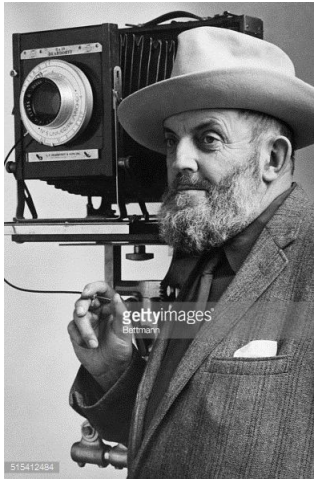
Capturing Sharp Detail with your Telephoto Lens

A Tech Topic

Presented to the Evergreen Camera Club
by Owen Newnan September 25, 2019.

onewnan@gmail.com
https://onewnan.myportfolio.com/.

Introduction



- I pursue Ansel Adams's ideal of photography as a performing art that that harnesses technology, in a disciplined way, for artistic purposes. I aspire to produce photos from time to time that might be considered fine art.
- Telephoto shots tend to push the limits of photographic equipment and technique, especially with wildlife or sports at high magnification. In years past my telephoto shots too often fell short of the crisp clean ideal I strive for. In particular, from my Tanzania safari where lots of compositions I liked seemed a bit blurry.
- I had bought a new camera body at that time but had an old telephoto lens. I later tried newer super-telephoto lenses but they didn't seem to help that much with sharpness. In this talk I'll explain some steps I've taken to improve and control the sharpness of my telephoto pictures.

The Sharpness of the Lens Depends on the Body

- This page recaps my 7/10 presentation.
- The DxO lens database allows us to compare the sharpness of lens/body combinations measured in perceptual Megapixels (p-Mpx).
- Results suggest
  - A 24Mpx full frame body averages ***about 1/3-2/3 sharper*** than a 24 Mpx crop frame when mounting the same lens.
  - That advantage is more like70% for telephoto zooms longer than 300mm.
  - The best lenses available on 24Mpx full frame take nearly full advantage of the body's pixels. That's not true for the 24Mpx crop frame.
  - A full frame body also offers ***more than a full stop more ISO sensitivity*** (S/N ratio) over crop frame.
- Still, moving to ***full frame means 1/3 less magnification*** than crop frame. ***Would that be worth it to me?*** That's a significant loss for distance photography, such as, wildlife.
- I decided to
  - Trade in DX gear and buy
    - D750 Full Frame body
    - Tokina 24-70mm F/2.8 lens
    - Nikon 70-200mm F/4 lens
  - For budgetary reasons keep my
    - obsolete 80-400mm Nikkor 80-400mm D

I bit the bullet with full frame. How's that going?

- ***I believe my upgraded gear is about 70%-100% sharper, as DxO suggested.*** Sharpness does not really seem to be a problem with the new lenses, used properly. They should also work fine on more advanced bodies.
- Besides having more than a full stop in noise reduction, I find the noise on my full frame camera ***much less bothersome*** versus the crop frame.
- With much sharper gear and much less noise, ***shutter speed is increasingly the issue***.
- My pack weighs two pounds more.
- All in all, *it worked out great!*!! But...

… There were surprises too--

- I could now shoot sharp expansive landscapes as I had not previously thought possible with telephoto lenses.
- The Tokina 24-70 didn't seem much sharper than the Tokina 12-28mm DX it replaced, although supposedly twice as sharp.
- How come a shot taken with my mediocre 80-400mm lens came out way sharper than the many thousands taken with it over the years?
- Why am I now having so much trouble with depth of field, like shooting wildflowers?

What's going on? ...

Expansive Landscapes w/ Telephotos

- Nikkor 70-200 F/4
- 70mm
- F/13
- ISO 100
- 1/50s w image stabilization
- Crop~=1x.
- ***Sharp enough to be fine art?***

Expansive Landscapes Continued

- Of course I'm working with much sharper gear than before.
- In addition the full frame body offers a 1/3 wider angle of view and also ***about 1/3 more depth of field*** than does crop frame at the same focal length.
- At 70mm
  - when focused around 40' (the "hyperfocal" distance);
  - and with foreground 20' or more away
  - ***we can take shots that have everything in focus off to the horizon.***
- Telephoto reach also gives us lots more compositions to choose from when standing in one place than with wide angle lenses.

  OK, that explains that. So, how come the full frame Tokina lens didn't seem that much sharper the crop frame Tokina I had traded in, as DxO numbers suggested it would?...

