Photography basics and setting up a 2D imaging station

John P. Sullivan, Cornell University Museum of Vertebrates

iDigBio Vertebrate Digitization Workshop, Berkeley, CA, April 4-6, 2016

Brian Sidlauskas

Adam Summers

In this talk:

- What makes a good specimen photograph and what are the common errors to be avoided?

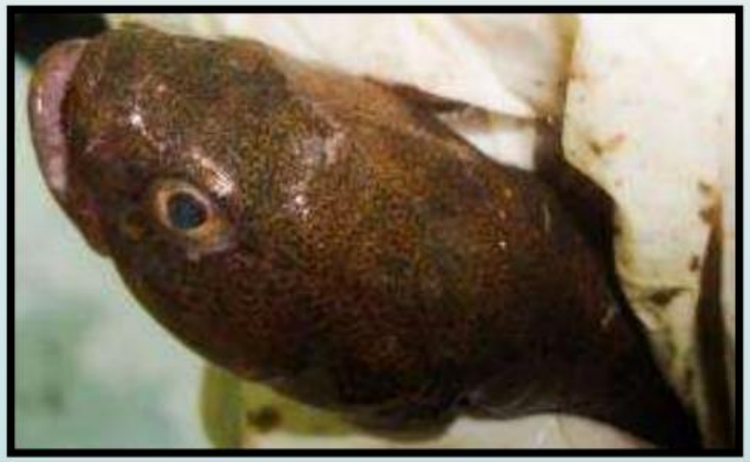
- Some basics of photography and cameras

- How to set up your DSLR for specimen photography

- Our photo setup at the CUMV & how we (mostly I) photograph dry specimens, wet specimens & cleared and stained specimens.


Nitto Kogaku
KOMINAR 1:1.9 f=4.8cm
Walz
ENVOY
"M35"

What's wrong with these photos?



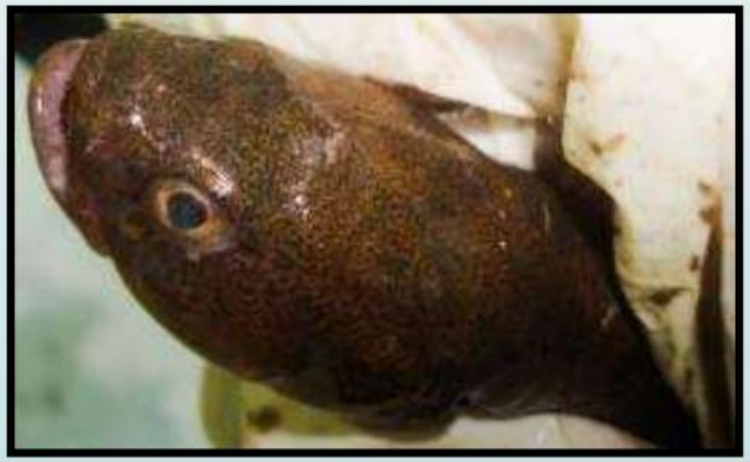
MRAC

I. How to take good specimen photos

-avoid the most common mistakes in specimen photography

- framing (specimen occupies too little of photo)
- specimen at oblique angle to lens
- no scale in photograph
- wrong exposure
- uneven illumination/background
- camera not stabilized
- depth of field too narrow
- wrong ISO
- color cast (white balance not set correctly)

What's wrong with these photos?



MRAC

How to take good specimen photos

What we want:

sharp, *properly exposed*, high resolution images that capture most important information about specimen

Photography Basics

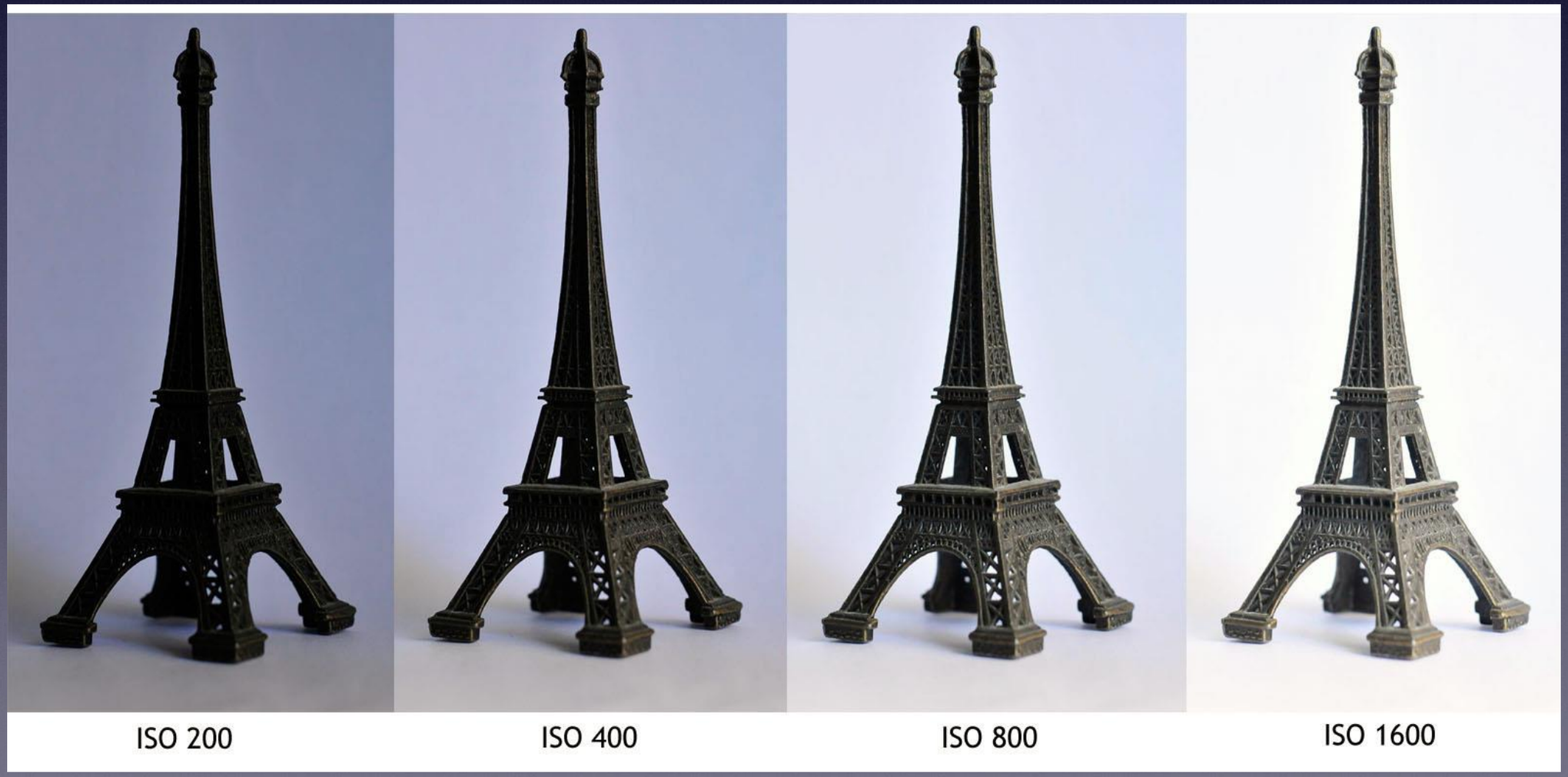
Exposure

Exposure

determine how much light comes into camera

- Aperture
- Shutter speed
- ISO (sensitivity of film or sensor)

