Count Light Pollution Out!

BY FRED SCHAAF

Opponents of light pollution have long heeded the maxim to "think globally and act locally." We think globally when we join the International Dark-Sky Association (IDA). We act locally by writing letters to newspapers and launching anti-light-pollution legislation for our communities. And now the time is ripe to combine the global and the local in a new, supremely important way. After nearly three decades of dark-sky activism, I think the single action that would serve us best in 2007 is perfecting a 20-year-old practice: the public star count.

It's a simple concept, really. A group of people, large or small, fans out across the landscape and estimates the darkness of the night sky by recording how many stars can be seen in a particular region of sky or by noting the faintest stars visible by eye. Then the results are combined and analyzed.

But do we need star counts to obtain accurate scientific data? After all, the night sky's brightness at different sites can now be gauged with satellite imagery, measured with light meters, or even calculated by computer modeling based on population density data and specific formulas.

It's true that all these exciting and valuable methods have the potential to determine sky brightness more accurately than visual star counts can. Yet each, while accurate in its own way, in practice also has its own limitations. Moreover, none of them tells us quite as directly what confronts an observer nightly the way a star count and visual inspection of the sky can.

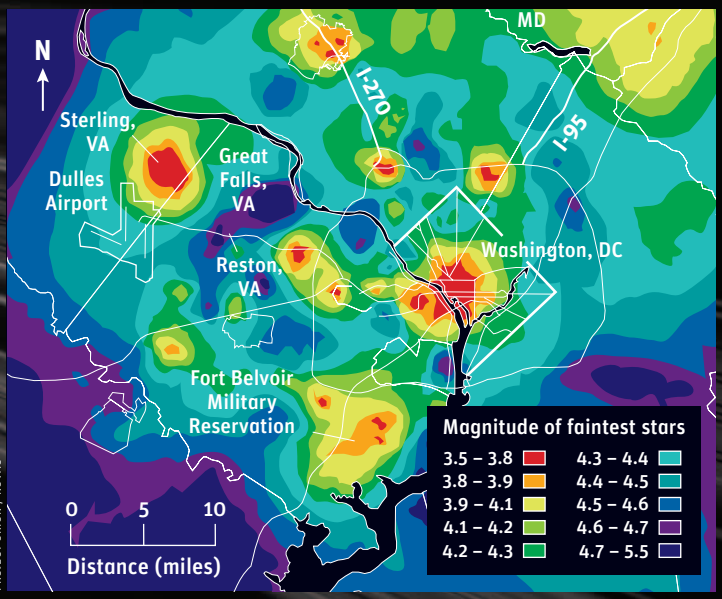
Two decades of effort suggests that a properly conducted star count really can produce scientifically useful data. But what's vital about these campaigns is the role they can play in educating ordinary citizens about light pollution and involving them in attempts to reduce it. It's in this role that star counts become the most potent means we have for turning the tide in our struggle against artificial skyglow.

Equipped with nothing more than their eyes, stargazers around the world are using organized star counts to assess light pollution.

Will our planet look like this at night in the years ahead? Earth's glowing problem of light pollution is already all too obvious from space.

S&T ILLUSTRATION BY GREGG DINDERMAN

SOURCE: CRAIG MAYHEW / ROBERT SIMMON / CHRIS ELVIDGE / NASA / NOAA



Left: In 1995 stargazers of all stripes participated in Project Orion and contributed a total of 719 measurements to create this sky-brightness map of greater Washington, DC. *Right:* Compare the sky's appearance looking up with this view from the International Space Station looking down (and taken several years later). Note how extra lighting within the District of Columbia clearly delineates its boundary.

The First Public Star Counts

The first organized effort to conduct a public star count to monitor light pollution occurred exactly two decades ago. In 1987 scientists at the National Astronomical Observatory in Tokyo initiated Japan's first annual "Star-Watch." This activity was also promoted by Japan's Environmental Agency as a way to monitor air quality. Upward of 10,000 people were eventually organized by local governments to count stars by eye and to photograph the night sky each year.

