cyprinidae). *Syst. Zool.* 38:126-143.
7. Dowling, T. E., G. R. Smith, and W. M. Brown. 1989. Reproductive isolation and introgression between *Notropis cornutus* and *Notropis chrysocephalus* (family Cyprinidae): Comparison of morphology, allozymes, and mitochondrial DNA. *Evolution* 43:620-634.
8. Echelle, A. A., T. E. Dowling, C. Moritz, and W. M. Brown. 1989. Mitochondrial DNA diversity and the origin of the *Menidia clarkhubbsi* complex of unisexual fishes (Atherinidae). *Evolution* 43:984-993.
9. Dowling, T. E., and W. R. Hoeh. 1991. The extent of introgression outside the hybrid zone between *Notropis cornutus* and *Notropis chrysocephalus* (Teleostei: Cyprinidae). *Evolution* 45:944-956.
10. Meagher, S., and T. E. Dowling. 1991. Hybridization between the cyprinid fishes *Luxilus albeolus*, *L. cornutus* and *L. cerasinus*, with comments on the hybrid origin of *Luxilus albeolus*. *Copeia* 1991:979-991.
11. Smouse, P. E., T. E. Dowling, J. A. Tworek, W. R. Hoeh, and W. M. Brown. 1991. Effects of intraspecific variation on phylogenetic inference: a likelihood analysis of mtDNA restriction site data in cyprinid fishes. *Syst. Zool.* 40:393-409.
12. Dowling, T. E., and M. R. Childs. 1992. Impact of hybridization on a threatened trout of the southwestern United States. *Conservation Biology* 6:355-364.
13. Dowling, T. E., B. D. DeMarais, W. L. Minckley, M. E. Douglas, and P. C. Marsh. 1992. Use of genetic characters in conservation biology. *Conservation Biology* 6:7-8.  
**Reprinted as pp. 176-177 in Readings from Conservation Biology: Genes, Populations, and Species, D. Ehrenfeld (ed.), Blackwell Sci. Inc., Cambridge, Mass.**
14. Echelle, A. A., and T. E. Dowling. 1992. Mitochondrial DNA variation and evolution of the Death Valley pupfishes (*Cyprinodon*, Cyprinodontidae). *Evolution* 46:193-206.
15. Dowling, T. E., W. R. Hoeh, G. R. Smith, and W. M. Brown. 1992. Evolutionary relationships of shiners in the genus *Luxilus* (Cyprinidae) as determined by analysis of mitochondrial DNA. *Copeia* 1992:306-322.
16. DeMarais, B. D., T. E. Dowling, M. E. Douglas, W. L. Minckley, and P. C. Marsh. 1992. Origin of *Gila seminuda* (Teleostei: Cyprinidae) through introgressive hybridization: Implications for evolution and conservation. *Proc. Natl. Acad. Sci. USA* 89:2747-2751.

17. Dowling, T. E., W. L. Minckley, M. E. Douglas, P. C. Marsh, and B. D. DeMarais. 1992. Use of molecular characters in conservation biology: Implications for management of the red wolf. *Conservation Biology* 6:600-603.  
**Reprinted as pp. 188-191 in Readings from Conservation Biology: Genes, Populations, and Species, D. Ehrenfeld (ed.), Blackwell Sci. Inc., Cambridge, Mass.**
18. DeMarais, B. D., T. E. Dowling, and W. L. Minckley. 1993. Post-perturbation genetic changes in populations of the endangered Virgin River chub. *Conservation Biology* 7:334-341.
19. Dowling, T. E., and W. M. Brown. 1993. Population structure of the bottlenose dolphin (*Tursiops truncatus*) as determined by restriction endonuclease analysis of mitochondrial DNA. *Marine Mammal Science* 9:138-155.
20. Dowling, T. E., and B. D. DeMarais. 1993. Evolutionary significance of introgressive hybridization promotes in cyprinid fishes. *Nature* 362:444-446.
21. Broughton, R. E., and T. E. Dowling. 1994. Length variation in mitochondrial DNA of the minnow, *Cyprinella spiloptera*. *Genetics* 138:179-190.
22. Schmidt, T. R., T. E. Dowling, and J. R. Gold. 1994. Molecular systematics of the genus *Pimephales* (Teleostei: Cyprinidae). *Southwestern Naturalist* 39:241-248.
23. Childs, M. R., A. A. Echelle, and T. E. Dowling. 1996. Development of the hybrid swarm between Pecos pupfish (Cyprinodontidae: *Cyprinodon pecosensis*) and sheepshead minnow (*C. variegatus*): a perspective from allozymes and mtDNA. *Evolution* 50:2014-2022.
24. Dowling, T. E., W. L. Minckley, P. C. Marsh, and E. Goldstein. 1996. Mitochondrial DNA diversity in the endangered razorback sucker (*Xyrauchen texanus*): analysis of hatchery stocks and implications for captive propagation. *Conservation Biology* 10:120-127.
25. Dowling, T. E., W. L. Minckley, and P. C. Marsh. 1996. Mitochondrial DNA diversity within and among populations of razorback sucker (*Xyrauchen texanus*) as determined by restriction endonuclease analysis. *Copeia* 1996:542-550.
26. Tibbets, C. A., and T. E. Dowling. 1996. Effects of intrinsic and extrinsic factors on population fragmentation in three North American minnows (Teleostei: Cyprinidae). *Evolution* 50:1280-1292.
27. Alves, M. J., M. M. Coelho, M. J. Collares-Pereira, and T. E. Dowling. 1997. Maternal ancestry of the *Rutilus alburnoides* complex (Teleostei, Cyprinidae) as determined by analysis of cytochrome b sequences. *Evolution* 51:1584-1592.
28. Broughton, R. E., and T. E. Dowling. 1997. Evolutionary dynamics of tandem repeats in mitochondrial DNA of the minnow *Cyprinella spiloptera*. *Mol. Biol. Evol.* 14:1187-1196.
29. Dowling, T. E., R. E. Broughton, and B. D. DeMarais. 1997. Significant role for historical effects in the evolution of reproductive isolation: evidence from patterns of introgression between the cyprinid fishes, *Luxilus cornutus* and *Luxilus chrysocephalus*. *Evolution* 51:1574-1583.
30. Dowling, T. E., and G. J. P. Naylor. 1997. Evolutionary relationships of minnows in the genus *Luxilus* (Teleostei: Cyprinidae) as determined from cytochrome b sequences. *Copeia* 1997:758-765.
31. Broughton, R. E., G. J. P. Naylor, and T. E. Dowling. 1998. Conflicting phylogenetic patterns caused by molecular mechanisms in mitochondrial DNA sequences. *Systematic Biology* 47:696-701.

