What about These "Polar Vortex" Events and How Do They Affect Bluebirders and Bluebirds?

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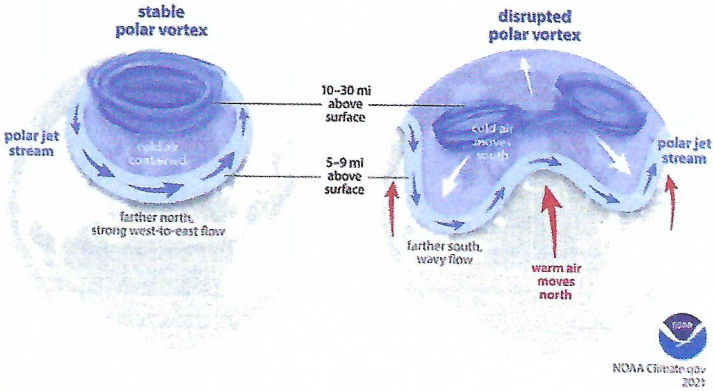
In late January of 2019, a large mass of frigid air escaped from the Arctic and descended upon the middle and eastern portions of North America. During this event many cities recorded historically low temperatures. For example, Chicago reported a brief period of −45°F, reportedly making it colder than Antarctica on that day.

Many other parts of the Midwest experienced temperatures below 40°F accompanied by mind-blowing wind chill factors of 75° below zero. Most weathercasters called this a "polar vortex" event. The term polar vortex is said to have entered the lexicon of local weather forecasters after a similar cold weather event in 2014. Many believe that these frigid air masses that sweep over the middle of the country are the polar vortex—but that is not really correct.

In fact, the term polar vortex is the name atmospheric scientists give to a powerful, counterclockwise-spinning jet stream that usually traps frigid Arctic air keeping it safely isolated in the stratosphere some 10–30 miles above the earth's surface. This mass of trapped cold air typically becomes smaller during the warm seasons and grows larger in the colder months. It is a good thing when this polar vortex is stable and intact because it prevents those masses of Arctic air from blowing over us and becoming part of our weather.

So, calling a winter cold snap a "polar vortex" is a misnomer. In fact, these sudden frigid weather events are caused by the breakdown of the polar vortex, in other words a "polar vortex disruption." To better understand this, take a look at the two diagrams in Figure 1. The left-side drawing shows a normal or intact polar vortex, and the right-side drawing depicts a disrupted polar vortex. When the polar vortex is disrupted it can allow the trapped cold air to escape, and then be captured by the jet streams some 5–10 miles below the troposphere. It is these winds that then blow the icy air over the middle of the continent.

So, a more important question then seems to be: What causes these polar vortex disruptions in the first place? Well, the "what" part seems clear. There is general agreement that polar vortex disruptions are triggered by events called Sudden Stratospheric Warmings (SSW). SSW are, just as the name indicates,



Credit: NOAA

Fig. 1. The "polar vortex" is a stratospheric-level jet stream located 10–30 miles above the earth's surface. The polar vortex does not generally interact with the "polar jet stream" (often referred to as "the jet stream"), which is located in the troposphere about 5–9 miles above the earth's surface. In the drawing above the left panel shows the normal relationship between the polar jet stream and the polar vortex. The drawing on the right shows what happens when warm air weakens the polar vortex and causes it to slip off its axis and distort. When this happens masses of frigid air slip out of the polar vortex and are captured by the polar jet stream below and then they are driven down through the middle of the continent.

periods when the polar vortex meets a warm air mass causing it to weaken dramatically—in extreme cases even reversing the direction of the polar vortex winds. This in turn leads to a situation as shown in the drawing on the right side of Figure 1. As the polar vortex is disrupted (or breaks down), the frigid Arctic air it was trapping escapes and, being cold and therefore dense, drops to lower altitudes. When this cold air reaches the troposphere it can be picked up by the polar jet stream (i.e., "the jet stream") and driven south. Of course, this begs the question: What causes SSW events? Unfortunately, as near as I can tell, there seems to be no conclusive agreement on the cause of SSW. In fact, it seems likely that maybe there is more than one cause of these events. This is a field of active research. At this time, it seems that we can anticipate SSW occurring at a rate of about six times each decade. It is not clear that every SSW will result in a polar vortex disruption, however.