determines how much is needed



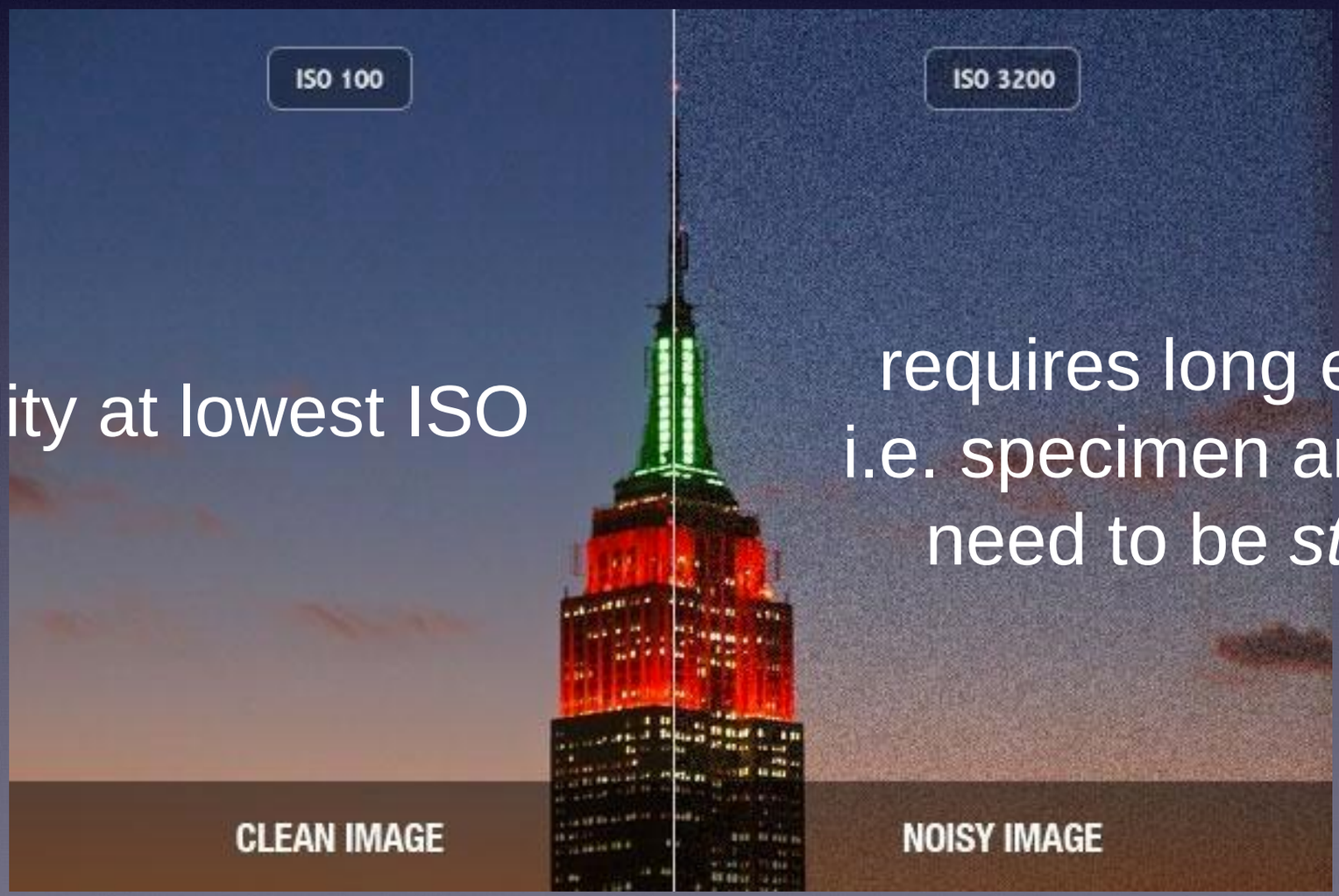
Exposure

determine how much light comes into camera

- Aperture
- Shutter speed
- ISO (sensitivity of film or sensor)

determines how much is needed

best image quality at lowest ISO

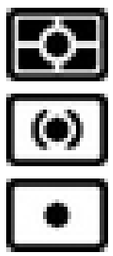


requires long exposure, i.e. specimen and camera need to be *stabilized*

Exposure

- Aperture
- Shutter speed
- ISO (sensitivity of film or sensor)

Nikon Metering Modes

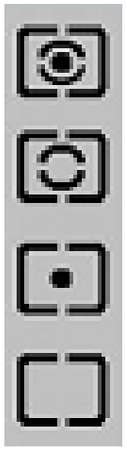


Matrix metering mode

Center-Weighted Average metering mode

Spot metering mode

Canon Metering Modes



Evaluative metering mode

Partial metering mode

Spot metering mode

Center-Weighted Average metering mode

For specimen photography use spot metering!

Put the spot on the specimen.

Exposure

- Aperture
- Shutter speed
- ISO (sensitivity of film or sensor)

lowest

Exposure

- Aperture
- Shutter speed arbitrary
- ISO (sensitivity of film or sensor)

Exposure

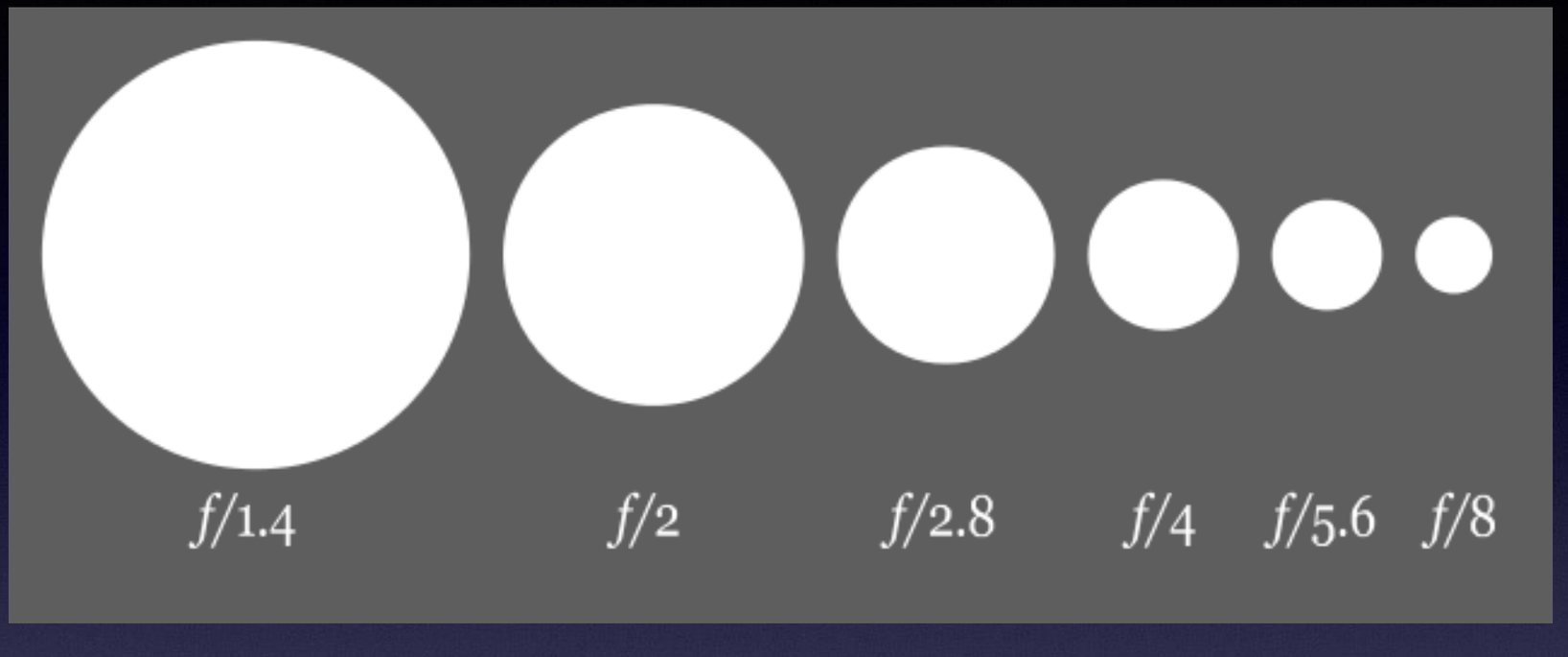
- Aperture not arbitrary
- Shutter speed
- ISO (sensitivity of film or sensor)

Depth of Field

effect of aperture or f-stop

This is roughly a linear effect: reducing the aperture by two F-stops increases the DOF by a factor of 2

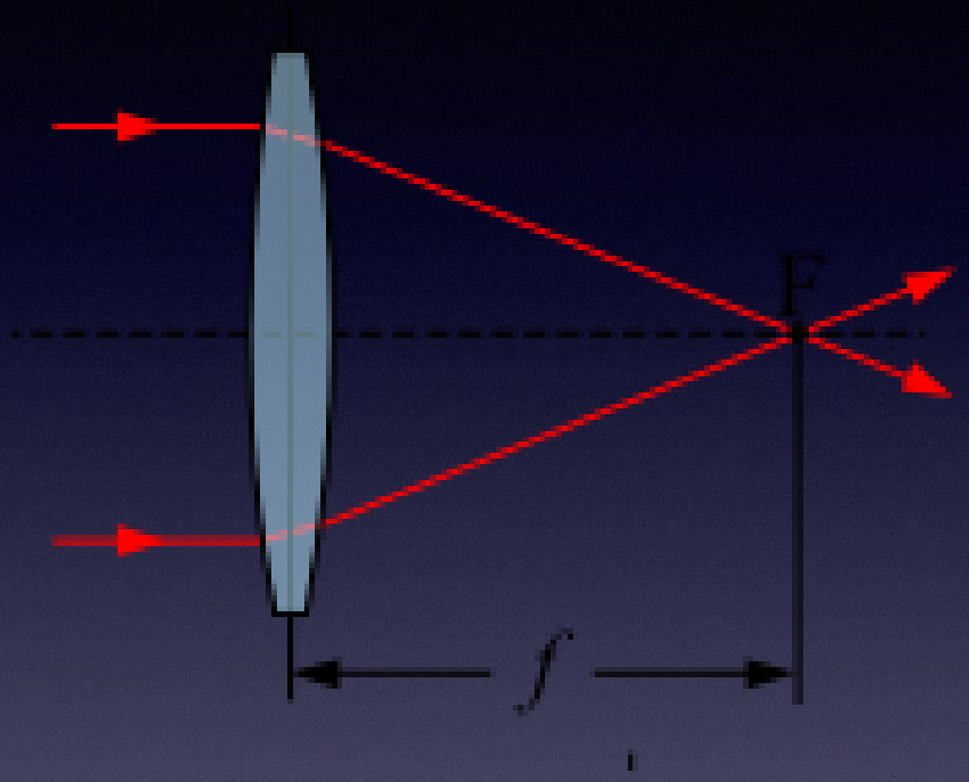
Aperture expressed as “F-number” or “F-stop”



the ratio of the lens's focal length to the diameter of the entrance pupil.