32. Weibel, A. C., T. E. Dowling, and B. J. Turner. 1999. The evolution of sexual reproduction in an hermaphroditic fish (*Rivulus marmoratus*): A phylogenetic and biogeographic study. *Evolution* 53:1217-1225.
33. Hedrick, P. W., T. E. Dowling, W. L. Minckley, B. D. DeMarais, and P. C. Marsh. 2000. Establishing a captive broodstock for an endangered species: Bonytail chub (*Gila elegans*) as a case study. *Journal of Heredity* 91:35-39.
34. Kumar, S., P. Hedrick, T. Dowling, and M. Stoneking. 2000. Questioning evidence for recombination in human mitochondrial DNA. *Science* 288:1931a.
35. Elser, J. J., J. O'Brien, D. R. Dobberfuhl, and T. E. Dowling. 2000. The evolution of ecosystem processes: growth rate and elemental stoichiometry of a key herbivore in temperate and arctic habitats. *J. Evol. Biol.* 13:845-853.
36. Gerber, A. S., C. A. Tibbets, and T. E. Dowling. 2001. The role of introgressive hybridization in the evolution of the *Gila robusta* complex (Teleostei: Cyprinidae). *Evolution* 55:2028-39.
37. Tibbets, C. A., A. C. Weibel, and T. E. Dowling. 2001. Population genetics of *Lepidomeda vittata*, the Little Colorado River spinedace. *Copeia* 2001:813-819.
38. Alves, M. J., M. J. Collares-Pereira, T. E. Dowling, and M. M. Coelho. 2002. The genetics of maintenance of an all-male lineage in the *Squalius alburnoides* complex. *J. Fish. Biol.* 60: 649-662.
39. Cunha, C., N. Mesquita, T. E. Dowling, A. Gilles, and M. M. Coelho. 2002. Phylogenetic relationships of Eurasian and American cyprinids using cytochrome *b* sequences *J. Fish Biol.* 61:929-944.
40. Dowling, T. E., D. P. Martasian, and W. R. Jeffery. 2002. Evidence for multiple genetic forms with similar eyeless phenotypes in the blind cavefish, *Astyanax mexicanus*. *Mol. Biol. Evol.* 19:446-455.
41. Dowling, T. E., C. A. Tibbets, W. L. Minckley, and G. R. Smith. 2002. Evolutionary relationships of the plagiopeterns (Teleostei: Cyprinidae) from cytochrome *b* sequences. *Copeia* 2002:665-678.
42. Garrigan, D., P. C. Marsh, and T. E. Dowling. 2002. Long-term effective population size of endangered Colorado River fishes. *Animal Conservation* 5:95-102.
43. Gorokhova, E., T. E. Dowling, L. J. Weider, T. J. Crease, and J. J. Elser. 2002. Functional and ecological significance of rDNA IGS variation in a clonal organism under divergent selection for production rate. *Proc. R. Soc. Lond. B* 269:2373-2379.
44. Minckley, W. L., P. C. Marsh, J. E. Deacon, T. E. Dowling, P. W. Hedrick, W. J. Matthews, and G. Mueller. 2003. A conservation plan for lower Colorado River native fishes. *BioScience* 53:219-234.
45. Johnson, J. B., T. E. Dowling, and M. C. Belk. 2004. Neglected taxonomy of rare desert fishes: congruent evidence for two species of leatherside chub. *Systematic Biology* 53:841-855.
46. Turner, T. F., T. E. Dowling, R. E. Broughton, and J. R. Gold. 2004. Variable microsatellite markers amplify across divergent lineages of cyprinid fishes (subfamily Leuciscinae). *Conservation Genetics* 5:279-281.
47. Dowling, T. E., P. C. Marsh, A. T. Kelsen, and C. A. Tibbets. 2005. Genetic monitoring of wild and repatriated populations of endangered razorback sucker (*Xyrauchen texanus*, Catostomidae, Teleostei) in Lake Mohave, Arizona-Nevada. *Molecular Ecology* 14:123-135.

48. Echelle, A. A., E. W. Carson, A. F. Echelle, R. A. Van Den Bussche, T. E. Dowling, and A. Meyer. 2005. Historical Biogeography of the New World Genus *Cyprinodon* (Teleostei: Cyprinodontidae). *Copeia* 2005:320-339.
49. Elser, J. J., J. H. Schampel, M. Kyle, J. Watts, E. W. Carson, T. E. Dowling, C. Tang, and P. D. Roopnarine. 2005. Response of grazing snails to phosphorus enrichment of modern stromatolitic microbial communities. *Freshwater Biology* 50:1826–1835.
50. Carson, E. W. and T. E. Dowling. 2006. Influence of hydrogeographic history and hybridization on the distribution of genetic variation in the pupfishes *Cyprinodon atrorus* and *C. bifasciatus*. *Molecular Ecology* 15:667-679.
51. Crespo-Lopez, M. E., T. Duarte, T. Dowling, and M. M. Coelho. 2006. Modes of reproduction of the hybridogenetic fish *Squalius alburnoides* in the Tejo and Guadiana rivers: An approach with microsatellites. *Zoology* 109:277-286.
52. Crespo-Lopez, M. E., I. Pala, T. Duarte, T. E. Dowling, and M. M. Coelho. 2007. Genetic structure of the diploid–polyploid fish *Squalius alburnoides* in southern Iberian basins Tejo and Guadiana, based on microsatellites. *Journal of Fish Biology* 71 (Supplement C):423–436.
53. Estabrook, G. F., G. R. Smith, and T. E. Dowling. 2007. Body mass and temperature influence rates of mtDNA evolution in North American cyprinid fishes. *Evolution* 61:1176-1187.
54. Turner, T. F., T. E. Dowling, P. C. Marsh, B. R. Kesner, and A. T. Kelsen. 2007. Effective size, census size, and genetic monitoring of the endangered razorback sucker, *Xyrauchen texanus*. *Conservation Genetics* 8: 417-425.
55. Berendzen, P., A. M. Simons, R. M. Wood, T. E. Dowling, and C. L. Secor. 2008. Recovering cryptic diversity and ancient drainage patterns in eastern North America: historical biogeography of the *Notropis rubellus* species group (Teleostei: Cypriniformes). *Molecular Phylogenetics and Evolution* 46:721-737.
56. Carson, E. W., J. J. Elser, and T. E. Dowling. 2008. Importance of exogenous selection in a fish hybrid zone: Insights from reciprocal transplant experiments. *Copeia* 2008:794-800.
57. Gante, H. F., M. J. Alves, and T. E. Dowling. 2008. Development of cytochrome b primers for mitotyping of barbels (*Barbus* spp.). *Molecular Ecology Notes* 8:786-789.
58. Gante, H. F., J. Micael, F. J. Oliva-Paterna, I. Doadrio, T. E. Dowling, and M. J. Alves. 2009. Diversification within glacial refugia: tempo and mode of evolution of the polytypic fish *Barbus sclateri*. *Molecular Ecology* 18:3240–3255.
59. Turner, T. F., T. E. Dowling, M. J. Osborne, M. V. McPhee, R. E. Broughton, and J. R. Gold. 2009. Microsatellite markers for the endangered razorback sucker, *Xyrauchen texanus*, are widely applicable to genetic studies of other catostomine fishes. *Conservation Genetics* 10:551-553.
60. Hamilton, C., S. H. Faeth, and T. E. Dowling. 2009. Distribution of hybrid fungal symbionts and environmental stress. *Microbial Ecology* 58:408-413.
61. Hamilton, C., S. H. Faeth, and T. E. Dowling. 2010. Hybridization in endophyte symbionts alters host response to moisture and nutrient treatments. *Microbial Ecology* 59:768-775.
62. Unmack, P. J., and T. E. Dowling. 2010. Biogeography of the genus *Craterocephalus* (Teleostei: Atherinidae) in Australia. *Mol. Phy. Evol.* 55:968-984.
63. Gante, H. F., M. J. Alves, and T. E. Dowling. 2011. Paralog-specific primers for the amplification of nuclear loci in tetraploid barbels (*Barbus*: Cypriniformes). *J. Hered.* 102:617-621.



