NABA Counts Butterflies

by Leslie Ries

In 2009, I wrote a "Count Column" showing the value of data coming from NABA's seasonal count program. My focus at that time was to impress upon the NABA community how much data there were (at the time) — and some metrics showing these data's ability to capture population dynamics of the North American butterfly communities.

It has been a long time since I wrote that column — and now I want to share with you the value those data have had for scientific research. As someone who has been working with NABA since 2004 to help organize and digitize your count data for use in scientific research, and now a new NABA board member as well, I am very proud to have been able to work with NABA on these efforts. The most important message I have for NABA's membership and especially those of you who participate in the count programs and/or submit records to NABA's other, more casual "sightings" platforms is that your efforts have had a tremendous effect on our understanding of butterfly dynamics in North America.

This research is especially critical as the evidence for global declines of insects worldwide continues to grow. The wider public's knowledge and concern about these declines means that the work that NABA and its' members are doing is more critical than ever. While this article is filed under this magazine's "Count Column", I am also going to emphasize how NABA's sightings and field trip programs are also starting to have a major impact on our understanding of butterflies,

My primary goal in this column is to highlight the growth of the data available from these programs and all of the research that has emerged using the NABA butterfly data, but I start with a brief history of the several butterfly monitoring programs under the NABA umbrella.

The count program was originally started by the Xerces Society in 1975 and was modeled on the Christmas Bird Counts, a once-per-year survey of winter birds started by the Audubon Society in 1895. That is why the count program first used the "Fourth of July" moniker.

In 1992, NABA took over the management of the count program, and it has grown substantially since then, leveling out in the early 2000s. In 2000, NABA added a "sightings" platform for more casual field trips and observations that could be posted by anyone. NABA's count program is currently the largest, longest-running butterfly monitoring program in the world. In 2001, NABA started a new program to allow members to keep their lists of butterflies observed, including adding ones they already had recorded (The "Butterflies I've Seen" (BIS) program).

Individual NABA chapters also launched their own programs. The Massachusetts Butterfly Club (MBC) in particular played a pivotal role. Formed in 1986, the MBC voted in 1995 to become one of the first NABA chapters. One of their first activities when they formed was coordinating field trips for their members. It became standard to report all of the field trips and observations, and this program has continued to grow and collect data providing one of the most dense collections of records in the NABA family of programs (see page 8).

There are currently 45 peer-reviewed publications (that I know of!) that use data

Jeffrey Glassberg

A portion of one count party conducting the NABA Northern Westchester Count in 1993, the first year the Counts were run by NABA. Front to back: Jean Craighead George, author of *Julie Among the Wolves* and *My Side of the Mountain*; Valerie Giles, an artist and daughter of Lee Bontecou; Jane Scott, NABA Sectry/Treas.; Andrew Vallely, author of *Birds of Central America*; and Paul Sweet, ornithological collections manager at the American Museum of Natural History. July 10, 1993. Chappaqua, Westchester County, New York.

from at least one of the NABA monitoring programs (see page 11). Even before NABA's official formation in 1992, the first peer-reviewed paper was published by Anne Swengel in 1990. She took the yearly count reports and transformed the data into tables to show the type of data available and its potential usage ("Monitoring butterfly populations using the fourth of July butterfly count"). She followed this up in 1995 showing fluctuations of Monarch populations in the East and West.

Following this, a few papers came out from year to year, but this process was difficult because of the need to digitize data manually. Two early papers focused on the synchrony of butterfly population dynamics at continental scales, demonstrating the ability of these data to inform our knowledge about factors driving butterfly dynamics at the largest scales. One by R. Vanderbosch, published in the influential journal Global Change Biology in 2003, showed the relationship between a yearly abundance index of Painted Ladies and two primary drivers of global climate dynamics, El Nino and the Pacific Decadal Oscillation.

In 2004, I started working with NABA on transforming the historical count data, stored as "free text" lists in the annual reports, into a formal database, completed in 2008. Starting

Keith Parker

The NABA Counts demonstrate that, at least at some locations, such as this one on the Cumberland Co., NJ Count on June 30, 2010, Rare Skippers aren't that rare!