Hiroki Kosai, Syuzo Isobe, and Hironori Nakayama presented results from Star-Watch's first years in *Sky & Telescope* (November 1992, page 564). They produced impressively detailed maps of sky brightness throughout Japan by using a densitometer to measure the submitted photographs. But the *visual* star counts, they admit, were something done "mostly to get people used to watching the stars and educate them about how to observe."

For a few years starting in 1990, the International Dark-Sky Association conducted a Star Watch program in North America patterned after the Japanese one. Each year the program drew several hundred participants, who observed the Pleiades star cluster by eye and with binoculars. More details on the results can be read in Information Sheet 59 at the IDA website (www.darksky.org)

Project Orion

In February 1995 a more localized public star count introduced some important innovations. That effort, dubbed Project Orion, succeeded in producing detailed sky-brightness maps for Washington, DC — the first for a US metropolitan area. It also provided insight, if not necessarily final answers, into several questions about the scientific usefulness of visual star counts.

It all began when members of the Northern Virginia Astronomy Club (NOVAC) convinced the *Washington Post*'s science editor to investigate the city's light-pollution problem and to publish a map of stars in Orion to encourage readers to judge sky brightness over a two-week period. The counts were made purely with the unaided eye — without optical aid or supporting photographs. NOVAC members did their own counts separately and monitored sky conditions, which turned out to be a very good idea.

The *Post* received more than 1,500 reports, and the resulting map of the District of Columbia appeared in an article with an attention-grabbing headline: "City Lights Have Stolen the Night Sky." The final map (at upper left), based on more than 700 observations, shows 10 brightness levels from downtown Washington (with a limiting magnitude of 3.5) to more than 30 miles away (4.7 to 5.5 in most locations).

NOVAC members William C. Burton and Peter S. Gural presented their final map and results from Project Orion in the June 1996 issue of *Sky & Telescope* (page 82). There they caution that the map's "variations in data are averaged out, and areas having sparse coverage are filled in with weighted averages from the neighboring points." Moreover, participants hadn't been asked to supply details that would have aided the analysis greatly, such as their age, visual acuity, or how much effort was made to spot faint stars. Was this good science? Apparently so, because the map is spotted with isolated bright and dark patches that correspond impressively well to known local features.

Interestingly, the star counts made by NOVAC members showed roughly as much scatter as those from the general public. Does this suggest that in a well-planned star count an observer's level of experience is irrelevant? It's important to note that the dimmest stars plotted on the Orion map were magnitude 5.4; for dimmer stars, differences in observational experience and in visual acuity would likely have played a major role. But how faint would you have to go before these factors become critical? Possibly the best way to address such unresolved questions is to investigate them through carefully designed campaigns.

NOVAC members had hoped to follow up Project Orion with a second assessment, but to date they've not done so. However, high-school student Anne Jaskot won one of IDA's 2004 youth awards for organizing about 40 volunteers to conduct star counts in Fairfax County, Virginia, and in neighboring counties. Her work discovered that the skies of northern Virginia had brightened — in some cases drastically — since 1995.

The flowering of the Internet has made it possible to spread the word quickly about efforts like Project Orion and to conduct them in novel ways. Günther Wuchterl, a dark-sky advocate at Kuffner Observatory in Vienna, Austria, has been collecting star-count data from Austrians on an ongoing basis (displayed at www2.astro.univie.ac.at/%7Escw/eng.html).

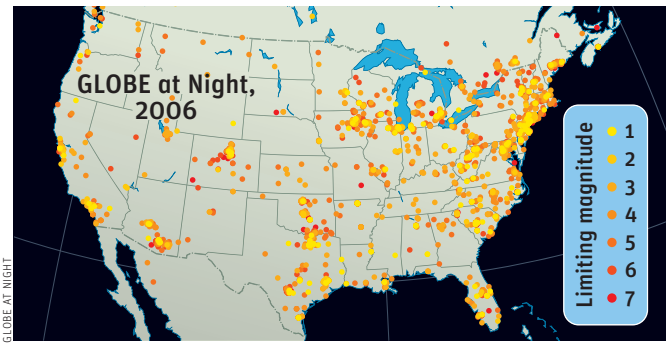
I particularly like Wuchterl's maps of Ursa Minor and Orion plotted at different limiting magnitudes. This makes it easy for even inexperienced observers to match what they see in the sky with the map that looks most like it. Even better maps of this sort can be found in IDA Information Sheet 120, entitled "Light Pollution and Limiting Magnitude," available at the IDA website.

