Information Sheet Number 120 (March 1997)

**International Dark-Sky Association**
3545 N. Stewart, Tucson, AZ 85716-1241 USA
crawford@darksky.org http://www.darksky.org

# Light Pollution and Limiting Magnitude

How faint a star can be seen with the unaided eye? This depends on the ability and experience of the observer, the state of dark adaptation of the observer, the sky brightness due to light pollution from electric lights and natural sources such as the Moon, and the clarity of the sky.

At an extraordinarily dark site, stars as faint as visual magnitude +7.0 can be seen by experienced observers with good eyes. There are about 14,000 stars brighter than magnitude +7.0, so under ideal conditions an observer could see somewhat under half of them ($\leq$ 7,000) due to only half the sky being visible and atmospheric extinction.

A magnitude +6.0 sky is still a reasonably good sky, with $\leq$ 2,400 stars visible to the unaided eye. There is some light pollution, and it is usually enough to illuminate clouds so that they no longer appear utterly black against the sky as with a magnitude +7.0 sky. The brighter parts of the Milky Way are still readily seen. Even so, only about a third of the stars are visible that can be seen under a magnitude +7.0 sky.

A magnitude +5.0 sky is affected by moderate light pollution, with $\leq$ 800 stars visible. This is only about a third of the stars that can be seen in a magnitude +6.0 sky, and just 10% of what can be seen under a magnitude +7.0 sky. The Milky Way is barely visible, if at all.

Less than 250 stars are visible in a magnitude +4.0 sky, and the Milky Way is never visible. Light pollution is a serious problem.

A magnitude +3.0 sky will show fewer than 50 stars, and light pollution is severe. This is the typical sky encountered inside a major city.

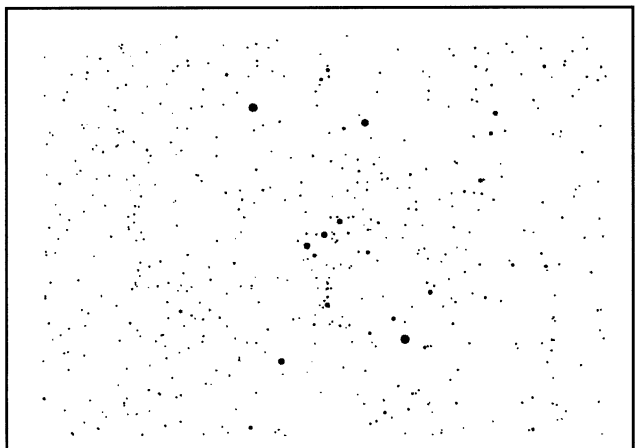
A magnitude +2.0 sky will show fewer than 25 stars. This is typical of the central regions of the largest cities.

On the following three pages, we show you how the appearance of some familiar constellations (Orion, Cygnus, and Ursa Minor) changes as the naked eye limiting magnitude (the faintest magnitude you can see) deteriorates from +7.0 to +2.0 in 1.0 magnitude steps.

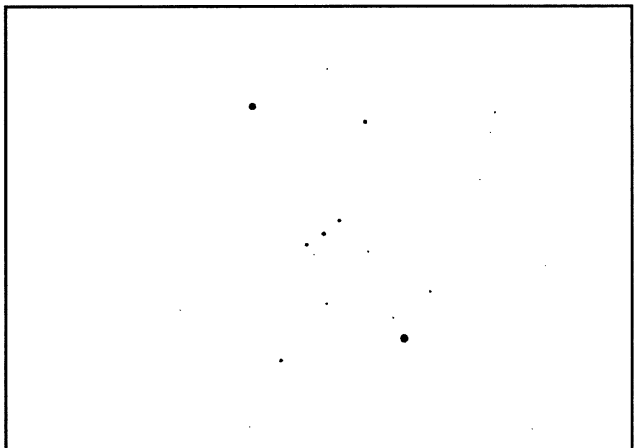
Let's take a look at Orion, the Hunter, on page 2. Orion, arguably the most prominent of the constellations, begins to look more like "Orion, the Hunted" under a magnitude +4.0 sky. Under a magnitude +3.0 sky, Orion is on his deathbed. When light pollution is so bad that we have a magnitude +2.0 sky, only blazing Betelgeuse, regal Rigel, and Bellatrix and Alnilam remain to regale us.