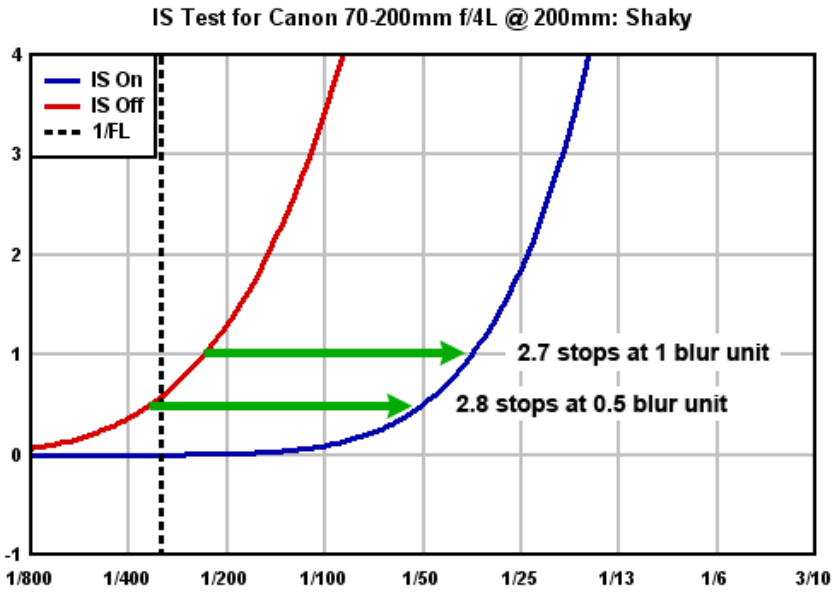
The Traditional Rule of Thumb

- For handheld photography, use a shutter speed no less than focal length * crop factor, i.e.,

  ss >= fl * cf

- The crop factor for a full frame camera is
  - 2X when enlarging 2x
  - 4X when enlarging 4x
  - Etc.
- When using a crop frame camera multiply the equivalent full frame crop factor by 1.5.
- Magnifying the image magnifies blurriness. The ***ROT requires you to estimate enlargement*** as you pick your shutter speed.

How ROT can give mediocre results.



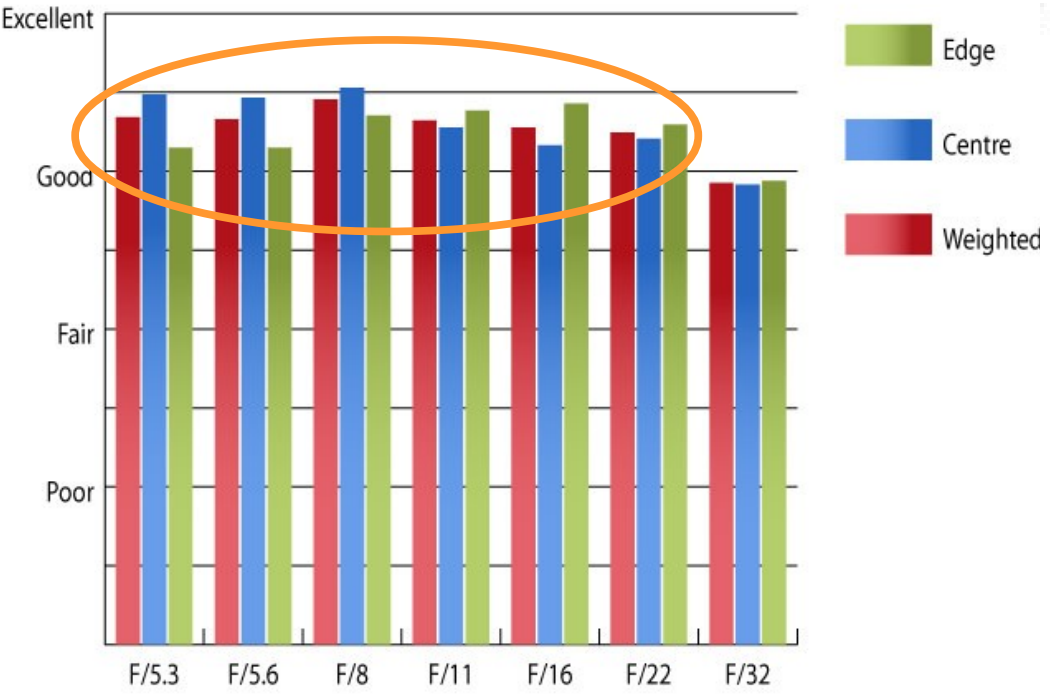
- Tests show ***ROT only gives "acceptable" results 60-80% of the time.***
- My old, less sharp, Tokina lens maybe corresponds more to the 1 blur unit curve of this diagram. My new lens corresponds more to .5 BU. Even .5 BU is noticeable *on a sharp lens.*
- My new Tokina, also lacking image stabilization, didn't seem that much sharper since camera shake using ROT masked its excellent optics.
- ***For optimal sharpness try 1.5-2x ROT.*** It's still a game of chance though.

What’s Right With This Picture?