focal length 50 mm
entrance pupil 25 mm
= f/2

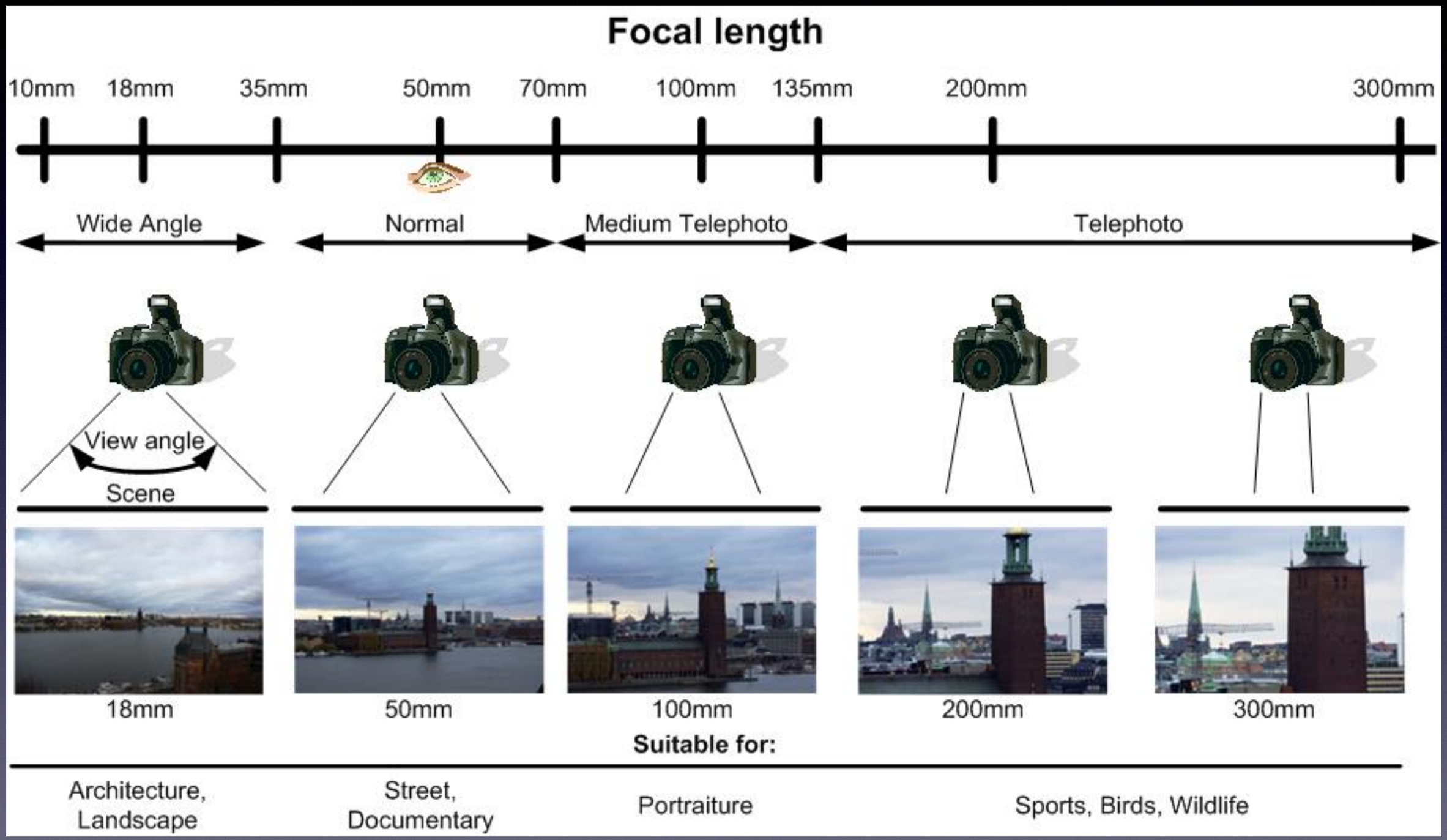
ance from the center of the lens to the principal foci (or focal p



longer focal length = higher magnification and a narrower angle of view

shorter focal length = lower magnification and a wider angle of view.