64. Unmack, P. J., M. P. Hammer, M. Adams, and T. E. Dowling. 2011. A phylogenetic analysis of pygmy perch (Teleostei: Percichthyidae) with an assessment of the major historical influences on aquatic biogeography in southern Australia. *Syst. Biol.* 60:797-812.
65. Carson, E. W., M. Tobler, W. L. Minckley, R. J. Ainsworth, and T. E. Dowling. 2012. Relationships between spatio-temporal environmental and genetic variation reveal an important influence of exogenous selection in a pupfish hybrid zone. *Molecular Ecology* 21:1209-1222.
66. Clarkson, R. W., P. C. Marsh, and T. E. Dowling. 2012. Population prioritization for conservation of imperiled warmwater fishes in an arid-region drainage. *Aquatic Conservation: Marine and Freshwater Ecosystems* 22:498-510.
67. Dowling, T. E., M. J. Saltzgeber, D. Adams, and P. C. Marsh. 2012. Assessment of genetic variability in a recruiting population of endangered fish, the razorback sucker (*Xyrauchen texanus*, Family Catostomidae), from Lake Mead, AZ-NV. *Transactions of the American Fisheries Society* 141:990-999.
68. Dowling, T. E., M. J. Saltzgeber, and P. C. Marsh. 2012. Genetic structure within and among populations of the endangered razorback sucker (*Xyrauchen texanus*) as determined by analysis of microsatellites. *Conservation Genetics* 13:1073-1083.
69. Schönuth, S., D. K. Shiozowa, T. E. Dowling, and R. L. Mayden. 2012. Molecular phylogeny and systematics of western North American cyprinids (Order Cypriniformes: Family Cyprinidae). *Zootaxa* 3586:281-303.
70. Unmack, P. J., M. P. Hammer, M. Adams, J. B. Johnson, and T. E. Dowling. 2013. The role of continental shelf width in determining freshwater phylogeographic patterns in southeastern Australian pygmy perch (Teleostei: Percichthyidae). *Molecular Ecology* 22:1683-1699.
71. Ley, G., M. J. Saltzgeber, T. E. Dowling, A. P. Karam, B. R. Kesner, and P. C. Marsh. 2014. Use of a molecular assay to detect predation on an endangered fish species. *Transactions of the American Fisheries Society* 143:49-54.
72. Dowling, T. E., T. F. Turner, E. W. Carson, M. J. Saltzgeber, D. Adams, B. Kesner, and P. C. Marsh. 2014. Genetic and demographic responses to intensive management of razorback sucker in Lake Mohave, Arizona-Nevada. *Evolutionary Applications* 7:339-354.
73. Unmack, P. J., T. E. Dowling, N. J. Laitinen, C. L. Secor, R. L. Mayden, D. K. Shiozawa, and G. R. Smith. 2014. Influence of introgression and geological processes on phylogenetic relationships of western North American mountain suckers (*Pantosteus*, Catostomidae). *PLoS ONE* 9: e90061. DOI:10.1371/journal.pone.0090061.
74. Dowling, T. E., C. D. Anderson, P. C. Marsh, and M. S. Rosenberg. 2015. Population structure in the roundtail chub (*Gila robusta* complex) of the Gila River basin as determined by microsatellites: Evolutionary and conservation implications. *PLoS ONE* 10(10): e0139832. doi: 10.1371/journal.pone.0139832.
75. Gante, H. F., I. Doadrio, M. J. Alves, and T. E. Dowling. 2015. Semi-permeable species boundaries in Iberian barbels (*Barbus* and *Luciobarbus*, Cyprinidae). *BMC Evolutionary Biology* 15:111. DOI: 10.1186/s12862-015-0392-3.
76. Marsh, P. C., T. E. Dowling, B. R. Kesner, T. F. Turner, and W. L. Minckley. 2015. Conservation to stem imminent extinction: the fight to save razorback sucker *Xyrauchen texanus* in Lake Mohave and its implications for species recovery. *Copeia* 103:141-156.

77. Dowling, T. E., Markle, D. F., G. J. Tranah, E. W. Carson, D. W. Wagman, and B. P. May. 2016. The role of hybridization in animal evolution: A case study from catostomid fishes. *PLoS ONE* 11(3): e0149884. doi:10.1371/journal.pone.0149884.
78. Carson, E. W., T. F. Turner, M. J. Saltzgeber, D. Adams, B. R. Kesner, P. C. Marsh, T. J. Pilger, and T. E. Dowling. 2016. Retention of ancestral genetic variation across life-stages of an endangered, long-lived iteroparous fish. *Journal of Heredity* 107:567-572.
79. Chow, J., T. E. Dowling, G. R. Smith, D. F. Markle, and P. J. Unmack. 2017. Mitochondrial DNA sequence variation, phylogeography, and divergence times in speckled dace, *Rhinichthys osculus* (Teleostei: Cyprinidae). *Miscellaneous Publication of the Museum of Zoology, University of Michigan*, No. 204:45-84.
80. Ehlo, C. A., M. J. Saltzgeber, T. E. Dowling, P. C. Marsh, B. R. Kesner. 2017. Use of molecular techniques to confirm nonnative fish predation on razorback sucker *Xyrauchen texanus* larvae in Lake Mohave, Arizona and Nevada. *Transactions of the American Fisheries Society* 146:201-205.
81. Marsh, P. C., R. W. Clarkson, and T. E. Dowling. 2017. Molecular genetics informs spatial segregation of two desert stream *Gila* (Cyprinidae). *Transactions of the American Fisheries Society* 146:47-59.
82. Osborne, M. J. A. V. Sanchez, T. E. Dowling, and T. F. Turner. 2018. Variance in reproductive success is driven by environmental factors, not mating system, in Bonytails. *Transactions of the American Fisheries Society* 147:1100-1114.