Just for completeness, it seems that one other area of confusion is the terminology used to describe "jet streams." The polar vortex is a jet stream—but as noted earlier it exists in the stratosphere and is not

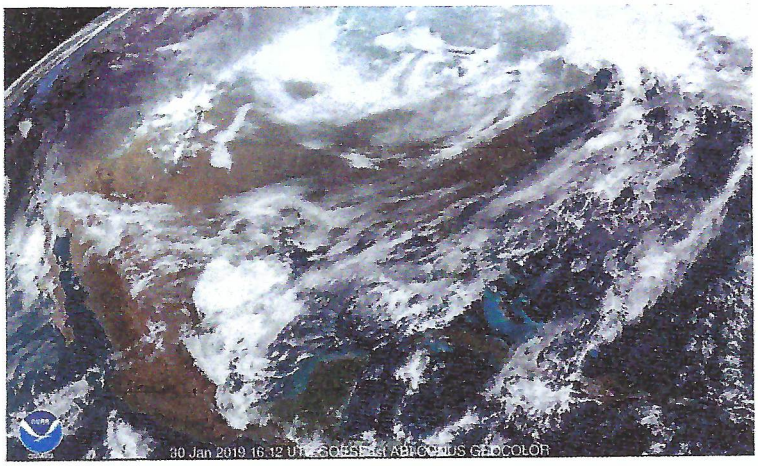


Fig. 2. An image captured by the NOAA GOES-East weather satellite on January 30, 2019, showing the cloud pattern blown by the jet stream across the center of the continent. What is not shown is that this jet stream blowing the clouds was also carrying large mases of frigid Arctic air that had been released by a polar vortex disruption.

something usually talked about in a typical weather report. When a weather forecaster talks about the "jet stream(s)" they are referring to the two weather-controlling winds that blow in the troposphere (5–10 miles above the surface and below the stratosphere). These two tropospheric jet streams are called the "polar jet stream" (in the north) and the "tropical jet stream" (in the south). Those two jet streams in the troposphere are the primary drivers that control most of the weather conditions we experience during most of the year in North America—but they are blowing some 5–10 miles below the polar vortex winds.

Figure 2 shows the image recorded by the GOES-East weather satellite on January 30, 2019. The streaking cloud patterns are produced by the same jet stream that is driving the Arctic air mass south across the continental land mass.

In Figure 3 you see a satellite image taken by a heat-sensitive infrared camera from approximately the same time (January 29, 2019). In this image you can see that the frigid air was driven south with temperatures as low as –40°F in the Midwestern states to –10°F in Louisiana and northeastern Texas.

The second part of this article's title asks why bluebirders might be interested in polar vortex disruptions and how they affect bluebirds. Obviously, these weather disruptions are consequential to all living things—even human beings. At least 21 people died because of that 2019 winter anomaly. In conditions of such extreme cold frostbite will occur on exposed skin in a matter of minutes, and prolonged exposure leads to hypothermia (i.e., the body losing heat faster than it can produce it). But what happens to humans in these situations pales in comparison to what happens to other living organisms—particularly wildlife that have no shelter. Thus, the next spring after the cold snap, NABS received reports on hundreds of dead Eastern Bluebirds (EABL) being found in nestboxes across the middle of the continent to as far south as Tennessee, Arkansas, and even Texas. The birds had sought shelter from the harsh conditions—but often to no avail.

Two years later, in the spring of 2021, another polar vortex event occurred, this time in early February. Before this event the national weather forecasters warned that the "coldest air of the season will be driven south, not leaving anyone out." In fact, these forecasts were accurate and every state in the US—including Hawaii—saw below freezing temperatures during the following week. In the end, about 86% of the US, including about 235 million people, received an icy blast of Arctic air. In some cases, so cold that boiling water would flash freeze, and frostbite could occur within minutes. Again, in the spring of 2021 NABS received numerous reports from our members who reported finding dead EABL when they reopened their nestboxes for the new season.