Take a look at Cygnus on page 3. Under a magnitude +7.0 sky, our celestial swan is awash in stars, and is flying along the greatest of all rivers—the river of stars we call the Milky Way. Under a magnitude +6.0 sky, the Milky Way in Cygnus is still prominent, but diminished. Lesser-known byways of the Milky Way have disappeared altogether, and much of the intricate structure of the Milky Way is no longer easily discernible. By the time we reach magnitude +5.0, the Milky Way in Cygnus is getting very difficult to see. At magnitude +3.0, the prominent "Northern Cross" asterism of Cygnus is no longer intact: Albireo, perhaps the prettiest double star in the northern skies, is utterly invisible. Under a magnitude +2.0 sky, only the star Deneb remains.

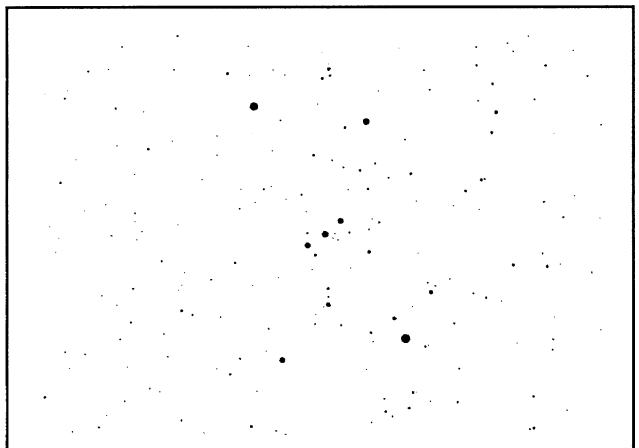
Looking at Ursa Minor on page 4, we see that under a magnitude +7.0 sky, stars can be seen inside the bowl of the Little Dipper. Under a magnitude +5.0 sky, the Little Dipper asterism is getting rather difficult to see. At magnitude +4.0, all that remains of the Little Dipper is Polaris and the two stars on the opposite side of the bowl, Kochab and Pherkad. At magnitude +2.0, even Polaris is extinguished, and we are left looking for darker pastures.