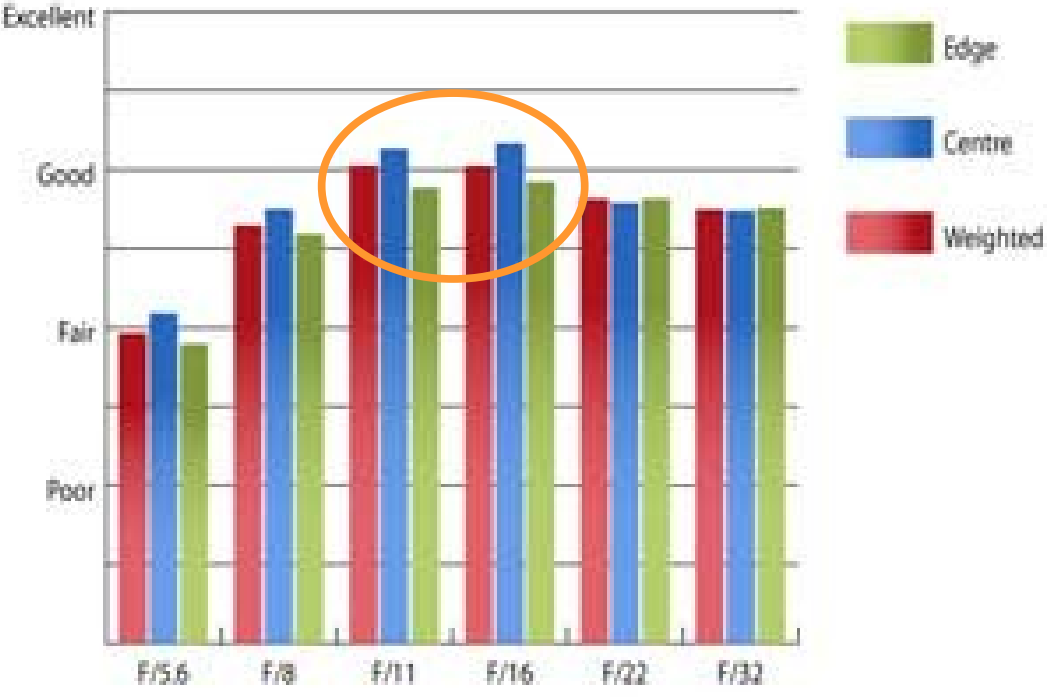
- Taken at 330mm, F11, 1/400s with IS, ISO 220, crop 1.46x.
- This shot, taken with my “unsharp” obsolete 80-400D lens is tack sharp. Why?

Know Your Sweet & Sour Spots

200 mm



400 mm

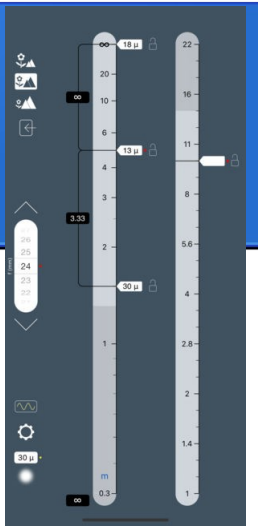


Imatest results for Nikkor 80-400mm f/4.5-5.6D ED VR AF on 16 Mpx D700

Depth of Field Gotchas

- Given equal magnification levels full frame actually offers even ***less*** DoF than crop.
- Note that DoF is in effectively cut in half when focusing on the nearest point of a subject because the foreground DoF will not be visible and thus wasted.
- So, zooming in with a full frame camera, DoF can become cramped if not ridiculous
  - .3” for flower @ 200mm, F9, 4’ away
  - .7” for flower @ 200mm, F/16, 4’ away
  - 3.2” for flower @ 100mm, F16, 4’ away
  - 3.5” for flower @ 200mm, F16, 8’ away
  - 1.2” for hummingbird @ 400mm, F8, 12’ away
  - 1.8” for hummingbird @ 400mm, F16, 12’ away
  - 9.7” for herons @ 400mm, F8, 30’ away
  - 1’ 3” for herons @ 400mm, F16, 30’ away