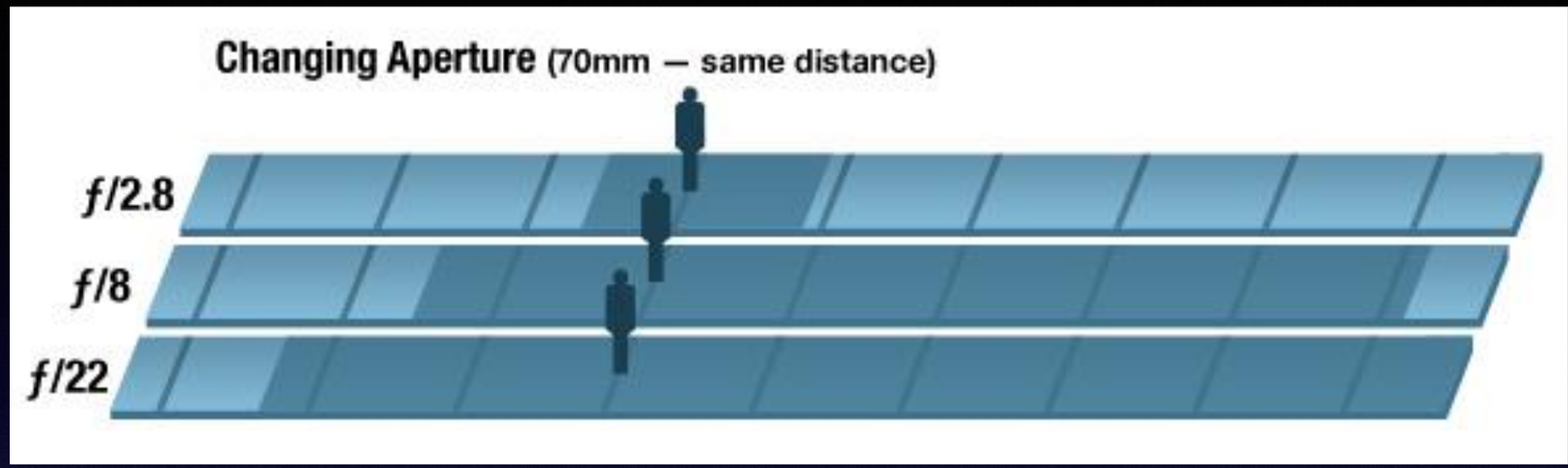
focal length

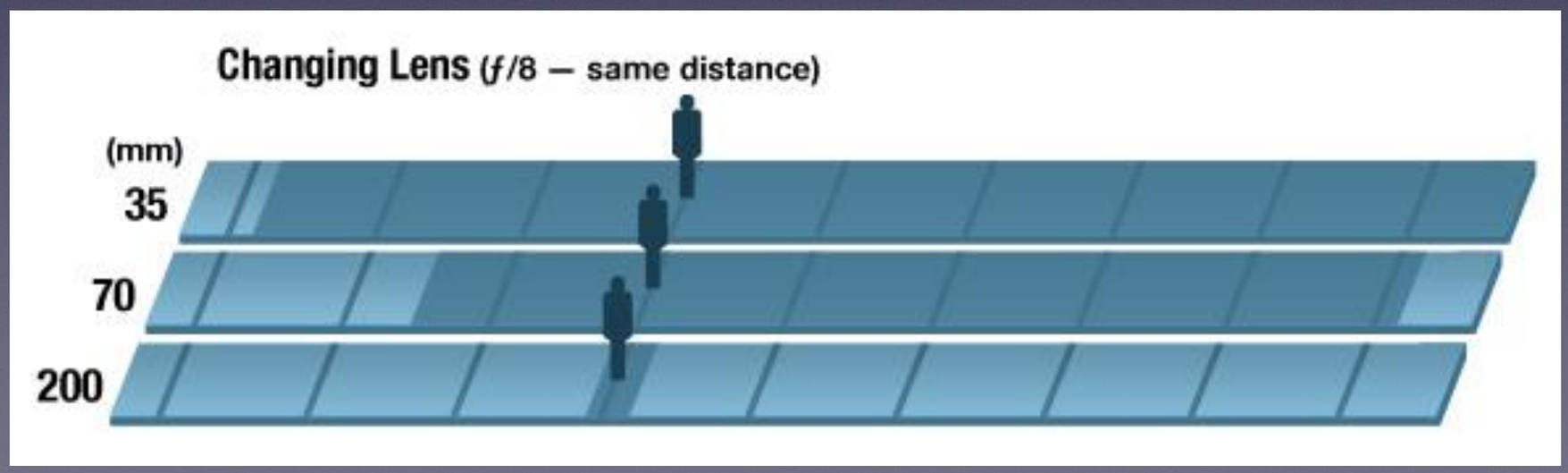


Depth of Field

1) *Aperture/f-stop*: The rule of thumb is as the aperture increases (f-stop decreases), the depth of field decreases (or become shallower).
2) *Focal Length*: as the focal length increases, the depth of field decreases (or becomes shallower).
3) *Distance from the subject*: as the subject distance increases, the depth of field increases (or become deeper).

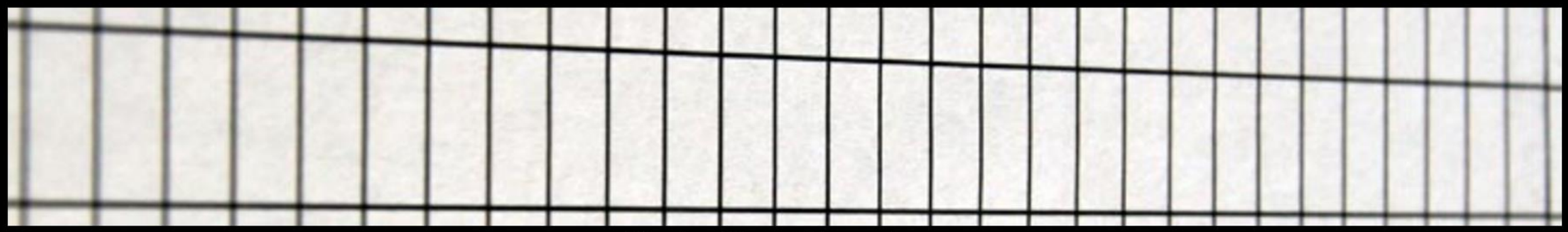
Depth of Field



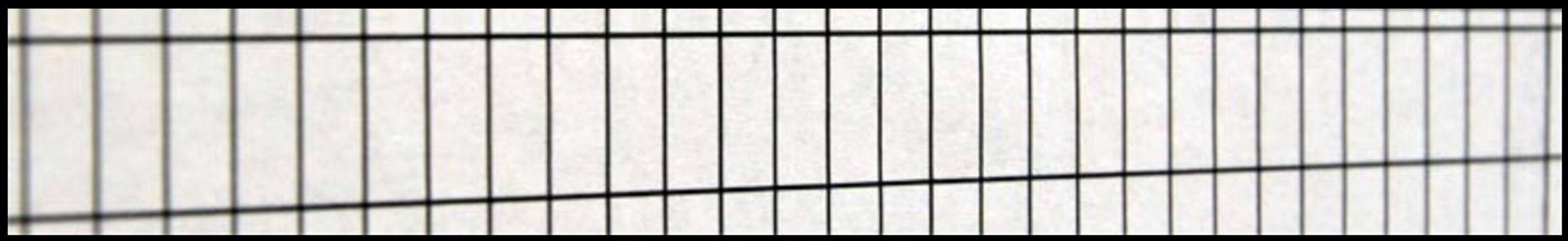


DOF effects of focal length and distance exactly cancel each other out when size of the image on the sensor is held constant.

Grid held at 45 degrees to the plane of the camera lens. Both lenses set to f/11.



Shot with a 50mm lens



Shot with a 200mm lens

Q: If focal length of lens isn’t chosen to change depth of field, why does it matter? (e.g. 100 mm macro lens vs. 40 mm macro)

A: optimal working distance from specimen.

Many types of photography the ability to have a shallow depth-of-field is important

However in specimen photography we always want MORE not less DOF

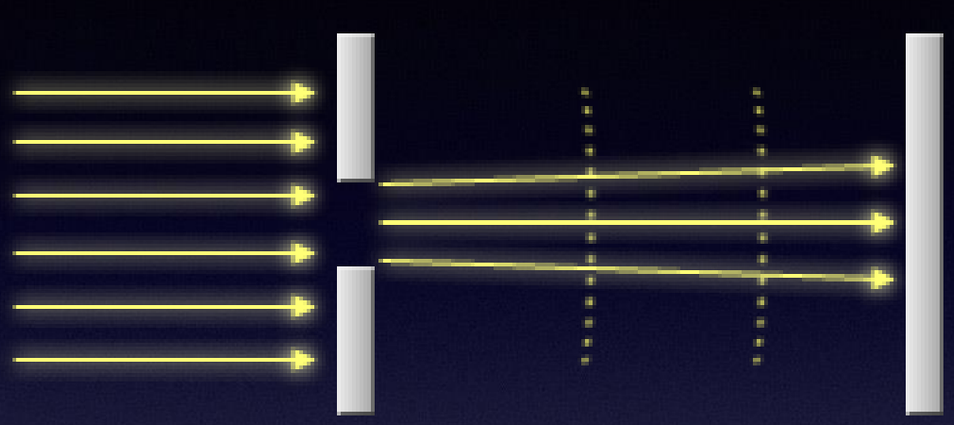
Q: So why not stop down lens as far as possible? (e.g. f/32, f/45) to maximize DOF?

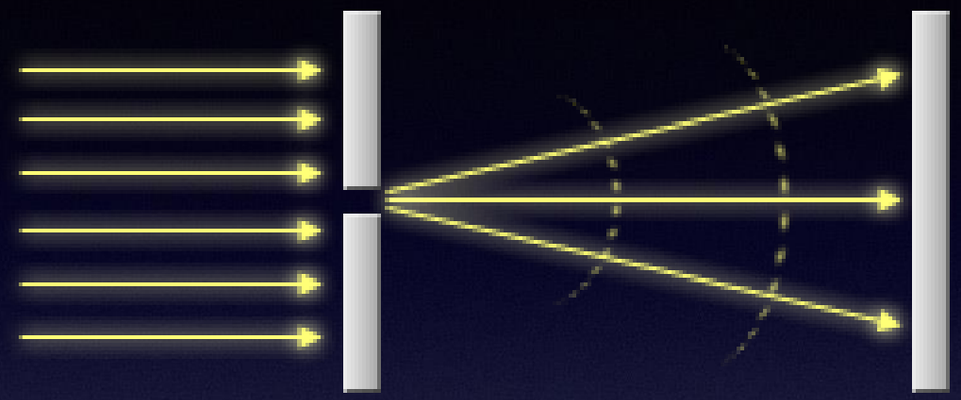
A. diffraction

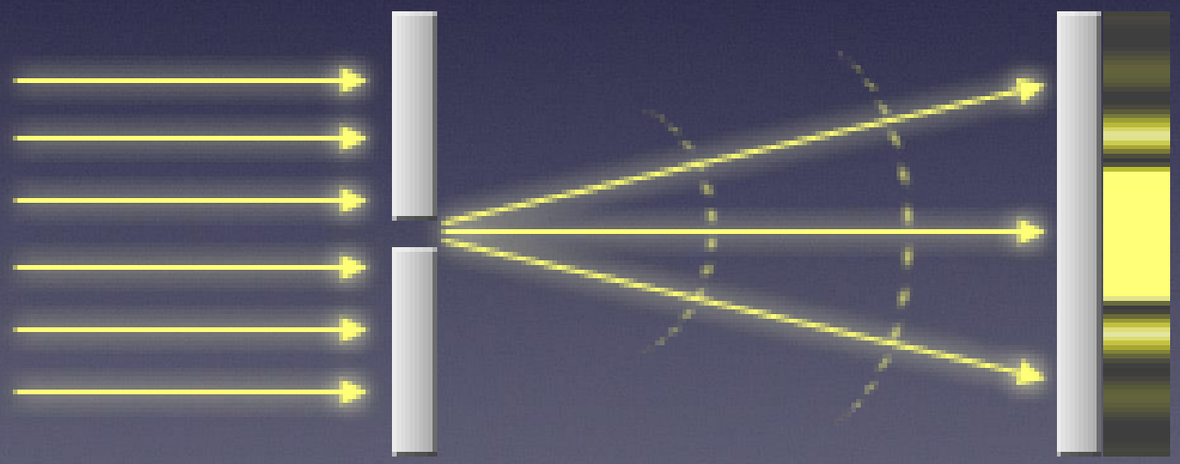
Max DOF vs. Diffraction trade-off

http://nzphoto.tripod.com/stereo/3dtake/fdof.htm

What is diffraction?