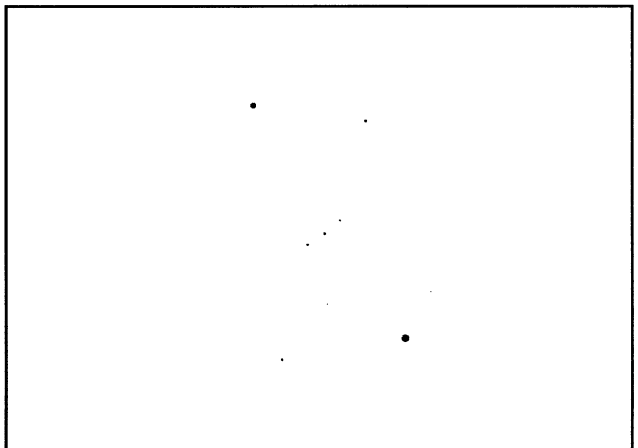
Orion, limiting magnitude 7.0



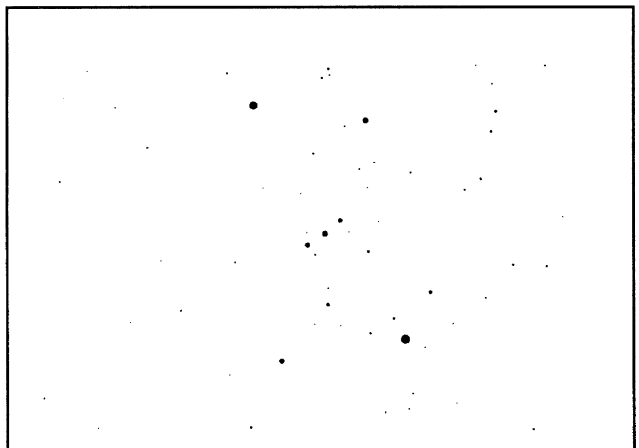
Orion, limiting magnitude 4.0



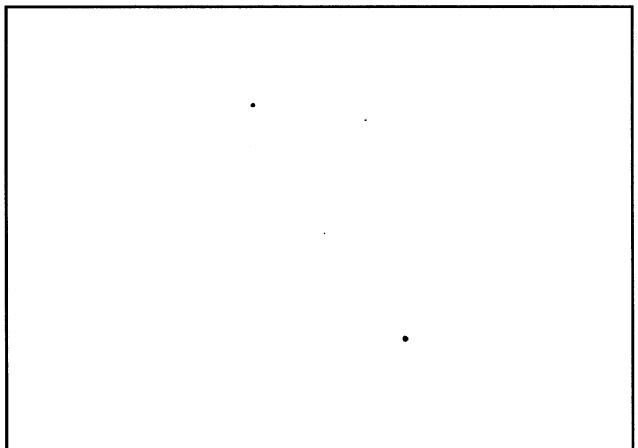
Orion, limiting magnitude 6.0



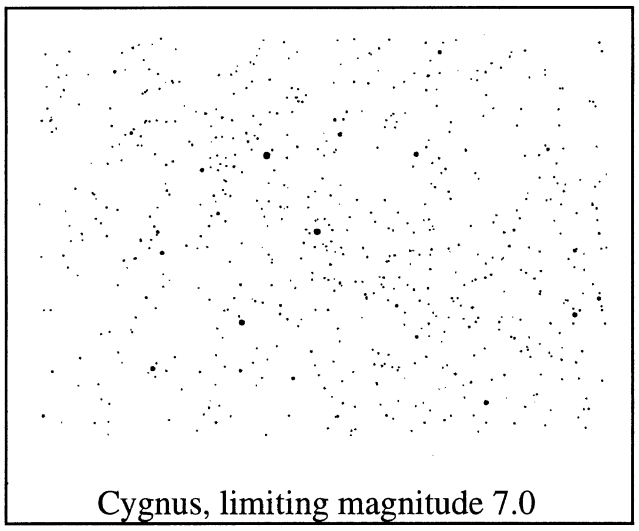
Orion, limiting magnitude 3.0



