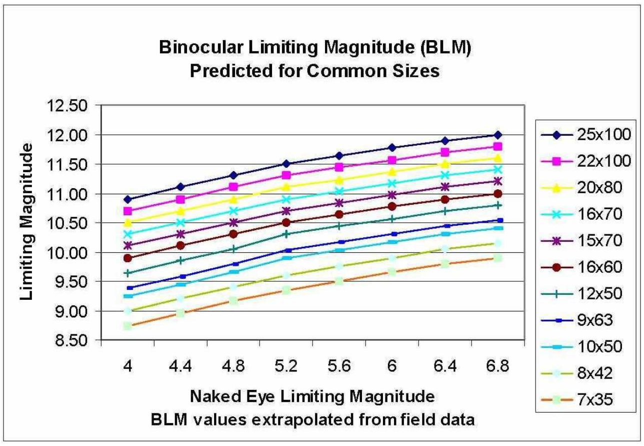
It is therefore necessary to consider the context in which the observations are carried out: If a birder has to read out codes on ringed birds in low light, then she has to employ foveal vision to identify the numbers. In such a situation, the twilight index (equation 10.11) offers valuable guidance for the perfect choice of her instrument. If, on the contrary, a hunter is about to locate a well hidden deer between the underbrush, or the astronomer seeking for a faint, diffuse comet after sunset, then the contrast-related binocular efficiency of Berek is offering superior solutions. Binocular performance is therefore not a priory a well defined quantity, since it requires the context, in which the perception process is taking place, to be set.

10.5 Night sky observations

10.5.1 Stellar magnitudes

The night sky is not entirely dark: In a moonless night, the background luminance of the sky typically varies between $3 \times 10^{-4}\mathrm{cd/m^2}$ and $3 \times 10^{-3}\mathrm{cd/m^2}$, while in the presence of the moon, higher values between $3 \times 10^{-3}\mathrm{cd/m^2}$ and $0.1\mathrm{cd/m^2}$ are common[7]. The deep sky astronomer, who is searching for faint diffuse nebula and galaxies, may apply the method of threshold-contrasts, as discussed in section 10.4, to evaluate the performance of her telescope or binocular on these objects. Quite generally, the performance reaches its maximum when the optical instrument operates at standard magnification, implying that the exit pupil diameter should be about the same as the eye pupil diameter. Occasionally, an over-magnification of such objects is being praised as a recipe to increase their contrast, and justified with the reduced background luminance of the sky at higher magnifications. However, the luminance of the object would be reduced by the same factor, leaving its contrast to the background invariant. What may change during extended, uninterrupted observation periods, is the state of adaption of the eye, but it is hard to see the advantage here, unless the object were sufficiently bright and structured to show additional details when over-magnified.

[7] R. Brandt, B. Müller und E. Splittgerber, *Himmelsbeobachtungen mit dem Fernglas*, Johann Ambrosius Barth Leipzig, S. 20 (1983)



10.9

Limiting magnitudes of stars (in mag) with binoculars, as a function of the limiting magnitude of the unaided eye (Courtesy of Ed Zarenski).

For limiting magnitudes of stars, the situation is different. If we compare two randomly selected stars, then their difference in brightness is a result of different luminous fluxes Φ_1 and Φ_2 that enter the eye, as defined in equation (10.2). Following the peculiar properties of visual perception of light intensities, and a tradition based on an ancient Greek classification scheme, astronomers measure the brightness of an object on a logarithmic scale, in which the magnitude difference is defined as

$$m_2 - m_1 = 100^{1/5} \log\left(\frac{\Phi_2}{\Phi_1}\right) \qquad (10.16)$$

and expressed in units of mag. The prefactor $100^{1/5} \approx 2.512$ is defined in such a way that a magnitude difference of 5mag corresponds to a factor of