Holly Salvato

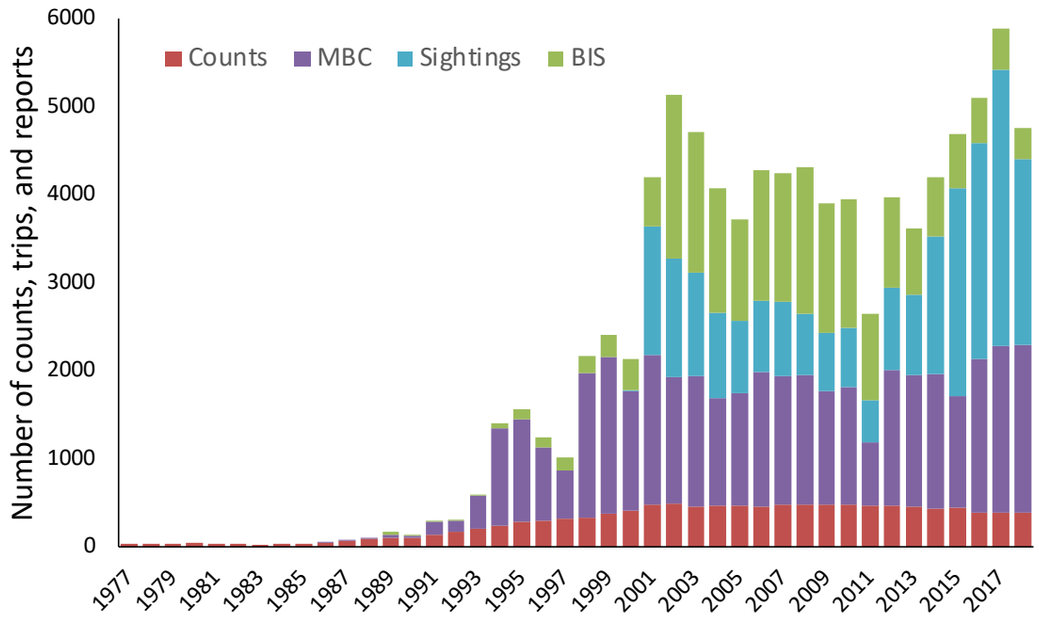
Some of the Counts bring in special equipment to help those butterfliers who can't, or won't, walk, as was demonstrated by Mark Salvato (left) and Dennis Olle (right) on May 12, 2007, participating in the NABA Elliott Key, Miami-Dade County, Florida, Count.

that year, the count data moved online to a data platform (butterflycounts.org) that not only allowed the counts to be rendered into the yearly count reports, but also to be more easily shared for scientific research.

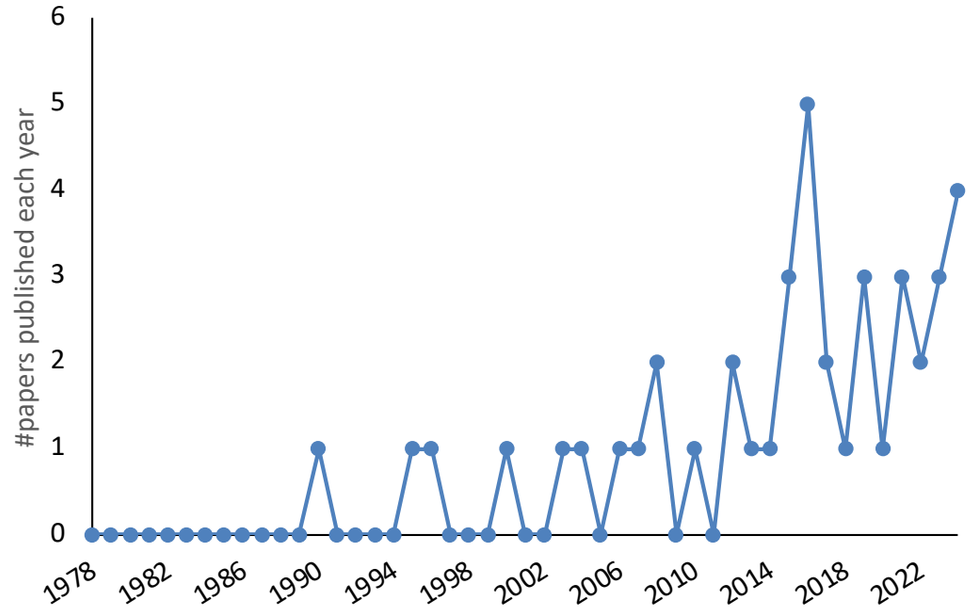
My first paper using that database, working with Sean Mullen of LeHigh University, showed the impact of Pipevine Swallowtails on the range position where White Admirals transition to Red-spotted Purples. Our results were the first to test a key theory about Batesian mimicry (named after the naturalist Henry Walter Bates who advanced the idea in 1861). This theory (by the famous biologist and statistician Ronald Fisher in 1927) on how distasteful models (here, the Pipevine) impact palatable mimics (Red-spotted Purple) posited that mimicry complexes could only be maintained where the model was common and the mimic rare (otherwise, how could predators like birds learn?). Our results were counter to these predictions showing that as soon as the Pipevine range overlapped with this admiral species, the group quickly transitioned over a very narrow band to Red-spotted Purples, even though Pipevines were rare at their range edge. The paper ("A Rare Model Limits the Distribution of its More Common Mimic: A Twist on Frequency-Dependent Batesian Mimicry") was published in the Journal Evolution in 2008.