#### **IV. Final Contract Reports:**

1. Dowling, T. E., and W. M. Brown. 1986. Preliminary analysis of delphinid mitochondrial DNA, with special emphasis on population discreteness of *Tursiops truncatus* in the Gulf of Mexico. Tech. Rep. Marine Mammal Commission.
2. DeMarais, B. D., T. E. Dowling, and W. L. Minckley. 1990. Genetic survey of the Virgin chub. Report to U.S. Fish and Wildlife Service.
3. DeMarais, B. D., T. E. Dowling, and W. L. Minckley. 1991. Genetic survey of wild and captive stocks of Virgin River chubs. Report to U.S. Fish and Wildlife Service.
4. Dowling, T. E., and W. M. Brown. 1992. Population structure of the bottlenose dolphin (*Tursiops truncatus*) as determined by restriction endonuclease analysis of mitochondrial DNA. National Technical Information Service, U.S. Dept. of Commerce, P-128411.
5. Tibbets, C. A., A. C. Weibel, and T. E. Dowling. 1993. Mitochondrial DNA variation within and among populations of the Little Colorado spinedace. Report to Coconino National Forest, Contract No. 030492-D17-178.
6. Dowling, T. E., and W. L. Minckley. 1994. Genetic diversity of razorback sucker as determined by restriction endonuclease analysis of mitochondrial DNA. Report to US Bureau of Reclamation, Award No. 0-FC-40-09530-004.
7. Dowling, T. E. 1998. Genetic diversity of the *Gila* complex as determined by analysis of mitochondrial DNA. Report to US Bureau of Reclamation, Award No. 4-FC-40-15700.
8. Dowling, T.E., and P.C. Marsh. 1999. Comparative genetics of native fishes in Salt River Project canals and in upper Salt River system: roundtail chub, desert sucker, and Sonora sucker. Report to U.S. Bureau of Reclamation, Phoenix Area Office, Federal Grant 98-FG-732-0020.

9. Dowling, T.E., and P.C. Marsh. 1999. Population structure in the desert sucker, *Pantosteus clarki*. Report to U.S. Bureau of Reclamation, Phoenix Area Office, Federal Grant 98-G-32-0020.
10. Dowling, T. E., P. C. Marsh, A. T. Kelsen, and C. A. Tibbets. 2004. Genetic monitoring of wild and repatriated populations of endangered razorback sucker in Lake Mohave, Arizona-Nevada. Report to U.S. Bureau of Reclamation, Boulder City Office, Federal Grant 01-FG-30-0023.
11. Dowling, T. E. 2005. Conservation genetics of endangered Lost River and shortnose suckers. Report to U. S. Fish and Wildlife Service, Klamath Fall, OR, Contract # 114500J516.
12. Dowling, T. E. and A. T. Kelsen. 2005. Conservation genetics of Modoc sucker. U.S. Fish and Wildlife Service, Klamath Falls, OR.
13. Dowling, T. E. and P. C. Marsh. 2005. Population structure in the roundtail chub complex, Gila River basin, Arizona and New Mexico, with special emphasis on populations from the upper Gila basin of New Mexico. Report to the U. S. Forest Service, Order No. 43-8399-2-1069.
14. Dowling, T. E., A. T. Kelsen, and P. C. Marsh. 2007. Continuing studies of razorback sucker genetics. Report to Lower Colorado River Multi-Species Conservation Office, Bureau of Reclamation, Agreement Number 01-FG-30-0023.
15. Dowling, T. E., P. C. Marsh, C. D. Anderson, M. S. Rosenberg, and A. T. Kelsen. 2008. Population structure in the roundtail chub (*Gila robusta* complex) of the Gila River basin as determined by microsatellites. Report to Arizona Game and Fish Department, Contract # AGR 4/21/04 through funding provided by U.S. Fish and Wildlife Service Agreement 20181-4-J824F and Bureau of Reclamation Agreement 1425-97-AA-32-00420 (Gila River Basin Native Fishes Conservation Program task 3-46).
16. Dowling, T. E., and M. R. Schwemm. 2008. Molecular characterization of Verde River broodstock of roundtail chub, *Gila robusta*. Report to Arizona Game and Fish Department, Contract # AGRE 02/19/08.
17. Dowling, T. E. and P. C. Marsh. 2011. Work task C31 of the LCR MSCP - RASU Genetic Diversity Assessment. Report to Lower Colorado River Multi-Species Conservation Office, Bureau of Reclamation, Agreement Number R09AP30001.
18. Dowling, T. E., P. C. Marsh, and T. F. Turner. 2013. Work task C31 of the LCR MSCP - RASU Genetic Diversity Assessment. Report to Lower Colorado River Multi-Species Conservation Office, Bureau of Reclamation, Agreement Number R12AC30001.

#### **V. Papers Presented at Meetings:**

1. Dowling, T. E. 1982. Study of reproductive isolation between two species of cyprinid fishes. American Society of Ichthyologists and Herpetologists, 62nd Annual Meeting, June 13-19, DeKalb, Illinois.
2. Dowling, T. E. (written by I. Kornfield). 1984. Genetic identification of United States stocks of Atlantic salmon in non-U.S. waters. Atlantic Salmon Workshop, Northeast Fisheries Center, August 28-29, Woods Hole, Massachusetts.
3. Dowling, T. E. 1986. Preliminary mitochondrial DNA analysis of several species of *Notropis* and related genera. American Society of Ichthyologists and Herpetologists, 66<sup>th</sup> Annual Meeting, June 15-21, Victoria, British Columbia.

4. Dowling, T. E. 1986. Test of reciprocity of hybridization between sibling species of cyprinid fishes. Society for the Study of Evolution, June 22-25, Durham, New Hampshire.
5. Dowling, T. E. 1987. Failure to resolve phylogenetic relationships of *Notropis* using restriction endonuclease analysis of mtDNA. American Society of Ichthyologists and Herpetologists, 67th Annual Meeting, June 21-26, Albany, New York.
6. Dowling, T. E. 1988. Applications of mitochondrial DNA for the analysis of hybridization and introgression. American Society of Ichthyologists and Herpetologists, 68th Annual Meeting, June 24-29, Ann Arbor, Michigan.
7. Dowling, T. E. 1989. Introgressive hybridization and gene flow outside of the contact zone between *Notropis cornutus* and *N. chrysocephalus*. American Society of Ichthyologists and Herpetologists, 69th Annual Meeting, June 17-24, San Francisco, California.
8. Dowling, T. E., and M. R. Childs. 1989. Preliminary biochemical analysis of hybridization among native and nonnative trout in Arizona. Desert Fishes Council, 21st Annual Symposium, November 16-18, Albuquerque, New Mexico.
9. Dowling, T. E. 1990. Evidence for displacement of the contact zone between *Notropis cornutus* and *N. chrysocephalus*. International Congress of Systematic and Evolutionary Biology IV, July 1-7, College Park, Maryland.
10. Dowling, T. E. 1991. Phylogenetic relationships among populations of *Notropis rubellus* (Cyprinidae) as determined by analysis of mitochondrial DNA. American Society of Ichthyologists and Herpetologists, 71st Annual Meeting, June 14-21, New York, New York.
11. Dowling, T. E., and W. L. Minckley. 1991. Genetic diversity in the razorback sucker as determined by analysis of mitochondrial DNA. Desert Fishes Council, 23rd Annual Symposium, November 14-16, Death Valley, California.
12. Dowling, T. E. 1992. Panel presentation - "Genetics - Management Implications." Upper Colorado River Endangered Fishes Researchers Meeting, February 11-12, Moab, Utah.
13. Dowling, T. E., and W. L. Minckley. 1992. Genetic diversity in the razorback sucker as determined by analysis of mitochondrial DNA. Desert Fishes Council, 24th Annual Symposium, November 19-21, Mesa, Arizona.
14. Dowling, T. E., and M. R. Childs. 1993. Impact of hybridization on the threatened southwestern trout, *Onchorhynchus apache*. Invited talk for the symposium, "Conservation and genetics of salmon, trout, and char." American Society of Ichthyologists and Herpetologists, 73rd Annual Meeting, May 27-June 2, Austin, Texas.
15. Dowling, T. E., C. A. Tibbets, and M. R. Childs. 1993. Case study 3: Genetics of cienega/stream-dwelling fishes: small entities, big picture. Invited talk for the symposium, "Conservation biology of western fishes." Society for Conservation Biology, 7th Annual Meeting, June 9-13, Tempe, Arizona.
16. Dowling, T. E. 1993. Genetics in endangered species management. Invited talk for the symposium, "Imperiled aquatic resources: gene pools to rivers." American Fisheries Society, 123rd annual meeting, August 29-September 2, 1993.
17. Dowling, T. E. 1994. The role of historical effects in geographic variation of reproductive isolation between the cyprinids *Luxilus cornutus* and *L. chrysocephalus*. American Society of Ichthyologists and Herpetologists, 74th Annual Meeting, June 2-8, Los Angeles, California.
18. Dowling, T. E. 1994. Introgression among cyprinid fishes of the genus *Luxilus*: a molecular perspective. Invited talk for the symposium, "Molecular markers in hybrid zones." Society for the Study of Evolution, June 15-19, Athens, Georgia.