About DoF Calculators



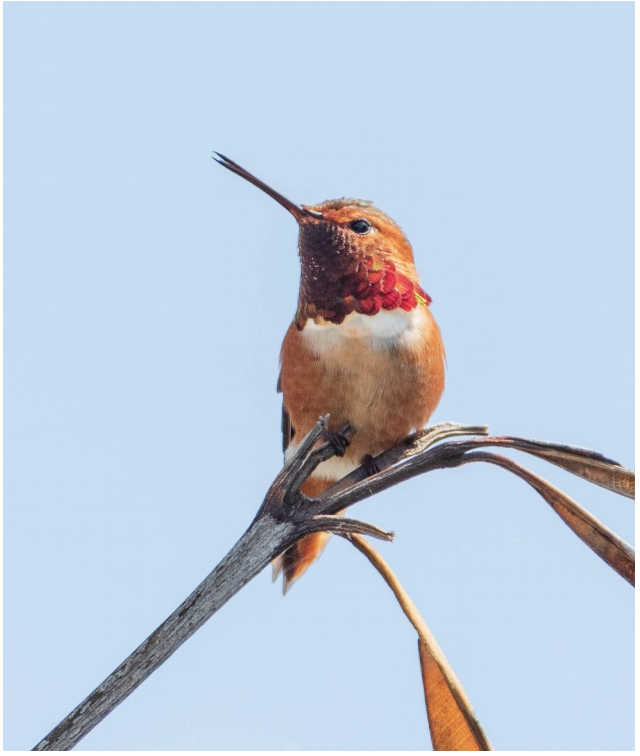
- Diffraction is a property of all lenses that adds increasing blurriness at narrower apertures. The effect is imperceptible wide open but of increasing importance starting around F/8.
- Some DoF calculators ignore diffraction, which leads to over-optimistic DoF results. Don’t use them!
- Allowing for diffraction, ***real world DoF tends to peak around F/16***. Worse, sharpness of the focal plane as much as DoF due to diffraction.

- Industry standard DoF calculations are for achieving “acceptably sharp” 8x12” prints.
- If you need a “tack sharp” or larger print adjust the blur factor on your calculator.

When F/16 isn’t enough

- Step or zoom back; then recompose and/or crop to compensate.
- Focus at the middle of the range of where you really need DoF.
- Focus on critical detail only, like the nearest eye of nearest subject. Plan to de-emphasize other non-critical details in post-processing.
- Consider focus stacking as an option for static scenes. In that case, use way less than F/16. DoF calculators can help with this decision.

Subject Blur can be Insidious



- Shot with my old Nikkor 80-400 @ 400mm, F/8, 1/1250s with IS, ISO 240, ***3.4X crop***. Perhaps 12' away.
- Managing camera shake does no good if there's too much subject blur, which can sneak up on you at high levels of magnification. ***IS and tripods are no help with subject blur! IS may even be detrimental past 1/800s.***
- I find his beak and chest a bit blurry, which I attribute to depth of field limitations but especially subject blur. I did not expect subject blur with a ***seemingly stationary*** subject at 1/1250.
- ***Caution: 3.4X crop not only magnifies subject blur but abandons over 90% of the pixels.***

Blur & Sports

- My goal was to take high quality “portraits” of Roger Federer playing before he retires.
- The trade-offs of tennis remained tight even with a full frame body. Shot with Sigma Sports 150-600mm @ 400mm, F/9, 1/1250s with IS, ISO 1250, 1.46X crop.
- The subject blur imparts a sense of motion. On the other hand, 1/1250s may be pushing it for portrait quality detail in face and hands.

Focusing Tips

- Use Back Button Autofocus
  - There are many good reasons to use separate buttons to focus and shoot.
  - One of them is to let IS settle down for optimal sharpness.
- Focus on nearest eye of nearest subject.
- Configure camera to display where pictures *were* focused —and sanity check your results.

Autofocus Fine Tune

JJC ACA-02

- Is a setting to adjust viewfinder/lens focus distance to match the sensor.
- Improves sharpness for most of SLR/lens combinations.
- Many cameras support AFFT. Some lens manufacturers even support firmware adjustment at multiple focal lengths.

Autofocus in Live Mode

- Method of choice when working with DSLR, tripod and static subjects, e.g., landscapes.
- No mirror flap. No discrepancy between sensor and focus points.
- Zoom in electronically to select exact focus point.
- Focus anywhere on sensor, trigger using remote.
- Slow but very accurate.
- Old lens again, 400mm 1 sec F7.1 ISO 1250, ***7x crop leaves about 2% of pixels.***

Conclusion

- Sharpness of the subject's key features is crucial to a photo's success. ***Blurriness can be the kiss of death*** for a photograph.
- ***You* decide** what is "acceptable sharpness" in motion blur or DoF, or what is "acceptable noise". Such decisions are for the most part more a matter of composition rather than performance.
- When composing, imagine the audience and visualize the entire execution. ***Give special thought to all forms of enlargement*** whether through
  - use of a telephoto lens;
  - cropping to magnify the raw image; and/or
  - enlarging the edited product to print or display.
- Enlargement magnifies all defects of your art.
- To succeed, your shutter speed must be sufficient for all that enlargement. It may not be obvious how much you need when you shoot!

Questions?

References

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- The Ultimate Guide to Back Button Focus", Dan Carr, 2018.
- JJC Autofocus Chart. I use this for autofocus fine tune and am pleased with it.
- Nikon 80-400mm f/4.5-5.6D ED VR AF Nikkor Interchangeable Lens Review.