

Theme: Recent work in speciation research by women authors

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The Society for the Study of Evolution was established in 1943 by merging the National Research Council with the Society for the Study of Speciation (Evolution, 2021). Two leaders of this group, Mayr and Dobzhansky, set the agenda for decades of speciation research. Mayr's Biological Species Concept (1942), see also (Dobzhansky, 1935) put the focus of speciation research squarely on the evolution of reproductive isolation, and his vehement arguments against the plausibility of sympatric speciation stoked decades of debates over whether or not reproductive isolation could evolve in the absence of geographical isolation. Likewise, Dobzhansky's list of "isolating mechanisms" (1951) and model for the evolution of intrinsic postzygotic isolation (the eponymous Bateson-Dobzhansky-Muller model; [Dobzhansky, 1935]) laid the groundwork for comparative and genetic speciation studies. Several prominent contributions to our understanding of speciation were published during the following decades: Bush's empirical study of sympatric host race formation in the apple maggot fly (1969), Felsenstein's modeling work demonstrating how recombination halts progress toward speciation in sympatry (1981), and Coyne and Orr's comparative analyses of the evolution of prezygotic and postzygotic isolation (Coyne & Orr, 1989, 1997). These papers, in turn, have had an enormous influence on modern speciation research, which continues to feature prominently in the pages of *Evolution* (Matute & Cooper, 2021).

In light of this history, a special issue focused on speciation seems a natural choice to celebrate *Evolution's* 75th anniversary. However, as is often the case when looking back on seminal research that has shaped a field, the papers that have garnered the most citations and influence come from a restricted pool that tended to exclude women. While it is certainly true

that women historically had limited opportunities to participate in speciation research, "hidden figures" (sensu [Dung et al., 2019]) such as Margarete "Gretel" Simon Mayr [Trivers 2005]), and Dobzhansky's long-time research assistant and coauthor, Olga Pavlovsky, almost certainly played important roles in the development of these ideas. And even despite limited opportunities for authorship, some of *Evolution's* earliest papers on hybridization and introgression in nature were written by women, including Lulu Gaiser's (1951) evidence for hybridization in *Liatris*, Barbara Calhoun's study of introgression between *Typha latifolia* and *T. angustifolia* (Fassett & Calhoun, 1952), and Margot Forde's study of hybridization between *Quercus dumosa* and the serpentine endemic *Q. durata* (Forde & Faris, 1962). Around this time, orchid breeder Helen Adams forged an academic-industrial partnership with Edgar Anderson to provide an overview of orchid hybrids for the readership of *Evolution* (Adams & Anderson, 1958).

In addition to documenting natural and experimental hybridization, early contributions to *Evolution* by women also identified the mechanisms that isolate populations and how such isolation evolves over time. In the third volume of the journal, Theresa Clay (1949) outlined isolating mechanisms in ectoparasites and connected these barriers to the diversification process. In collaboration with their husbands, Edna Haskins documented patterns of sexual isolation between three species of poeciliid fishes (Haskins & Haskins, 1949), and Karen Grant exposed a case of mechanical isolation between a sympatric *Salvia* species pair (Grant & Grant, 1964). Meanwhile, more than 30 years before the publication of Coyne & Orr's (1989) classic, Charlotte Avers published her work on experimental crosses between

multiple *Aster* species to infer correlates of reproductive isolation and how reproductive isolating barriers accumulate over time ((1953b) and (1953a) published in the *American Journal of Botany*), and Barbara Briggs connected isolating mechanisms to observed patterns of hybridization in *Ranunculus* (Briggs, 1962) and *Darwinia* (Briggs 1964) species.

Women published an increasing number of speciation papers in *Evolution* throughout 1960s, 1970s, and 1980s. Over this time, women continued to document patterns of hybridization in nature, including Batia Pazy's study of *Aegilops* (Pazy & Zohary, 1965), Sara Bedichek Pipkin's (1968) study of introgression between *Drosophila metzii* and *D. pellewae*, Hana Bar-El's work on mole rats (Nevo & Bar-El, 1976), Flavia O'Rourke's study of milkweed bugs (O'Rourke, 1979), and Janiece McHale's use of chemical patterns to identify hybrid legumes (McHale & Alston, 1964). As the speciation field matured, women published *Evolution* papers that addressed the pressing conceptual questions of the day, including the study of ecological (Kellogg 1975) and sexual (Koepfer, 1987a, b; Wasserman & Koepfer, 1977) character displacement and studies of hybrid zones (Galler & Gould 1979; Patton et al., 1979). Women also published *Evolution* papers that took advantage of new molecular tools for studying speciation, including allozyme analysis of genetic differentiation in flies (Johnson, 1978) and quantitative immunological analysis of frog divergence history (Roberts & Maxson, 1985). Together, these works paved the way for the papers we feature here.