19. Dowling, T. E., and G. J. P. Naylor. 1995. Evolutionary relationships of minnows in the genus *Luxilus* as inferred from cytochrome b sequences. American Society of Ichthyologists and Herpetologists, 75th Annual Meeting, June 15-19, Edmonton, Alberta.
20. Dowling, T. E., C. A. Tibbets, and G. J. P. Naylor. 1995. Evolutionary genetics of *Gila* based on mitochondrial DNA restriction site and sequence data: a progress report. Desert Fishes Council, 27th Annual Symposium, November 16-18, Reno, Nevada.
21. Dowling, T. E., D. G. Buth, and C. A. Tibbets. 1996. Evolutionary genetics of *Ptychocheilus* (Cyprinidae) inferred from cytochrome b sequences. American Society of Ichthyologists and Herpetologists, 76th Annual Meeting, June 13-19, New Orleans, Louisiana.
22. Dowling, T. E., L. Nyanti, and G. R. Smith. 1997. Viability of hybrid progeny of the cyprinids *Luxilus cornutus* and *L. chrysocephalus*. American Society of Ichthyologists and Herpetologists, 77th Annual Meeting, June 26-July 2, Seattle, Washington.
23. Dowling, T. E., and W. L. Minckley. 1997. Molecular biogeography of Great Basin Fishes: Potentials and pitfalls. Symposium, Great Basin Aquatic System History, September 17-20, Salt Lake City, Utah.
24. Dowling, T. E. 1998. The role of geographic structure and hybridization in speciation. Symposium, The ecology of hybrid zones, International Congress of Ecology, July 19-26, 1998, Florence, Italy.
25. Dowling, T. E. and C. L. Secor. 1999. The role of glaciation patterns on genetic variation and introgression in the minnows *Luxilus cornutus* and *L. chrysocephalus*. Symposium, Evolutionary diversification: insight from studies of geographic variation and hybridization. June 20-21, Columbia, Missouri.
26. Dowling, T. E., W. L. Minckley, C. L. Secor, G. R. Smith, C. A. Tibbets, and J. Chow. 1999. Biogeographic relationships of western North American freshwater fishes: inference from phylogenetic analysis of DNA sequences. Invited symposium talk, Geological Society of America, October 1999, Denver, CO.
27. Dowling, T. E., A. Gilles, and G. R. Smith. 2000. Does hybridization play a role in diversification of animals? A case study from catostomid fishes. Invited symposium talk, 4èmes Journées "Évolution Biologique," June 21-23, Marseilles, France.
28. Dowling, T. E., E. W. Carson, D. F. Markle, M. R. Cavalluzzi, and D. Simon. 2000. Hybridization among suckers of the Klamath River basin, California-Oregon. Desert Fishes Council, 32nd Annual Symposium, November 16-19, Death Valley, California.
29. Dowling, T. E., E. W. Carson, C. L. Secor, A. Gilles, and G. R. Smith. 2001. Phylogenetic relationships of Catostomine suckers as determined by mitochondrial DNA sequences. American Society of Ichthyologists and Herpetologists, 81<sup>st</sup> Annual Meeting, July 5-10, State College, Pennsylvania.
30. Dowling, T. E., A. Kelsen, and D. F. Markle. 2001. Mitochondrial DNA variation among year classes of endangered suckers of Klamath Lake, Oregon. Desert Fishes Council, 33<sup>rd</sup> Annual Symposium, November 14-17, Alpine, Texas.
31. Dowling, T. E., P. C. Marsh, A. T. Kelsen, and C. A. Tibbets. 2003. Genetic monitoring and repatriation of and endangered western fish. American Fisheries Society, 133<sup>rd</sup> annual meeting, August 10-14, Quebec City, Canada.
32. Dowling, T. E., P. C. Marsh, A. T. Kelsen, and C. A. Tibbets. 2003. Genetic monitoring and repatriation of razorback sucker (*Xyrauchen texanus*) in Lake Mohave. Desert Fishes Council, 35<sup>th</sup> Annual Symposium, November 19-22, Death Valley, California.

