His equation is plotted in figure 10.6: Already at low powers of 6x, the resolving power of the handheld device has dropped to 77 %, and when approaching magnifications of 20x, the binocular performs rather like a mounted device of 10x power.

These are empirical facts, extracted from data sets that were obtained with test persons in the field. Yet, the experienced user may hesitate to acknowledge their validity to daily life application: Most binocular users seem to agree that binoculars of lower power, such as 7x or less, are conveniently hand-held without any perceived difficulties arising from jitter. On the other hand, the majority of observers regard binoculars of 12x magnification or above utterly useless for handheld applications. A sharp turn appears to take place about 10x, separating the handheld from the mounted regime of magnifications.

More than once we are going to hit discrepancies of this kind between synthetically derived test results and daily life experience. This is due to a fundamental feature of human perception: Visual performance results from a tremendously complex body of data processing, and no simple laboratory setup is ever able to encompass the entire range of parameters that contribute to the impression of performance of a binocular. Applications in the field are not restricted to the identification of letters on test charts, and it makes a difference whether an observation is carried out in a relaxed mood and at ease, or in the framework of an experimental setup which requires the observer's full attention and concentration.

As a side note, investigations have been done to analyze how the weight of a binocular affects its hand-held efficiency. In fact, since it contributes inertia to the hand-arm chain, its mass is suppressing parts of the high frequency jitter. Once the weight is passing over a certain threshold, however, the additional work is tiring the muscles and subsequently increasing their tremble. It is no surprise to learn that the optimum weight turned out to depend strongly on the physical fitness of the test person, as much as on other factors like level of exhaustion, coffee consumption or altitude of the observation site. As a rule of thumb, the average binocular user may profit most from binoculars of roughly 800g weight[4].

10.4 Performance: Target sighting

The resolution-based efficiency E_r refers to observations of objects with fine-structured textures – after all, it was designed around data sets drawn from observations of Landolt-rings (figure 9.1). However, the nature enthusiast is often confronted with wildlife that is perfectly adapted to its environment, and the daily battle of survival has equipped wild animals with well camouflaged outfits. Such targets do neither offer fine structured details nor high levels of contrast that are part of the paradigms the resolution tests are based on. Instead of asking: *What is the finest detail visible in the binocular?*, the question turns into: *Is the object still visible under the available ambient luminance?* The fundamental difference between these approaches has been addressed before in section 9.1.2: Object visibility is often not a matter of resolution, but rather of contrast. Under low light, the wild boar, barely 10m away, may remain undetected, while a fixed star, though grossly under-resolved, is standing brightly above the landscape.

It is therefore instructive to first analyze the threshold contrast C at which a given target turns visible to the unaided eye. In a second step, the corresponding threshold C' is determined, which applies to image of that object, as seen through an optical instrument, and finally to define

$$E_c = \frac{C}{C'} \tag{10.13}$$

[4] Walter Besenmatter, personal communication.