Is Aperture King? Mel Bartels: https://www.bbastrodesigns.com/Is%20Aperture%20King.html

Is a 4-5mm exit pupil ideal for deep sky observing?

What is an acceptable amount of illumination drop-off near the edge of the field of view?

To test these statements, I employed two telescopes, a 6 inch [15cm] and a 13 inch [34cm], and selected the galaxy, M104, the Sombrero Galaxy.

The Sombrero Galaxy is 8th magnitude and about 9 by 4 arc-minutes in size, well within the grasp of both telescopes. The galaxy is representative of many objects visible in amateur telescopes. The 13 inch gathers 1.7 more magnitude of light than the 6 inch.

If aperture is king then the view through the 13 inch should be vastly superior to the view through the 6 inch, given the same magnification, 55x, in both scopes. Surprisingly, that is not the case: the 6 inch is only somewhat inferior. This is also true at 150x, where the view through both scopes is noticeably better than at the lower magnification. Through the 6 inch the companion star was very faint and the nucleus non-existent. The star and nucleus was prominent in the 13 inch.

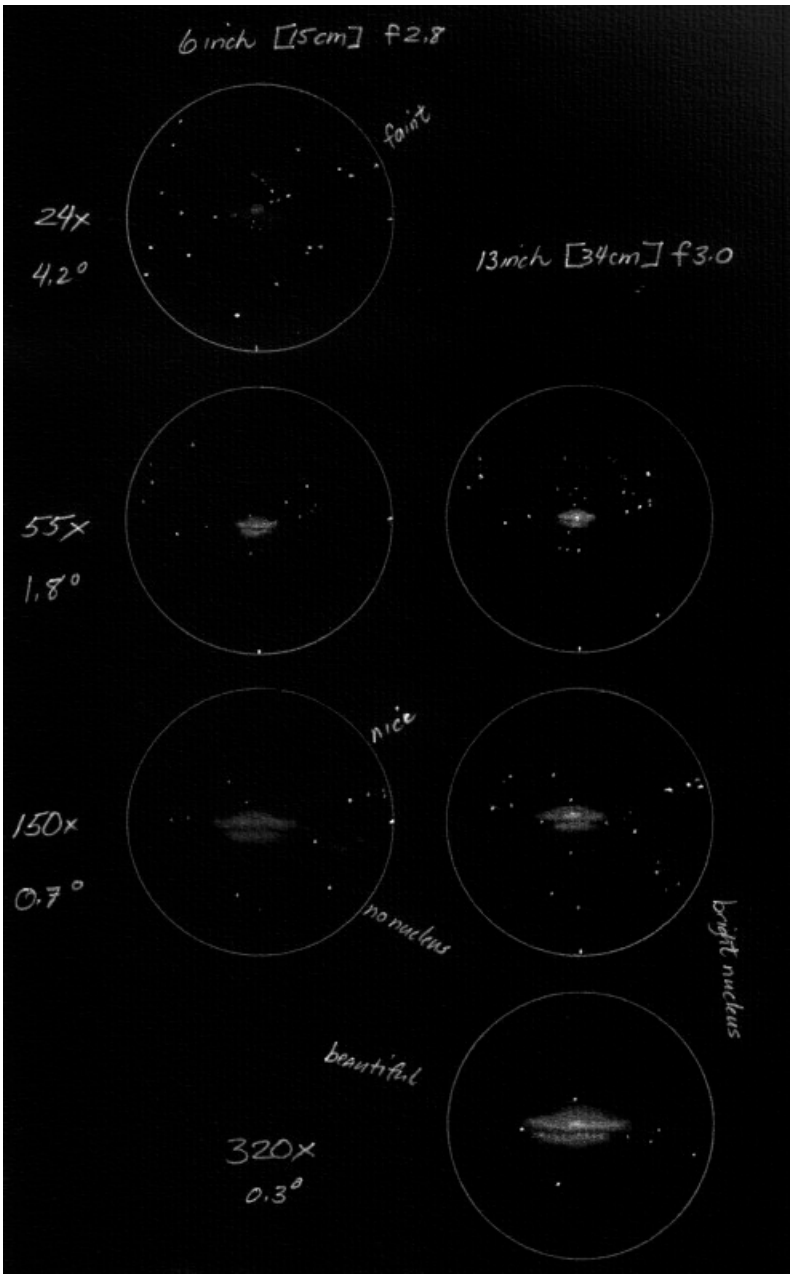
This observation shows that a smaller scope can do nicely, given sufficient magnification. But how much magnification is best? Should it be limited to 4-5mm exit pupil as commonly recommended?

Increasing magnification greatly enhances the view through both scopes. The Lowest power view for both scopes is 6mm exit pupil, medium power is 3mm exit pupil, and highest power is 1mm exit pupil. The best views occur at the highest magnifications. In fact, the view through the 13 inch at 320x is stunningly beautiful – now that's what visual observing is all about. This observation shows that magnification for deep sky objects should not be restricted to 4-5mm exit pupil, that in fact, high magnifications provide the best viewing.

The 6 inch can be considered an extreme case of illumination drop-off compared to the 13 inch, in this case a drop-off of 1.7 magnitudes! Since the 6 inch is only somewhat inferior, then perhaps the common advice that off-axis illumination drop-off should not exceed 0.3-0.4 magnitudes is too tight. A drop-off approaching a whole magnitude, considering that it is the edge of the field of view, is a better recommendation. Why is this so? I suspect it is because both the object* and the sky background lose brightness equally, preserving the contrast between the two as the illumination drops off.

My telescope selection and observing rule is very simple: favor increasing magnification over aperture; get out to dark skies; ensure that I am dark adapted; and keep in mind while salivating on aperture that a smaller scope joyfully used is better than a hunker scope that rarely makes it out under the stars.

*Technically, the sky background lies in front of the object, so contrast is actually sky background + object divided by sky background. The Sombrero Galaxy's brightness is ~20.5 mag/arc-second^2 while a country sky's brightness is ~21.5.

Mel Bartels 


Ken Lulay's additional notes. Here are the exit pupils for the sketches:

| **Exit pupils** | mag | 150 | 340 |
|---|---|---|---|
| | 24 | **6.3** | |
| | 55 | **2.7** | **6.2** |
| | 150 | **1.0** | **2.3** |
| | 320 | | **1.1** |

| **eyepiece FL** | mag | 150 | 340 |
|---|---|---|---|
| | 24 | **17.5** | |
| | 55 | **7.6** | **18.5** |
| | 150 | **2.8** | **6.8** |
| | 320 | | **3.2** |