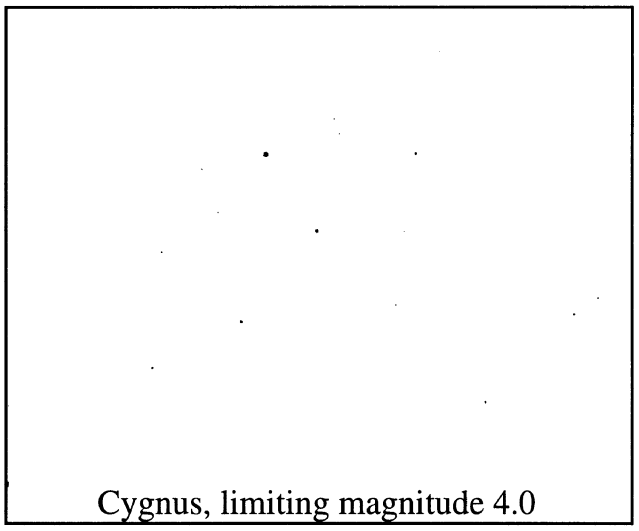
Orion, limiting magnitude 5.0



Orion, limiting magnitude 2.0



Cygnus, limiting magnitude 7.0



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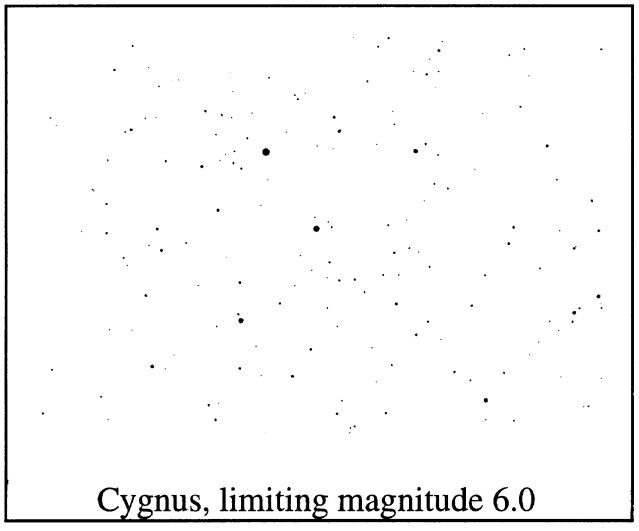
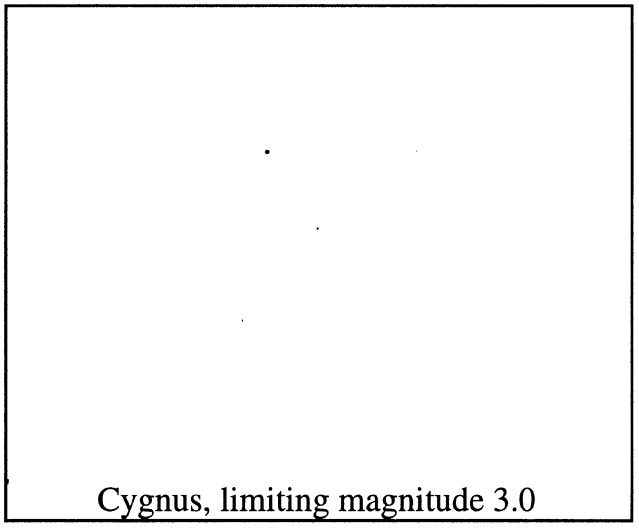
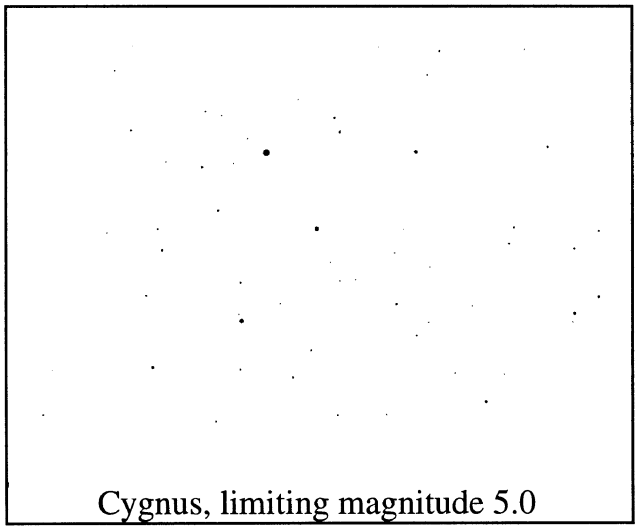