33. Dowling, T. E., L. Espinasa, and W. R. Jeffery. 2004. Evolutionary genetics of the blind cavefish, *Astyanax mexicanus*. American Society of Ichthyologists and Herpetologists, 84<sup>th</sup> Annual Meeting, May 26-31, Norman, Oklahoma.
34. Dowling, T. E. and P. C. Marsh. 2009. Molecular markers and management of endemic fishes from the mainstream Colorado River: razorback sucker (*Xyrauchen texanus*) as a case study. American Fisheries Society, 139<sup>th</sup> annual meeting, August 30 - September 3, Nashville, Tennessee.
35. Dowling, T. E. and P. C. Marsh. 2010. Genetic monitoring of recovery of *Gila* in Fossil Creek. Fossil Creek working group, January 2010.
36. Dowling, T. E., D. F. Markle, B. May, et al. 2010. Hybridization and the evolution of catostomid fishes: Klamath River basin suckers as a case study. Western Division of the American Fisheries Society, April 19 – 23, Salt Lake City, Utah.
37. Saltzgiver, M.J., T.E. Dowling, and P. C. Marsh. 2011. Patterns of genetic variation in razorback sucker from Lakes Mohave and Mead. Colorado River Aquatic Biologists meeting, January 12-13. Laughlin, Nevada.
38. Dowling, T. E., P. C. Marsh, T. F. Turner, M. J. Saltzgiver, and D. Adams. 2012. Impact of repatriation on genetic variation in the Lake Mohave population of razorback sucker. Colorado River Aquatic Biologists meeting, January 11-12. Laughlin, Nevada.
39. Dowling, T. E., T. F. Turner, and P. C. Marsh. 2013. Molecular markers and management of endemic fishes from the mainstem Colorado River: razorback sucker (*Xyrauchen texanus*) as a case study. Joint Meeting of Ichthyologists and Herpetologists, 93<sup>rd</sup> annual meeting, Albuquerque, New Mexico, July 10-15, 2013.
40. Saltzgiver, M. J., T. E. Dowling, P. C. Marsh, and T. F. Turner. 2013. Reproductive success of individual razorback sucker in isolated backwaters: A progress report. Desert Fishes Council, 45<sup>th</sup> Annual Symposium, November 20-24, Flagstaff, AZ.
41. Dowling, T. E., P. C. Marsh, T. F. Turner, and B. Kesner. 2014. Status of razorback sucker in Lakes Mohave and Mead: a conservation genetic perspective. Colorado River Aquatic Biologists meeting, January 8-9. Laughlin, Nevada.
42. Dowling, T. E., P. C. Marsh, T. F. Turner, and B. Kesner. 2015. Status of razorback sucker in Lakes Mohave and Mead: a conservation genetic perspective. Colorado River Aquatic Biologists meeting, January 7-8. Laughlin, Nevada.
43. Dowling, T. E., M. J. Saltzgiver, B. K. Kesner, P. C. Marsh, and T. F. Turner. 2016. Reproductive success of individual razorback sucker in isolated backwaters: A progress report. Colorado River Aquatic Biologists meeting, January 6-7. Laughlin, Nevada.
44. Dowling, T. E., P. C. Marsh, T. F. Turner, and B. Kesner. 2016. Status of razorback sucker in Lakes Mohave and Mead: a conservation genetic perspective. Colorado River Aquatic Biologists meeting, January 6-7. Laughlin, Nevada.
45. Dowling, T. E., T. F. Turner, and P. C. Marsh. 2016. Molecular markers and management of endemic fishes from the mainstem Colorado River: razorback sucker (*Xyrauchen texanus*) as a case study. 76<sup>th</sup> Annual Midwest Fish and Wildlife Conference, Grand Rapids, Michigan, January 24-27, 2016.
46. Dowling, T. E., P. C. Marsh, and R. W. Clarkson. 2016. Molecular markers identify segregation of two species of chubs (genus *Gila*) in an Arizona stream. Joint Meeting of Ichthyologists and Herpetologists, 96<sup>th</sup> annual meeting, New Orleans, Louisiana, July 6-11, 2016.

47. Dowling, T. E., P. C. Marsh, and R. W. Clarkson. 2016. Molecular markers support specific status of *Gila robusta* and *G. nigra* in Fossil Creek, AZ. Desert Fishes Council, 48<sup>th</sup> Annual Meeting, Albuquerque, New Mexico, November 15-19, 2016.

#### **VI. Meetings, Symposia, and Workshops organized:**

1. Mitochondrial DNA in ichthyology and herpetology (organized with I. Kornfield). American Society of Ichthyologists and Herpetologists, 68th Annual Meeting, June 24-29, Ann Arbor, Michigan.
2. Mitochondrial DNA workshop (organized with W. M. Brown). American Society of Ichthyologists and Herpetologists, 68th Annual Meeting, June 24-29, Ann Arbor, Michigan.
3. Desert Fishes Council, 24th Annual Symposium, November 19-21, Mesa, Arizona. **Assisted P. C. Marsh, M. E. Douglas, and W. L. Minckley.**
4. Society for Conservation Biology, 7th Annual Meeting, June 9-13, Tempe, Arizona. **Involved several ASU faculty. My responsibilities included organization of abstracts, placing papers in time slots, and audio-visual.**
5. Special symposium honoring W. L. Minckley and J. E. Deacon, Desert Fishes Council, 35th Annual Symposium, November 19-22, Death Valley, California. Co-organized with Walter Courtney, Florida Atlantic University.

#### **VII. Invited Seminars and Symposium/Panel Participation:**

1. Department of Wildlife and Fisheries Sciences, Texas A & M University, February 1988.
2. Department of Ecology and Evolutionary Biology, University of Arizona, December 1988.
3. Department of Wildlife and Fisheries Sciences, Texas A & M University, February 1991.
4. Upper Colorado River Endangered Fishes Researchers Meeting, February 1992
5. Department of Zoology, Brigham Young University, March 1993.
6. Symposium, "Conservation and genetics of salmon, trout, and char." American Society of Ichthyologists and Herpetologists, June, 1993.
7. Symposium, "Conservation biology of western fishes." Society for Conservation Biology, June 1993.
8. Symposium, "Imperiled aquatic resources: gene pools to rivers." American Fisheries Society, September 1993.
9. Symposium, "Studies in the evolution of fishes inferred from DNA sequences", American Society of Ichthyologists and Herpetologists, June, 1994. Paper presented by Robert M. Wood.
10. Symposium, "Molecular markers in hybrid zones." Society for the Study of Evolution, June, 1994.
11. Workshop presentation, "Synopsis of the genetic diversity of extant razorback sucker populations," Glen Canyon Environmental Studies group, January 1996.
12. Workshop presentation, "*Gila* genetics: mtDNA variation," U. S. Fish and Wildlife Service, February 1996.
13. Department of Wildlife and Fisheries Sciences, Texas A & M University, November 1996.
14. Symposium, Great Basin Aquatic System History. September 1997.
15. Department of Biology, New Mexico State University, February 1998.
16. Department of Biology, Texas Tech University, March 1998.
17. Department of Ecology and Evolutionary Biology, University of Tennessee, April 1998.