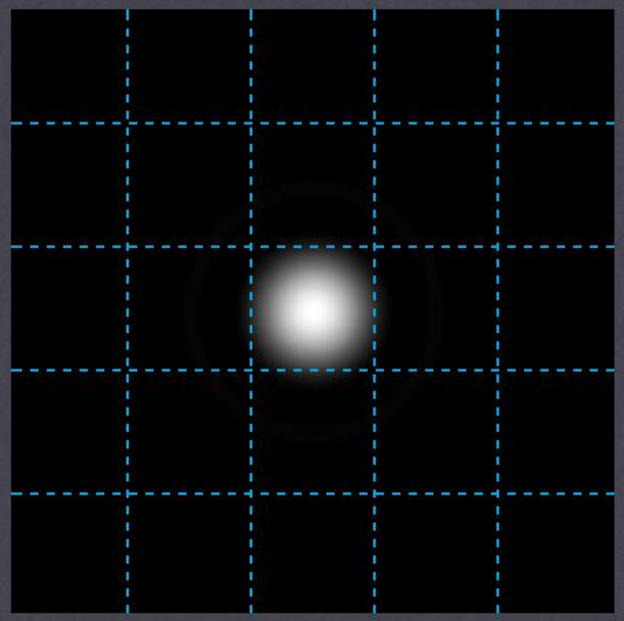






http://nzphoto.tripod.com/stereo/3dtake/fdof.htm

What is diffraction?



Lens Aperture

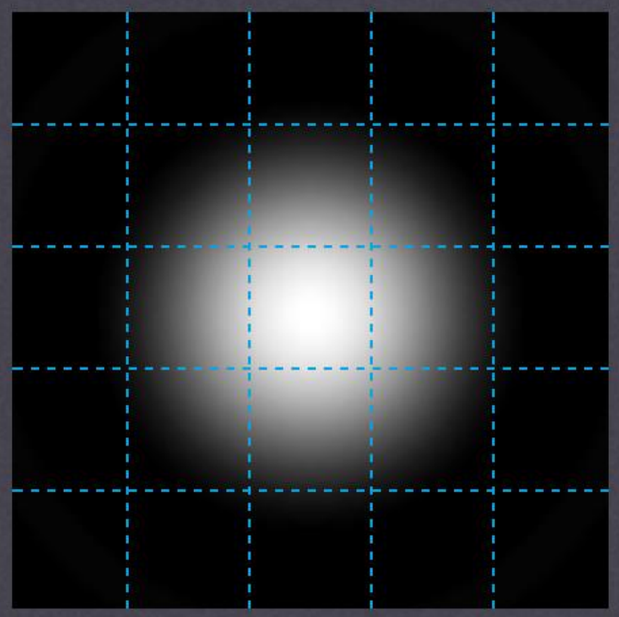
f/8.0

Airy Diameter: 10.7 µm

Camera

Canon EOS 1D X

Pixel Diameter: 6.9 µm



Lens Aperture

f/22

Airy Diameter: 29.3 µm

Camera

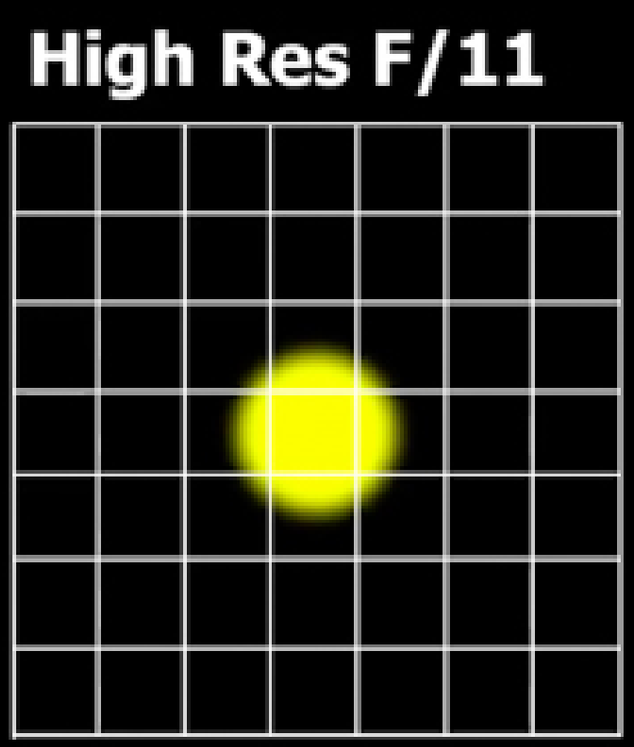
Canon EOS 1D X

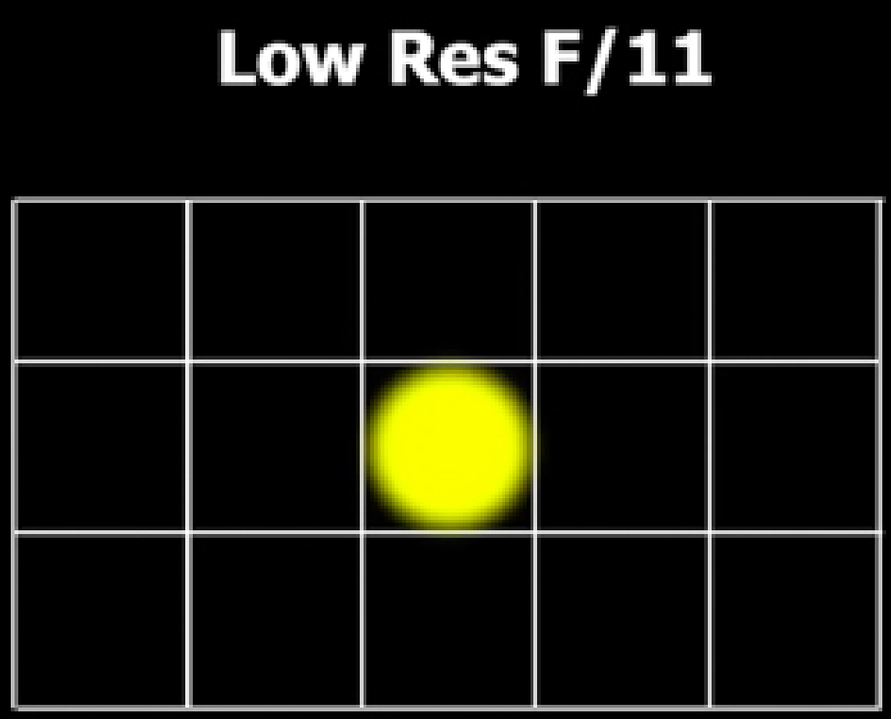
Pixel Diameter: 6.9 µm

What is diffraction?

http://nzphoto.tripod.com/stereo/3dtake/fdof.htm

Diffraction becomes a problem at larger apertures on sensors with higher pixel densities





You see diffraction sooner on a high res sensor because it's capturing much more fine detail than the low res sensor

https://www.slrlounge.com/

II. 2D Imaging Stations: Components and Setup

Hardware:

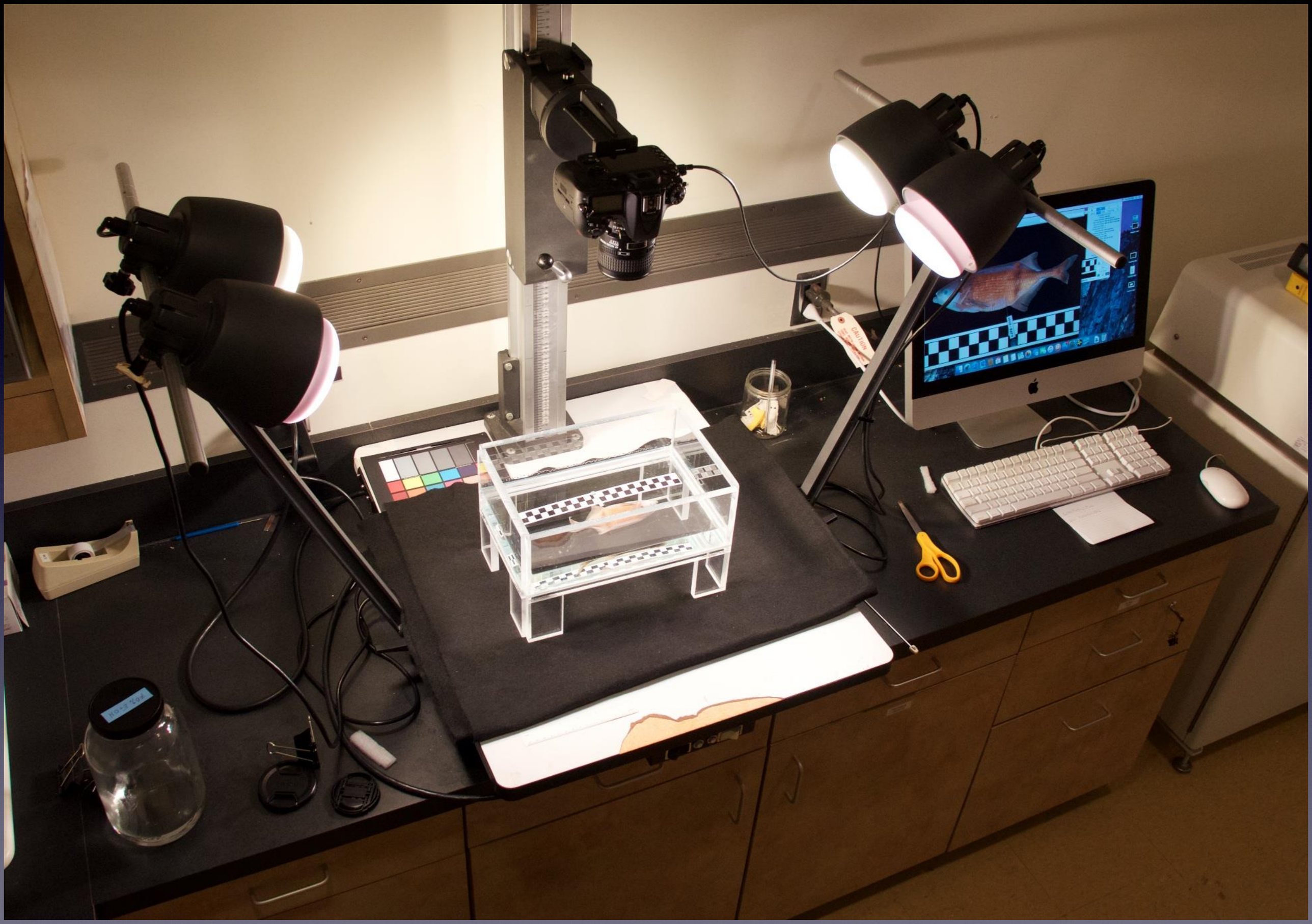
- cameras
- lenses
- tripod
- copy stand & lights
- computer & tether cable
- squeeze tank
- wet box
- light table

Software:

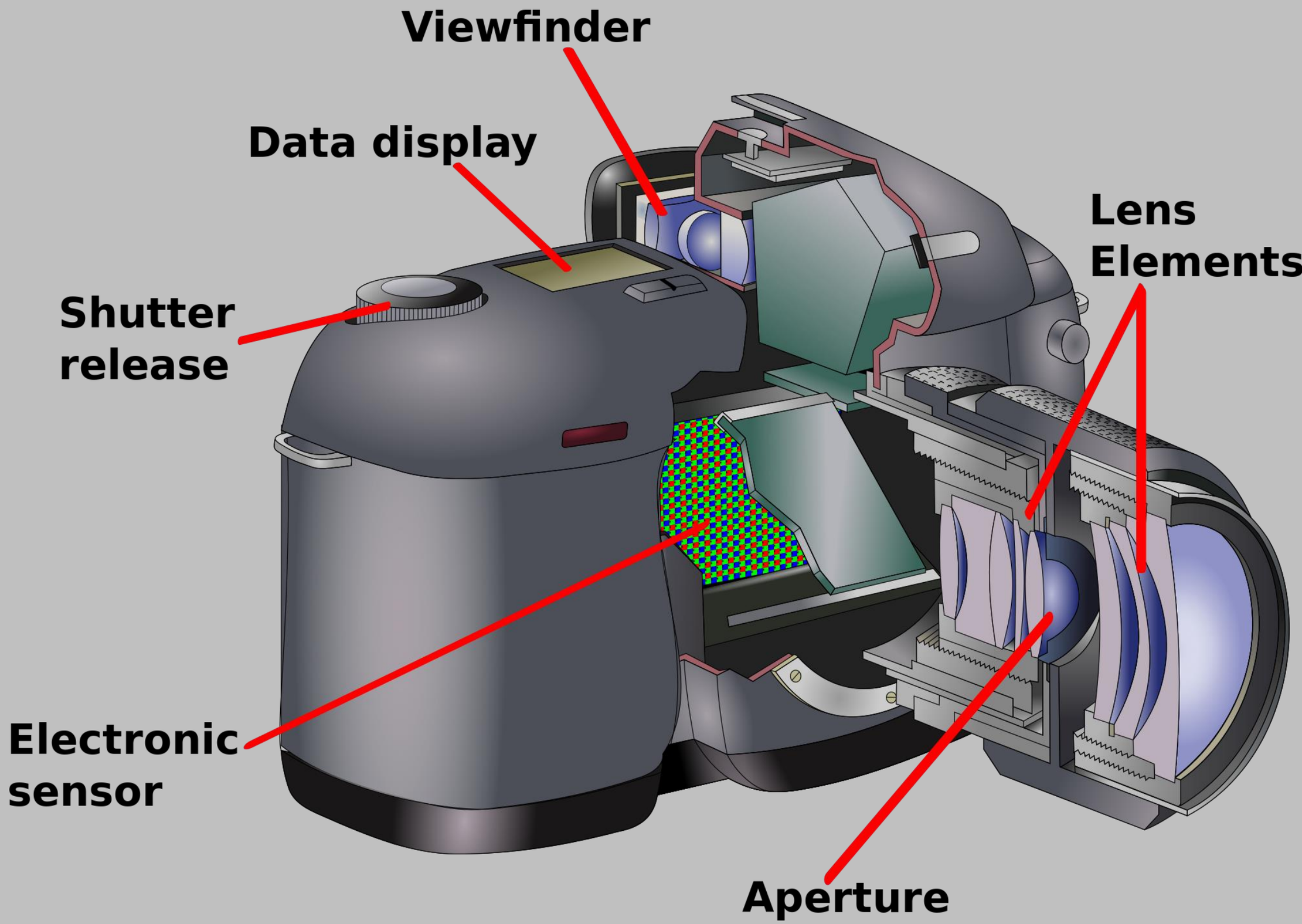
- Nikon Control Pro 2 or Canon EOS utility
- Helicon Focus

extras:

- flatbed scanner
- Manfrotto magic arm
- iPhone microscope ocular adapter



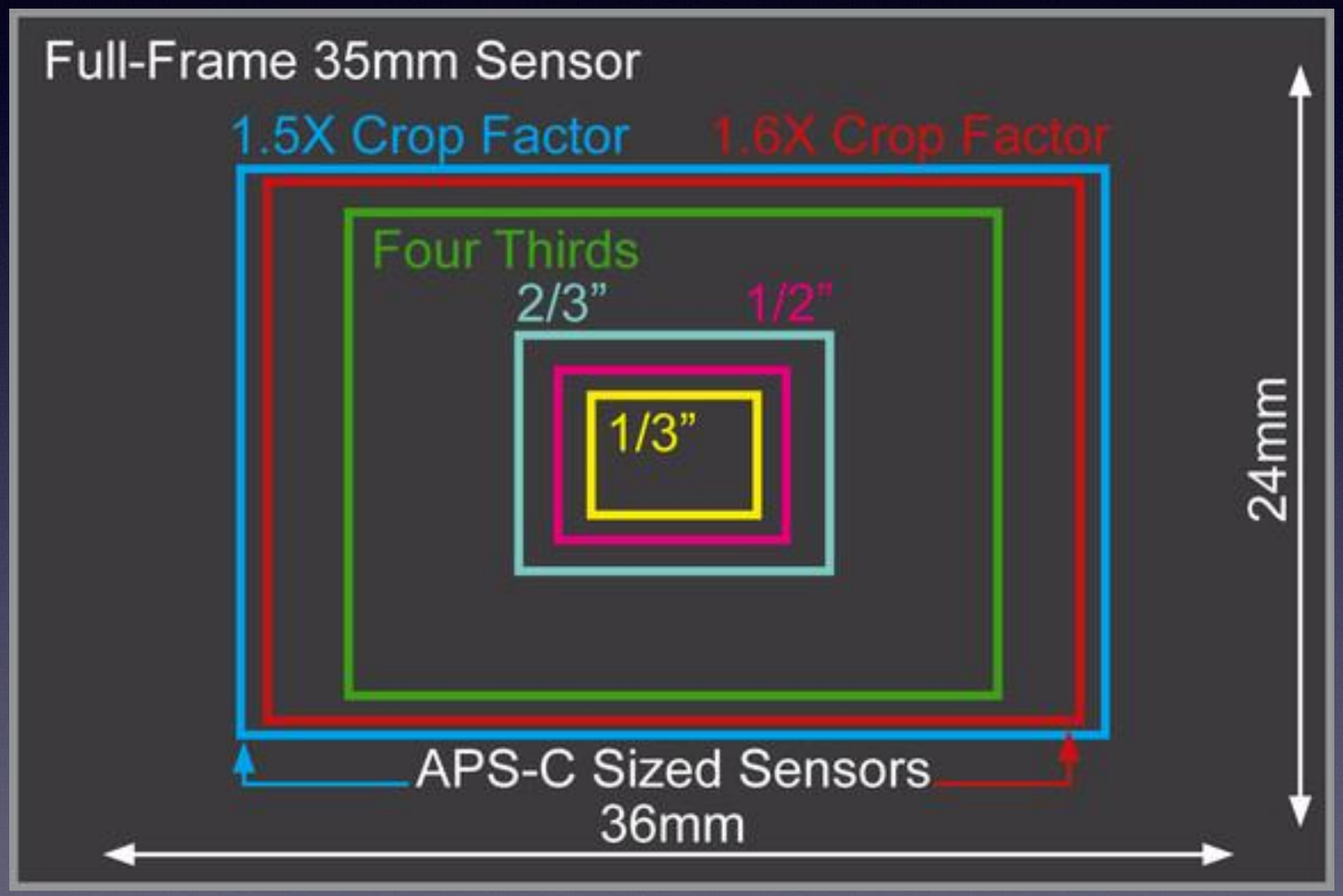
DSLR


Viewfinder
Data display
Shutter release
Lens Elements
Electronic sensor
Aperture

Full frame vs. crop-sensor DSLR

Nikon D750

Nikon D7200


Full-Frame 35mm Sensor
1.5X Crop Factor
1.6X Crop Factor
Four Thirds
2/3”
1/2”
1/3”
24mm
APS-C Sized Sensors
36mm

What's better for specimen photography: full-frame DSLR or crop-sensor?

Depth of Field Equivalents

Sensor #1

35 mm (full frame)

Selected Aperture: f/22

Lens Focal Length: 60 mm

Sensor #2

Digital SLR with CF of 1.5X

CALCULATE

Required* Focal Length: **40 mm**

Required Aperture: **f/14.5**

*If the same perspective is desired.

http://www.cambridgeincolour.com/tutorials/digital-camera-sensor-size.htm

What's better for specimen photography: full-frame DSLR or crop-sensor?

24 MP

$2300

Nikon D750

24 MP

$1100

Nikon D7200

$550

Nikon 60mm AF-S G

$2850

$280

Nikon 40mm f/2.8 G (DX)

$1380

Features of **full-frame** DSLRs relative to crop-sensor cameras for specimen photography

FEATURE	ADVANTAGE	NOT IMPORTANT	NOT GOOD
higher FPS & larger buffer		X	
better low-light performance		X	
shallower depth of field at f-stops			X
better for wide-angle work		X	
More AF points		X	
4K video		X	
ultra-high pixel count (some)	X	X	

Features of **crop-sensor** DSLRs relative to full-frame cameras for specimen photography

FEATURE	ADVANTAGE	NOT IMPORTANT	NOT GOOD
less expensive	X		
lenses less expensive	X		
wider depth of field at f-stops	X		
better for telephoto work		X	

24 MP

Nikon D7200

$1100

Nikon 40mm f/2.8 G (DX)

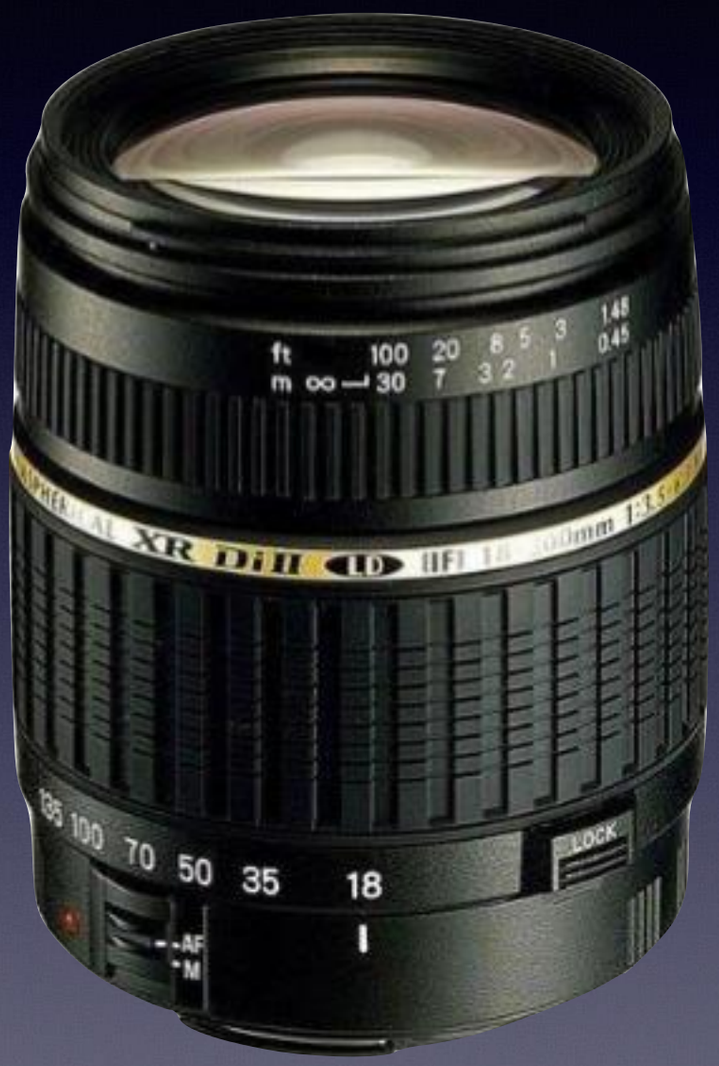
$280

Nikon 105mm f/2.8 VR G

$900

$2280

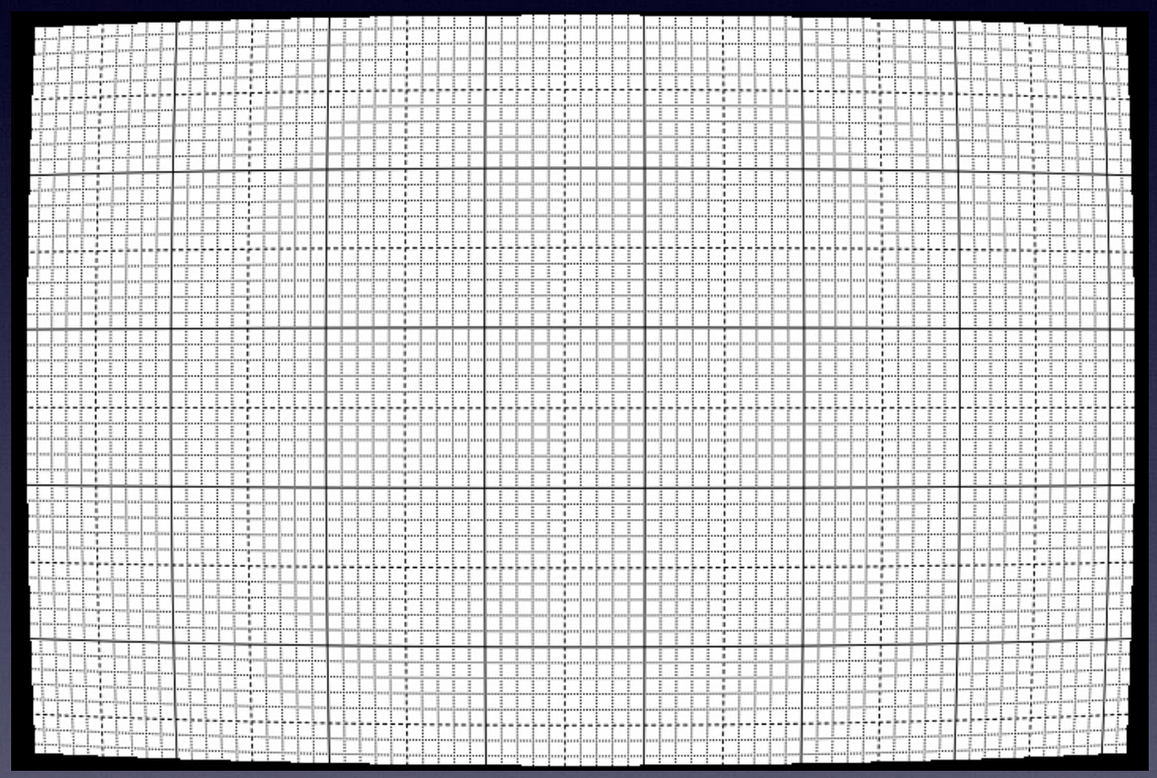
Q: Instead of 2 primes, why not 1 zoom?