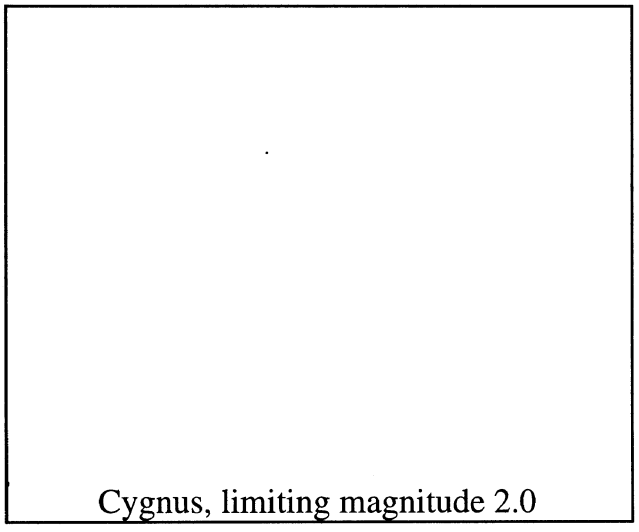
Cygnus, limiting magnitude 6.0



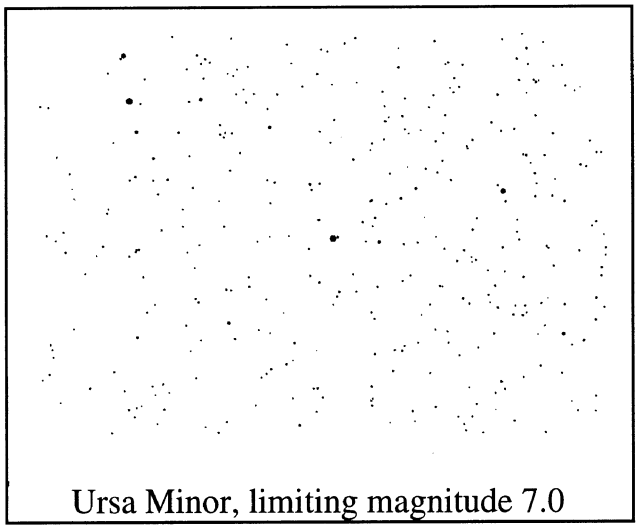
Cygnus, limiting magnitude 3.0



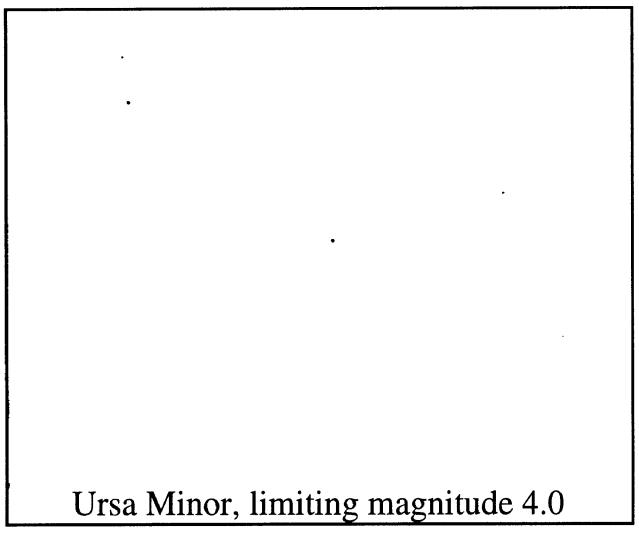
Cygnus, limiting magnitude 5.0



Cygnus, limiting magnitude 2.0



Ursa Minor, limiting magnitude 7.0



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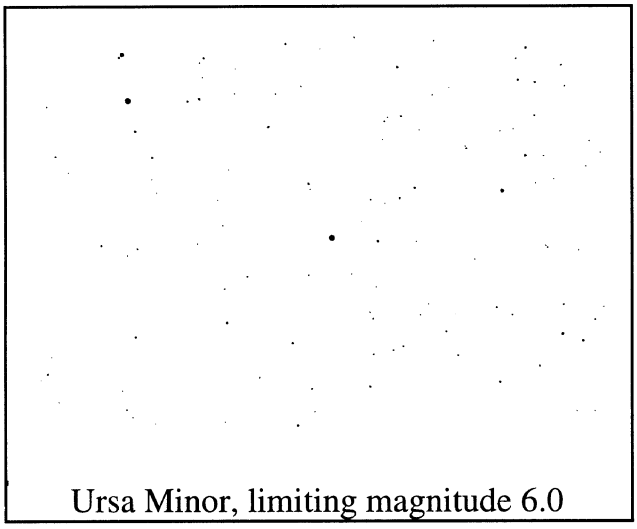

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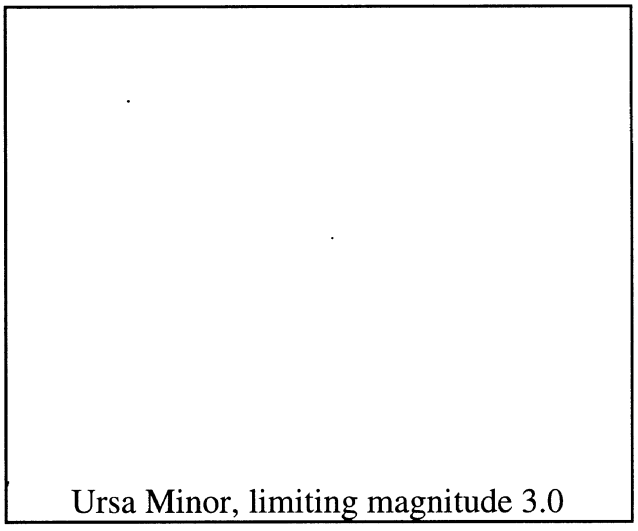

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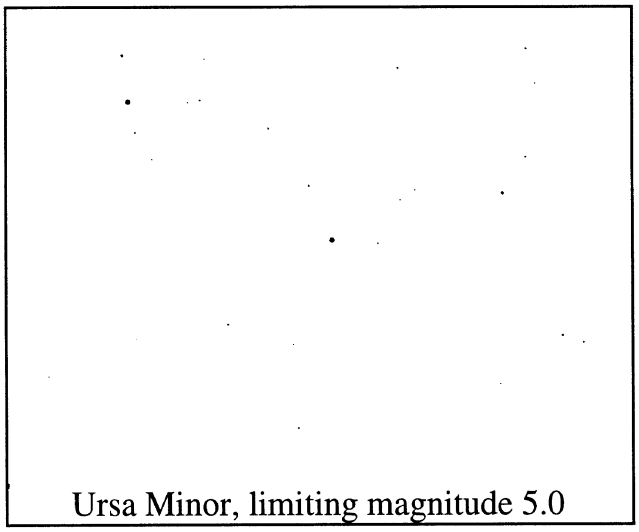

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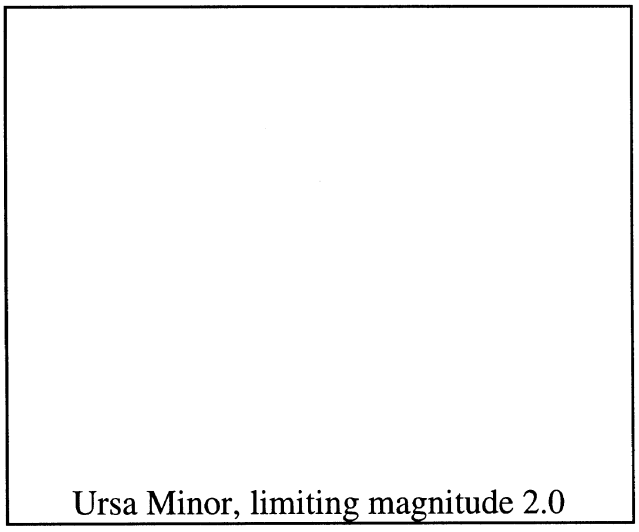

Ursa Minor, limiting magnitude 2.0