Despite much progress since the founding of the journal *Evolution*, however, gender gaps in opportunities to participate in research persist (Shen, 2013). Moreover, even as the number of papers authored by women has grown in recent years, women evolutionary researchers still tend to be cited less often (Grogan, 2019) and invited for fewer talks at symposia (Schroeder et al., 2013). These metrics diminish the perceived importance of work by women, and, to all of our detriment, reduce their influence on our field. For these reasons, we are highlighting 26 outstanding speciation papers written by women (either first or last author, or both) that we believe will (or should) shape the future of speciation research. This list is not exhaustive - there are certainly other important speciation papers authored by women and published in *Evolution* that are not included. Our goal was to select a range of relatively recent papers that included both empirical and theoretical approaches and touched on a wide range of themes in current speciation research.

The papers we highlight are representative of the breadth of speciation work published in *Evolution* over the last 20–30 years. These papers tackle classic speciation themes such as reinforcement (Bank et al., 2012; Dyer et al., 2014; Liou and Price, 1994; Servedio, 2000), Haldane's Rule (Brothers & Delph, 2010), the genetic mechanisms of speciation (Barnard-Kubow et al., 2016; Fishman et al. 2013; Hopkins et al. 2012; Moehring, 2011; Shaw,

1996; Sweigart et al., 2007; Yamaguchi & Otto, 2020), the evolution and relative importance of different types of reproductive barriers (Fuller, 2008; Kay, 2006; Moyle et al., 2004), and the geography of speciation (Knowles, 2000; Malay & Paulay, 2010; Via, 1999). These papers also explore the selective pressures that drive speciation (Duffy et al., 2007; Scordato, 2018) and the evolutionary consequences of hybridization and introgression (Grant & Grant, 1994; Larson et al., 2013; Maroja et al., 2009; Schumer et al., 2014; Singhal & Moritz, 2012; Tucker et al., 1992). Our authors use a diversity of approaches, including: evolutionary theory (Bank et al., 2012; Liou & Price 1994; Servedio, 2000; Yamaguchi & Otto, 2020); quantitative genetics (Fishman et al., 2013; Shaw, 1996; Sweigart et al., 2007); interspecific crosses (Barnard-Kubow et al., 2016; Brothers and Delph, 2010; Fuller, 2008; Moehring, 2011; Moyle et al., 2004); manipulative experiments (Dyer et al., 2014); field studies (Grant & Grant, 1994; Kay, 2006; Scordato, 2018); experimental evolution (Duffy et al., 2007); population genetics and genomics (Hopkins et al., 2012; Larson et al., 2013; Maroja et al., 2009; Singhal & Moritz, 2012; Via, 1999); phylogenetics (Knowles, 2000; Malay & Paulay, 2010), and meta-analysis of published research (Schumer et al. 2014). Diversity is also reflected in the study systems involved, from viruses (Duffy et al., 2007) to plants (Barnard-Kubow et al. 2016; Brothers & Delph, 2010; Fishman et al., 2013; Hopkins et al., 2012; Kay, 2006; Moyle et al., 2004; Sweigart et al., 2007) to arthropods (Dyer et al., 2014; Knowles, 2000; Larson et al., 2013; Malay & Paulay, 2010; Maroja et al., 2009; Moehring, 2011; Shaw, 1996; Via, 1999) and vertebrates (Fuller, 2008; Grant & Grant, 1964; Scordato, 2018; Singhal & Moritz, 2012; Tucker et al., 1992).

Our collection of papers focuses on major contributions in speciation research from corresponding authors we could contact. We have taken this approach to recognize the damage that can be done by misgendering and because names alone do not necessarily represent gender correctly. We recognize, however, that the approach is flawed. For example, our approach would have missed papers by authors who identify as women, but have gender-neutral or gender-atypical names. Our approach also did not yield papers by authors who are non-binary, genderfluid, agender, or gender nonconforming. Note also that our assumptions of gender for authors of historical texts could also obscure gender diversity. Although we made every effort to confirm gender presentation of authors of each paper cited above by the use of pronouns in acknowledgements, webpages or obituaries, we made no attempt to contact cited authors who are not featured in this mini issue. Finally, we note that we are able to highlight the contributions of women speciation researchers precisely because the proportion of evolutionary biologists who identify as women has increased substantially since the founding of SSE (Debarre et al., 2018; Rushworth et al., 2021). Our field remains deficient

in representing global ethnic, racial, and gender diversity (Rushworth et al., 2021). Thus, we acknowledge that there is much more to do, but our hope is that by recognizing the contributions of these women, we will promote an academic culture of recognizing, celebrating, and *citing* underrepresented voices in our field.

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