GLOBE at Night

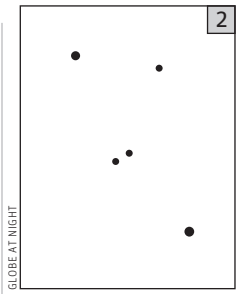
While I'm encouraged by Project Orion, youth involvement, and star-count websites, Jaskot's finding of brightening skies underscores the fact that past efforts have been too limited and infrequent to really make a difference. Can the scope and impact of star counts be increased? One hope that they can stems from a new effort called GLOBE at Night.

GLOBE stands for Global Learning and Observations to Benefit the Environment, a program to involve primary- and secondary-school students in scientific activities worldwide. Conceived by staffers at the National Optical Astronomy Observatories in Tucson, Arizona, the GLOBE at Night endeavor is managed by the University Corporation for Atmospheric Research and Colorado State University. Its first full-up star count took place in March 2006 (*S&T:* December 2006, page 108).

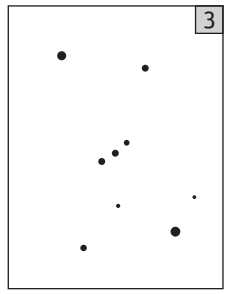
What's amazing to me is that the project's staff, operating with just a shoestring budget, managed to collect 4,591 nighttime observations from more than 18,000 "citizen-scientists" in all 50 US states and 95 other countries. Some of the results are shown below; you'll find more at the program's website: www.globe.gov/GaN.



The 2006 GLOBE at Night effort garnered nearly 4,600 sky-brightness estimates worldwide. Organizers hope for much greater participation during this year's campaign, which runs March 8–21. For more details, visit www.globe.gov/GaN.



Hint: You can see two stars in Orion's Belt.



Hint: You can see three stars in Orion's Belt.

Unlike traditional, chart-intensive methods of estimating the sky's limiting magnitude, the GLOBE at Night campaign employs simplified whole-magnitude charts that even unskilled observers can use.

This year's installment of GLOBE at Night will be conducted March 8–21, and I wholeheartedly encourage all *S&T* readers to participate!

One potential drawback is that participants report their limiting magnitudes in whole numbers, which sacrifices precision. But GaN educational technologist Dennis Ward counters that the current protocol makes it possible to return reasonably precise data from thousands of locations and from much younger participants than would otherwise be possible. In 2006, about 400 of the students who submitted observations were less than 12 years old.

Although Ward agrees that GLOBE at Night is primarily "an educational citizen-science program rather than a purely scientific campaign," he believes that it does produce valuable data. Moreover, this year's campaign will involve the eyes of more experienced amateur astronomers, and their visual observations will be augmented with photometric measurements made with relatively inexpensive Sky Quality Meters (*S&T:* February 2006, page 104), calibrated digital photography, and GPS-aided location reckoning.

The Great Backyard Star Count

In addition, the GaN staff is exploring a second effort, timed later this year, dubbed the "Great Backyard Star Count." When I first learned about GLOBE at Night in early 2006, it reminded me of the GBSC that I'd proposed the year before in *Sky & Telescope* (July 2005 issue, page 50). I'd conceived it as the stargazing equivalent of the Great Backyard Bird Count (GBBC) sponsored by the scientist-citizen collaborative known as BirdSource.

Over just 4 days in February 2006, the GBBC received more than 60,000 e-mailed checklists that recorded sightings of 623 bird species and 7.5 million individual birds! Submitted observations are typically compiled within minutes into lists, maps, and map animations at the GBBC website (www.birdsource.org/gbbc) — with final tabulations available about two weeks after the end of each count.

I think we need a Great Backyard Star Count to do the same for starry skies! So let's hear from *S&T* readers who are interested in saving dark skies — e-mail me at fschaaf@aol.com and Dennis Ward at dward@ucar.edu. And by all means participate in the GLOBE at Night effort either individually or through your astronomy club. ✶

During the 1990s contributing editor Fred Schaaf *served on a New Jersey state commission that assessed light pollution and recommended ways to reduce it.*