The MBC's field trip program has also been an important source of data for scientific research. Since the beginning of their program, the checklist from each trip was shared with club members (not rendered into tables for analysis), but a joint effort to look at butterfly population trajectories and potential links to climate change was undertaken by Greg Breed (currently at the University of Alaska-Fairbanks, but working at the time in Harvard Forest with Elizabeth Crone). Greg worked closely with Sharon Stichter to transform the data into an analyzable format, and this resulted in a high-profile publication in the journal Nature Climate Change ("Climate-driven changes in northeastern US butterfly communities"). This paper not only showed how some butterfly species were "winners or losers" under current climate shifts, but how butterfly traits, especially mean range position (warm or cool) and the stage the species overwinters at were important factors for making sense of the variable patterns exhibited by different species.

NABA data has been essential in understanding the dynamics of Monarchs on their breeding grounds. Without data coming from NABA and other butterfly



Each “excursion” made by NABA members and volunteers (counts, trips, sighting reports) provides priceless data to the scientific community and other users (e.g., conservation or educational groups). The number of excursions is presented rather than the number of butterfly observations because the “zeros” that come from survey data (butterflies that WEREN’T seen) is important for our analyses.



The number of papers published each year using NABA data has grown, especially after all historical data were digitized and an online portal (butterflycounts.org) was launched (2008). In terms of the impact of research on the field, the size of the study and the number of years included (insets) is much more important than the number of years of data.

monitoring networks, our understanding of the reproductive phase of their annual cycle, where populations rebound from losses during winter and migration, were very poorly understood. The first in-depth analysis of Monarchs’ breeding dynamics used data from a regional butterfly monitoring program started by the Ohio Lepidopterist Society. This was a collaboration between myself and a graduate student in the lab where I was employed, Elise Zipkin and the “grande dame” of Monarch research, Karen Oberhauser.

Ohio is among many regional programs that carry out “Pollard” walks, which uses a stricter survey protocol where a fixed transect is walked multiple times per year by the same observer using a restricted observation window. Because these protocols more closely resemble the types of surveys carried out by academics or agency technicians, there were many statistical models already in existence. We used these models to link the dynamics of Monarch summer populations to both overwinter colony sizes and climate in both spring and summer. Our analysis showed that spring weather in Texas was the best predictor of summer population sizes in Ohio. Our paper (“Tracking climate impacts on the migratory monarch butterfly”) was published by Global Change Biology in 2012.

However, these Pollard programs were in a limited number of regions. The first was started in Illinois, and they have spread to many states and more local regions since then; there are currently more than 20 of these programs in the U.S. and Canada. However, most of them started after 2011 and so long-term data were not available. Because of this, there was a great desire not only to use the NABA data, but also to develop new

Unlike some monitoring programs, participants on NABA Counts often go off-path in order to find butterflies (Creole Pearly-eyes) in cane growth that they wouldn’t otherwise see. Sept. 5, 2019. Francis Marion National Forest NABA Count.

Wendy Allen

National Park Service

The 2024 NABA Yosemite National Park Count had 80 participants! July 29, 2024. Yosemite National Park, California.

models that allow NABA data to be combined with the more spatially limited but temporally dense data that come from these Pollard programs.