18. Symposium, "The ecology of hybrid zones." 7th International Congress of Ecology, July 1998.
19. Department of Zoology, Washington State University, March 1999. (Two seminars)
20. Department of Biology, University of California, Santa Cruz, October 1999.
21. Symposium, "Geologic and Biologic Evidence for Late Cenozoic Drainage Rearrangements in North America: Implications for Aquatic Biogeography," Geological Society of America, October, 1999, Denver, Colorado.
22. Symposium, 4èmes Journées "Évolution Biologique," June 21-23, 2000, Marseilles, France.
23. Department of Biology, University of South Carolina, March 2001.
24. Department of Fisheries and Wildlife, Utah State University, November 2001.
25. National Marine Fisheries Service, March 2002.
26. Symposium, "Use of genetic markers for management and conservation: beyond population structure analyses," American Fisheries Society, 133<sup>rd</sup> annual meeting, Quebec City, Canada, August 10-14, 2003.
27. National Science Foundation, Evolutionary Genetics Panel, October 13-15, 2004.
28. National Science Foundation, Evolutionary Genetics Panel, October 5-7, 2005.
29. Department of Ecology and Evolutionary Biology, University of Tennessee, February 2007.
30. Arizona Game and Fish Department, March 2008.
31. Arizona Game and Fish Department, November 2008.
32. Symposium, "Conservation of genetic diversity in unexploited populations," American Fisheries Society, 139<sup>th</sup> annual meeting, Nashville, Tennessee, August 30 - September 3, 2009.
33. Fossil Creek working group, January 2010.
34. Department of Zoology, Southern Illinois University, Carbondale, April 2011.
35. Gila Recovery Team, June 2011.
36. Department of Biological Sciences, Wayne State University, October 2011.
37. Department of Zoology, Oklahoma University, May 2013.
38. Symposium, "Fish Out of Water," Joint Meeting of Ichthyologists and Herpetologists, 93<sup>rd</sup> annual meeting, Albuquerque, New Mexico, July 10-15, 2013.
39. Lake Mead Razorback Sucker Work Group, "Status of razorback sucker in Lake Mead: A conservation genetic perspective," March 27, 2014.
40. Lake Mead Razorback Sucker Work Group, "Status of razorback sucker in Lake Mead: A conservation genetic perspective," March 9, 2015.
41. Lake Mead Razorback Sucker Work Group, "Status of razorback sucker in Lake Mead," March 9, 2016.
42. ASIH/AFS Names Committee on Names of Fishes, "Molecular variation within and among members of the *Gila robusta* complex, AZ-NM," April 4, 2016.
43. Department of Biology, Mercer University, "Fishes without a river: The battle against extinction for fishes from the Colorado River," April 26, 2016.

#### **VIII. Presentations, general public:**

1. AP day, Wayne State University, "The importance of evolutionary biology in everyday life," April 22, 2014.
2. Science Saturday, Belle Isle Aquarium, "A fish-eye view of the biodiversity crisis: The impact of invasive species," December 6, 2014.



3. Mercer University, History 110R (Fundamentals of Western Civilization: Writing the History of Western Scientific Thought), April 26, 2016.

**IX. Major collaborative initiatives not listed above:**

1. Evolution of blind cavefishes (*Astyanax*) - with W. Jeffery (University of Maryland)
2. The Iberian endemic *Rutilus alburnoides* complex: a case study of evolution in action through hybridization, unisexuality, and genome polyploidization - with M. J. Alves, M. M. Coelho, and M. J. Collares-Pereira (University of Lisbon, Portugal)
3. Hybridization and evolution of polyploid fishes: information from the Iberian cyprinid genus *Barbus* - with M J Alves (Museo Bocage, Lisbon, Portugal)
4. Evolution of catostomid fishes – with Gerald R. Smith (University of Michigan)
5. Evolution of speckled dace – with Gerald R. Smith (University of Michigan)
6. Population size and conservation of endangered razorback sucker – with Thomas Turner (University of New Mexico)
7. Evolution of minnows in the genus *Campostoma* – with Peter Unmack (University of Canberra) and Evan Carson (US Fish and Wildlife Service)
8. Evolution of redbreast dace in the Pacific Northwest – with Douglas Markle (Oregon State University)
9. Genomics of tetraploid catostomid fishes – with Gerald R. Smith (University of Michigan) , Trevor Krabbenhoft (University of Buffalo), Weilong Hao (Wayne State University)

**Departmental Activities:**

**I. Teaching:**

***Arizona State University:***

BIOL 181/187: Introductory Biology (Genetics portion), Spring 1991, Fall 2001

BIOL 411: Conservation Biology, Fall 1998-2001

BIOL 345/445: Organic Evolution, Fall 1991-1995, 1997-1998, 2004-2006, 2010; Spring 2000-2002, 2005-2011, 2013

ZOOL 490: Undergraduate Research, Fall 1989

ZOOL 494: Speciation, Spring 1991; Molecular Systematics, Spring 1993

BIOL 545 (ZOOL 515): Population Genetics, Fall 1989, 2000, Spring 1992, 1994, 1996, 1998

ZOOL 517: Techniques in Evolutionary Genetics, Spring and Fall 1990, Spring 1993, 1995

ZOOL 590: Readings in Conference, Fall 1989, Spring and Fall 1992, Fall 1997, Spring 1998

BIOL 591: Advances in Evolutionary Biology, Spring 1999, Fall 2000, Fall 2007

BIOL/ZOOL 598: Seminars in Evolutionary Biology/Genetics, Spring 1989, Spring 2000

***Wayne State University:***

BIO 8995: Graduate seminar in Biology, Fall 2014

BIO 6090: Population Genetics, Fall 2015, Winter 2016

BIO 6190: Conservation Genetics, Winter 2017

BIO 1500: Basic Life Diversity, Fall, Winter 2015, Fall 2016-2017

**II. Student Supervision:**

**A. High school students**

1. Kelly Briner, Jr. (Fall 2006)

## **B. Undergraduate/post-graduate supervision:**

### ***Arizona State University:***

1. Michael R. Childs (1989-1990, completed M.S., Oklahoma State University, currently employed by U.S. Forest Service)
2. Amy C. Weibel (1993-1994, completed M.S., New Mexico State University, completed Ph. D., Wayne State University)
3. Shauna Gustaveson (1993-1994, worked for NIH, Phoenix, currently in PhD program, University of Pittsburgh)
4. Anthony Philippakis (1996, completed undergraduate at Yale University, MS at Cambridge, currently in M. D. program, Harvard)
5. Jeffery Chow (1997-2000, MS program at Duke University, Fall 2000)
6. Teresa Tibbets (with Jim Elser, 1997-1998, Ph. D. program, University of New Mexico)
7. Leanna Andersen (1998-1999)
8. Cassandra Clemans (1998-1999, attended law school)
9. Kristen Popple (2000-2001)
10. Joshua Manygoats (2000-2001)
11. Stephanie Reina (2002)
12. Ryan Ainsworth (2001-2004, veterinarian)
13. Cindi Girardin (2002-2004)
14. Shannon Ranum (2004-2005)
15. Kevin Forsberg (2006)
16. Ioana Hociata (2008-2009)
17. Beth Trobaugh (2011)
18. Stephanie King (2009-2013)
19. Mark O'Donnell (2010-2012)
20. Paul Dority (2012-2013)
21. Kyle Overton (2012-2013)

### ***Wayne State University:***

22. Andrew Yan (2013-2015)
23. Kristen Kargol (2013-2018)
24. Sergiu Lupea (2015-2017)
25. Isley Coleman (2016-2017)
26. Chandana Channasiddeswaraiah (2017-present)
27. Julie Nitz (2017-present)

## **C. Undergraduate Honor's Thesis Committee:**

### ***Arizona State University:***

1. Ruby Scheffer, completed Spring 1993
2. Mary Atkinson, completed Summer 2010

### ***Wayne State University:***

3. Chad Coleman (mentor), completed Winter 2015
4. Miles Bowman (2015-present)

5. Emily Buckeridge (2016-2018)
6. Rami Youssef (2016-2018)

**D. Research technicians**

1. Anne Kelsen, 2000-2006
2. Michael Schwemm, 2007-2008
3. Michael Childs, 2009
4. Melody Saltzgiver, 2009-2015
5. Charlotte Johnston, 2010-2013
6. Deborah Adams, 2011-2013
7. Kelly Pollard, 2015-present