So, what is going on? Is this a "new" thing or merely a normal weather event more severe or more frequent than those in the past? Well for certain it is not a "new thing"! Public awareness or not, the polar vortex and its disruptions have been in place for probably hundreds of thousands of years or longer. There is

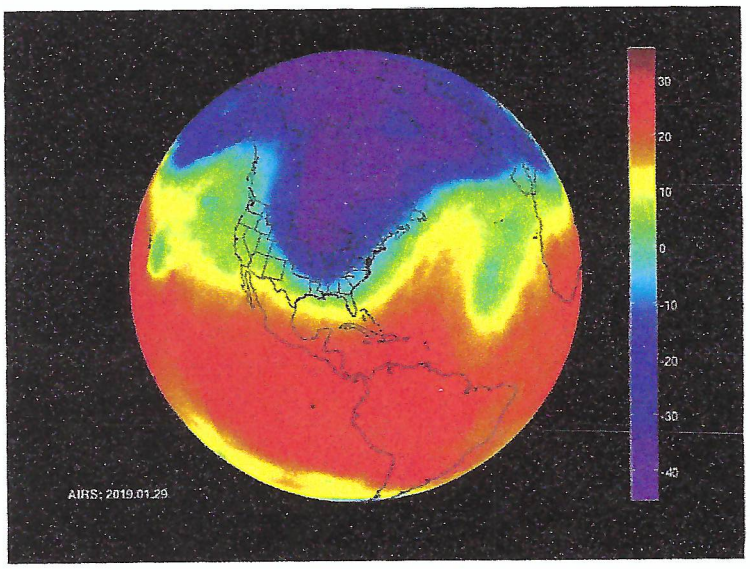


Fig. 3. An image taken on January 29, 2019, by a satellite that is fitted with an infrared camera. The image illustrates how far south the frigid conditions extended on that day.

Fig. 4. Range maps as described by eBird for the three bluebird species. The red-shaded areas are the summer breeding range, blue-shaded areas are places the species is seen in the wintering season; the purple designates areas that the species can be found year-round, and the yellow areas are places the species is seen during migration periods, i.e., moving from breeding to wintering grounds or the reverse. A darker shade of color indicates a higher density of birds.

some thought that these events might be happening with greater frequency now, but both their frequency and their severity are still a topic of scientific debate.

Some atmospheric scientists contend that there is a link between climate (e.g., warming) and the polar vortex disruptions. But that relationship has not been established at this time. On the other hand, there is some solid evidence that (despite the brutal conditions just discussed for the polar vortex disruptions of 2019 and 2021) we might be experiencing "warmer cold snaps" than were recorded in the past. Kenneth Kunkel, an atmospheric physicist from the University of North Carolina who also works for NOAA, has studied the record of polar vortex disruptions that occurred in of the past (e.g., in 1936, 1970, 1977, 1983, 1989, and 1996) and he states that all of these were "much worse than the one of 2019." He is also quoted as saying the current polar vortex disruptions have been "wimpy" compared to those of the past 100 years.

So, we are left with the hopeful hypothesis that even if climate change or warming is really triggering more of these episodic polar vortex disruptions, the cold weather they produce will be less intense—hence perhaps also less damaging to bluebirds and other wildlife?

Let's close this discussion by coming back to some speculation on bluebirds. Clearly most of these polar vortex disruptions that occur in the winter months will usually be more damaging to EABL than the other two species. I suggest this will be the case after inspection of the winter ranges of the three bluebird species (Figure 4).

These range maps show that at least parts of the EABL population spends its entire life cycle in the path of the cold snap induced by polar vortex disruptions. Notice that nearly the entire area marked by the cold temperatures (Figure 3) are within the purple area or permanent range of the EABL. A significant part of the winter and year-round range of the other two species lies beyond the extreme cold area caused by the polar vortex disruption.

I think the harm done by these polar vortex disruptions is compounded by the fact that they frequently appear during abnormally warm winters. During these periods I expect that EABL are likely to be distributed more heavily in the northern latitudes. Thus, a large percentage of the population would be exposed to the colder temperatures.

I think it is quite possible that a careful analysis of Christmas Bird Count and eBird data could perhaps shed light on the extent of EABL migration as a function of temperature in winter months. Perhaps this is a research area wherein NABS should request proposals?

Finally, I would like to again raise the question about the practical feasibility of providing more substantially constructed and more heavily insulated roost boxes for EABL. On the two occasions that I have had winter bird kills on my trail I have never seen anything except dead EABL in the nestboxes. I have never found a Carolina Chickadee, Carolina Wren, or House Sparrow carcass in any of my winter roost boxes. Therefore, I suggest that if we provided winter roost boxes that are either insulated only (passively protection) or insulated and fitted with a small amount of heat we could selectively protect bluebirds. I would be interested in hearing about the experiences and the thoughts of others on these topics.