Our first test of whether this made sense showed that NABA data had very similar year-to-year fluctuations when compared to overwinter numbers, and the Illinois and Ohio Pollard data (“ Connecting Eastern Monarch Population Dynamics across Their Migratory Cycle”), published in the 2015 book “Monarchs in a Changing World”.

This led to multiple collaborations with Elise and Karen and many other collaborators, including Mexican colleagues including Eduardo Salinas-Rendon, the lead of the World Wildlife Fund’s monarch program. Elise, who is now a professor at Michigan State University, is one of the leading researchers in the world developing new models that can integrate monitoring data from different types of programs. Our collaborative work on Monarchs culminated in a 2021 paper in Nature Ecology and Evolution (“Changes in climate drive recent monarch butterfly dynamics”), led by Erin Zylstra, a scientist in Elise’s lab.

This study continued to show Texas spring climate as the main driver of Monarch population sizes from year to year, but as the climate had warmed substantially in their summer breeding grounds since the first paper in 2012, we now showed that summer heat was increasingly impacting Monarch population sizes, and not in a good way!

Erin then used this analysis to show potential population sizes for Monarchs under different climate scenarios (“Multi-Season Climate Projections Forecast Declines in Migratory Monarch Butterflies.”).

Although we can’t really ever know what might happen in the future, including how Monarchs might adapt to climate change, Erin showed that if we assume the factors governing their yearly dynamics stay the same, the potential for overwinter colony sizes to fall below the critical threshold of 0.67 hectares (a boundary of special concern determined by the Monarch conservation community), grew substantially through time under multiple climate scenarios.

A more recent development is the use of the sightings and BIS data in analyses that integrate data with different methods. Although individual sightings records were traditionally not used to track population trajectories (only range boundaries and boundary dynamics), recent breakthroughs in statistical modeling have made it possible to use these data to help inform our understanding of year-to-year population dynamics. The greatest value of these data is that they often “fill in the gaps” where more intensive monitoring rarely takes place. Monarch population dynamics in the spring was a great test case for developing these models because not only had the spring climate consistently been identified as the most important to Monarch yearly population sizes, but there were almost no surveys done in the spring in that region and, even if there were, Monarchs are particularly scarce this time of year.

This set up the perfect opportunity to test whether sparse sightings could be used to understand yearly dynamics. Matt Farr, a student of Elise’s, showed that even very sparse data could be used to show that spring population sizes were connected to the size of Monarch populations at the end of the summer (“Overcoming Data Gaps Using Integrated Models to Estimate Migratory Species’ Dynamics during Cryptic Periods of the Annual Cycle.” published in Methods in Ecology and Evolution). This work provided the first evidence directly connecting the success of spring reproduction to annual Monarch population sizes, a real breakthrough for Monarch research. But more importantly, his model showed the potential to carry out large-scale research on any species where data during part of its annual cycle is sparse.

Since then, there has been steady growth in the number of papers using NABA data, culminating in the just-published *Science* paper showing that butterflies have declined by 22% from 2000-2020 (““Rapid Butterfly Declines across the United States during the 21st Century.”). This paper, emerging from a workshop sponsored by the USGS’s Powell Center and led by Collin Edwards, a post-doctoral scholar at Washington State University, represents the efforts of a collaborative group, including butterfly ecologists, ecological modelers, and the directors of several butterfly monitoring groups, coming together to assemble our most comprehensive view of the state of the butterflies in the United States. The analysis was based on 76,957 surveys from 35 different monitoring programs. Even though NABA programs represented just two of those (the NABA count program and the MBC field trip program), together they submitted 11,919 surveys representing 15.5% of all surveys used in the analysis. In addition to this outsized contribution of data in terms of numbers, the NABA count data provided information for large swaths of the country where no other monitoring programs existed.

Other research is now emerging each year, more and more frequently integrated with other butterfly data sets, such as Pollard networks and even photo uploads to iNaturalist. These analyses continue to show the transformative value of the NABA data for our understanding of butterfly population dynamics at the largest spatial and temporal scales. These types of analyses will always be impossible without an army of dedicated volunteers, including the NABA community, who contributes data every year to the count and sightings program. I know that I speak for the entire scientific community (and other downstream data users) when I say “THANK YOU” for all of your efforts to help collect these priceless data!

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