**E. Masters:**

1. C. Alana Tibbets, completed May 1993
2. Robert Reed (with M. E. Douglas), completed May 1995
3. Angela Hutchison, completed December 1995
4. Michael Schwemm, completed December 2006 (Ph.D., Oklahoma State University; US Fish and Wildlife Service)
5. Jason Schooley, completed April 2010 (M.S., Oklahoma Department of Wildlife Conservation)

**F. Doctoral:**

***Arizona State University:***

1. Bruce D. DeMarais (with W. L. Minckley), December 1992 (University of Puget Sound)
2. Richard E. Broughton, Jr., May 1995 (Professor and Chair, University of Oklahoma)
3. C. Alana Tibbets, May 1998 (Southern Illinois University, Edwardsville)
4. Gregory D. Hocutt (with T. Markow), May 2000 (Mesa Community College)
5. David. D. Oakey (with M. E. Douglas), May 2001(deceased)
6. Evan W. Carson, completed May 2005 (US Fish and Wildlife Service)
7. Peter Unmack, completed August 2005 (University of Canberra)
8. Hugo Gante, completed August 2009 (Indiana State University)
9. Cyd Hamilton (with S. H. Faeth), completed August 2009
10. Erica Tassone (with B. C. Verrelli), completed April 2013
11. Carol L. Secor (never finished)

***Wayne State University:***

12. Melody J. Saltzgiver, withdrew August 2015
13. Abby J. Wicks, Winter 2014 - present

**G. Postdoctoral:**

1. Robert M. Wood, 1993-1994 (Associate Professor, St. Louis University)
2. Gavin J. P. Naylor, 1994-1995 (Associate Professor, Florida State University)
3. Anne S. Gerber, 1996-1997 (Assistant Professor, University of North Dakota)
4. Andre Gilles, 1998-2000 (Assistant Professor, Universit e de Provence)

5. Elena Gorokhova, 1999-2001
6. Trevor Krabbenhoft, 2014-2018 (Assistant Professor, University of Buffalo)
7. Joel Corush, 2018-date

#### **H. Visiting Scientists:**

1. Anthony A. Echelle, 1989 (Oklahoma State University)
2. Donald G. Buth, 1994 (University of California, Los Angeles)
3. Maria Judite Alves, 1996 (University of Lisbon, Portugal)

#### **I. Supervisory Committees (\* = degree completed; <sup>W</sup> = withdrew from program):**

##### *Arizona State University:*

1. Kirk Anderson, Ph.D.\*
2. Chris Armstrong, Ph.D.\*
3. Brad Buckley, Ph.D.\*
4. Jesse Brunner, Ph.D.\*
5. Jason Dunham, M.S.\*
6. Bridget Dunnigan, M.S.\*
7. Daniel Garrigan, Ph.D.\*
8. Erik Gergus, Ph.D.\*
9. Alan Giese, Ph.D.\*
10. Root Gorelick, Ph.D.\*
11. Amy Greer, Ph.D.\*
12. Jamie Howard, Ph.D.\*
13. Reg Hoyt, Ph.D.<sup>W</sup>
14. Joe Jones, Ph.D.\* (University of California, Santa Cruz)
15. Andrea Jani, M.S.\*
16. Glennis Julian, Ph.D.\*
17. Steve Kalinowski, Ph.D.\*
18. Wendy Marusich, Ph.D.\*
19. Phil Miller, Ph.D.\*
20. Megan McPhee, Ph.D.\* (University of New Mexico)
21. Lyle Nichols, Ph.D.\*
22. Steven M. Norris, Ph.D.\*
23. George Ohlandt, M.S.\*
24. Randi Papke, Ph.D.\*
25. Joel Parker, Ph.D.\*
26. Mary Peacock, Ph.D.\*
27. Angela Picco, Ph.D.\*
28. Danna Schock, Ph.D.\*
29. Ruby Scheffer, Ph.D.\*
30. Lisa Schmoetzer, Ph.D.<sup>W</sup>
31. Rhonda Snook, Ph.D.\*
32. David Spadafore, M.N.S.\*
33. Harry Spanglet (Botany), M.S.\*
34. Daryn Stover, Ph.D.\*

35. T. J. Sullivan, Ph.D.\*
36. Barb Terkanian, Ph.D.\*
37. Ross Timmons, M.S.\*
38. Keith Malmos, Ph.D.
39. James Watts, Ph.D.

***Wayne State University***

1. Anna Boegehold
2. Darrin Hunt
3. Corey Krabbenhoft
4. Benjamin Spei
5. Madelyn Tucker
6. Alison Rifenburgh
7. Ali Shakoor
8. Julia Sosin
9. Douglas Putt

**II. Departmental Committees:**

***Arizona State University:***

1. Wildlife Program Evaluation Committee, Spring 1989
2. Graduate Programs Committee, Fall 1989-Spring 1996, Fall 1998, Fall 2001-Spring 2002
  - a. Chair, Genetics Comprehensive Exam Subcommittee, 1989-1990
  - b. Member, Graduate Student Research Fund Subcommittee, 1990-1991
  - c. Chair, Graduate Student Research Fund Subcommittee, Fall 1991-Spring 1996
  - d. Interim Director, Fall 1998
  - e. Director, Fall 2002-Fall 2003
3. Advisory Committee, Fall 1990-Spring 1994, Fall 1997-Spring 2001
4. Seminar Committee, Fall 1990
5. Personnel Committee, Fall 1994-Spring 1996
6. Septennial Review Committee, 1994-1995, 2000-2001
7. Facilities Committee, Fall 2005-Spring 2010
8. SoLS Executive Committee, Fall 2009-Summer 2013
9. Museum Committee, co-chair, Fall 2009-Summer 2013

***Wayne State University:***

1. Tenure and Promotion committee, Fall 2014 – Winter 2015
2. Research Committee, Fall 2014 – Winter 2015
3. Division lead (EEB), Fall 2015 – present
4. Policy Committee, Fall 2015 – present
5. Undergraduate Committee, Fall 2015 – present

**IV. Search Committees:**

1. Terrestrial Ecology, 1990-1991
2. Ullman Professor, 1991-1992
3. Integrative Biologist, 1994-1995

4. Evolutionary Biologist (chair), 1997-1998
5. Molecular Genetics (co-chair), 1998-1999
6. Del Webb Chair (co-chair), 1998-2000
7. Conservation Biologist, 2000-2001
8. Maytag postdoctoral fellow, 2001, 2003
9. Museum Curator, 2001-2003

**V. University Committees:**

***Arizona State University:***

1. Radiation Safety Committee, Fall 2004-Summer 2013

***Wayne State University:***

1. Life Sciences Subcommittee, University Grant Committee, Fall 2015 – present

**VI. External Committees:**

***Wayne State University:***

1. Names of Fishes Committee, AFS-ASIH, Fall 2018 - present