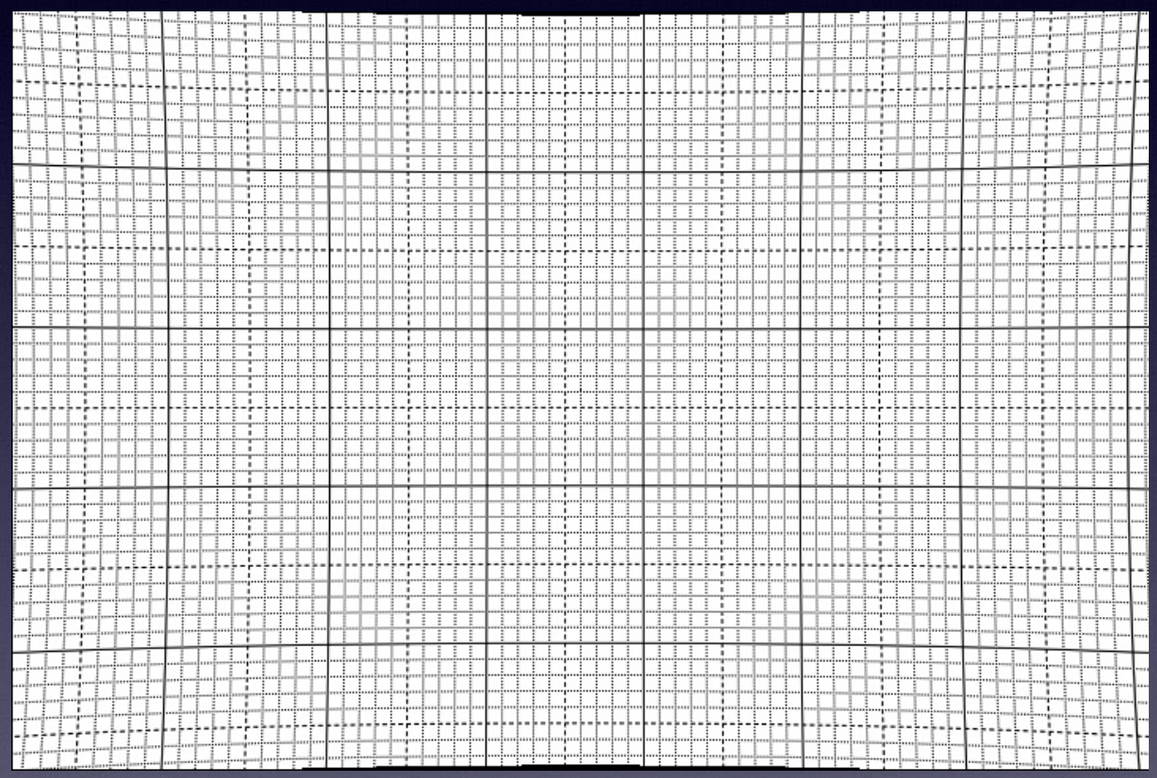
Tamron Auto Focus 18-200mm f/3.5-6.3 XR Di II LD Aspherical (IF) Macro Zoom

$189

A: Distortion



barrel distortion



pincushion distortion

Nikon 105mm f/2.8G AF-S VR

Nikon 60mm f/2.8

Nikon 40mm f/2.8 G (DX)

II. 2D Imaging Stations: Components and Setup

Hardware:

- cameras
- lenses
- tripod
- copy stand & lights
- computer & tether cable
- squeeze tank
- wet box
- light table

Software:

- Nikon Control Pro 2 or Canon EOS utility
- Helicon Focus

extras:

- flatbed scanner
- Manfrotto magic arm
- iPhone microscope ocular adapter


old Polaroid copy stand
old iMac with Nikon Control Pro 2
120w flood lights
Manfrotto heavy-duty tripod

“squeeze tank”

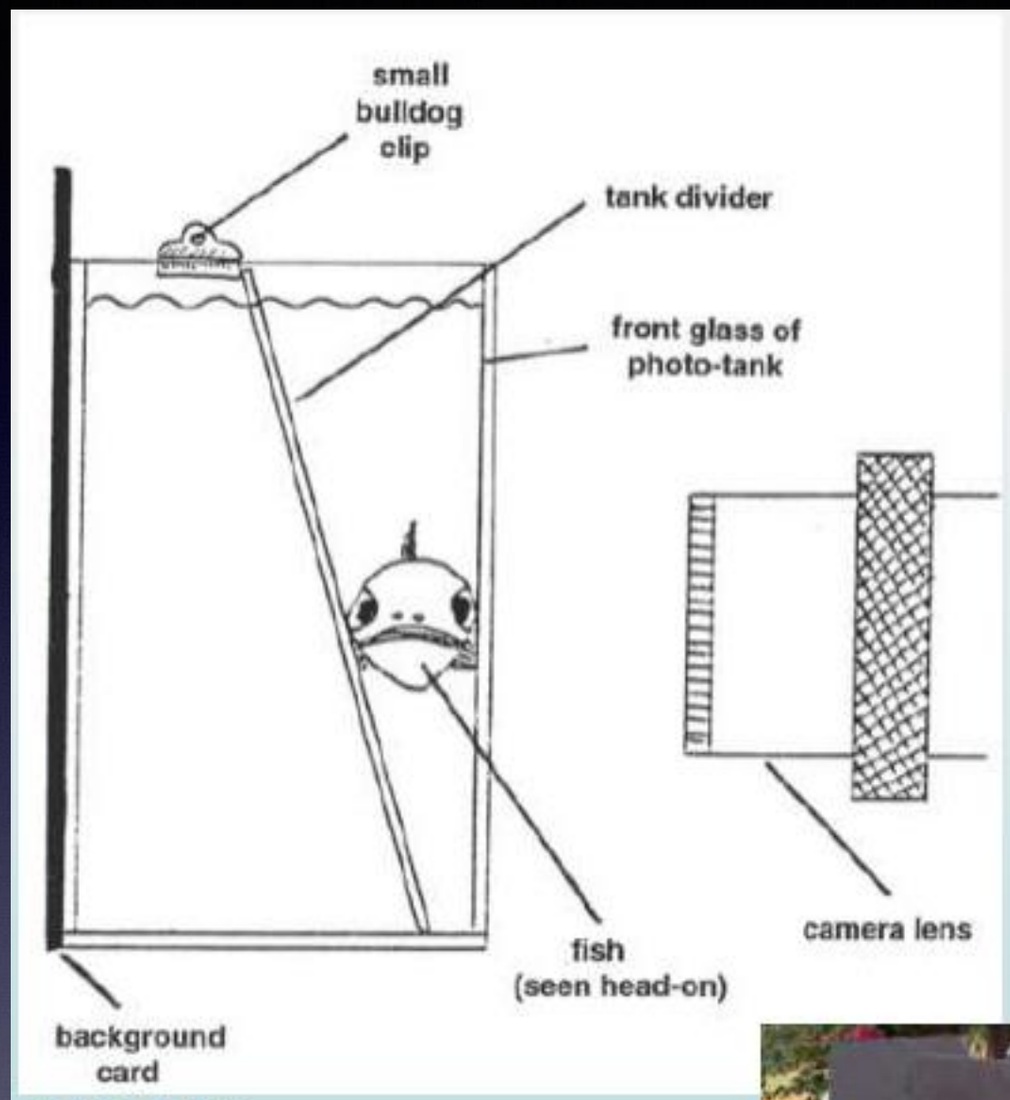
“squeeze tank”

in the lab

“squeeze tank”

in the field

“squeeze tank”



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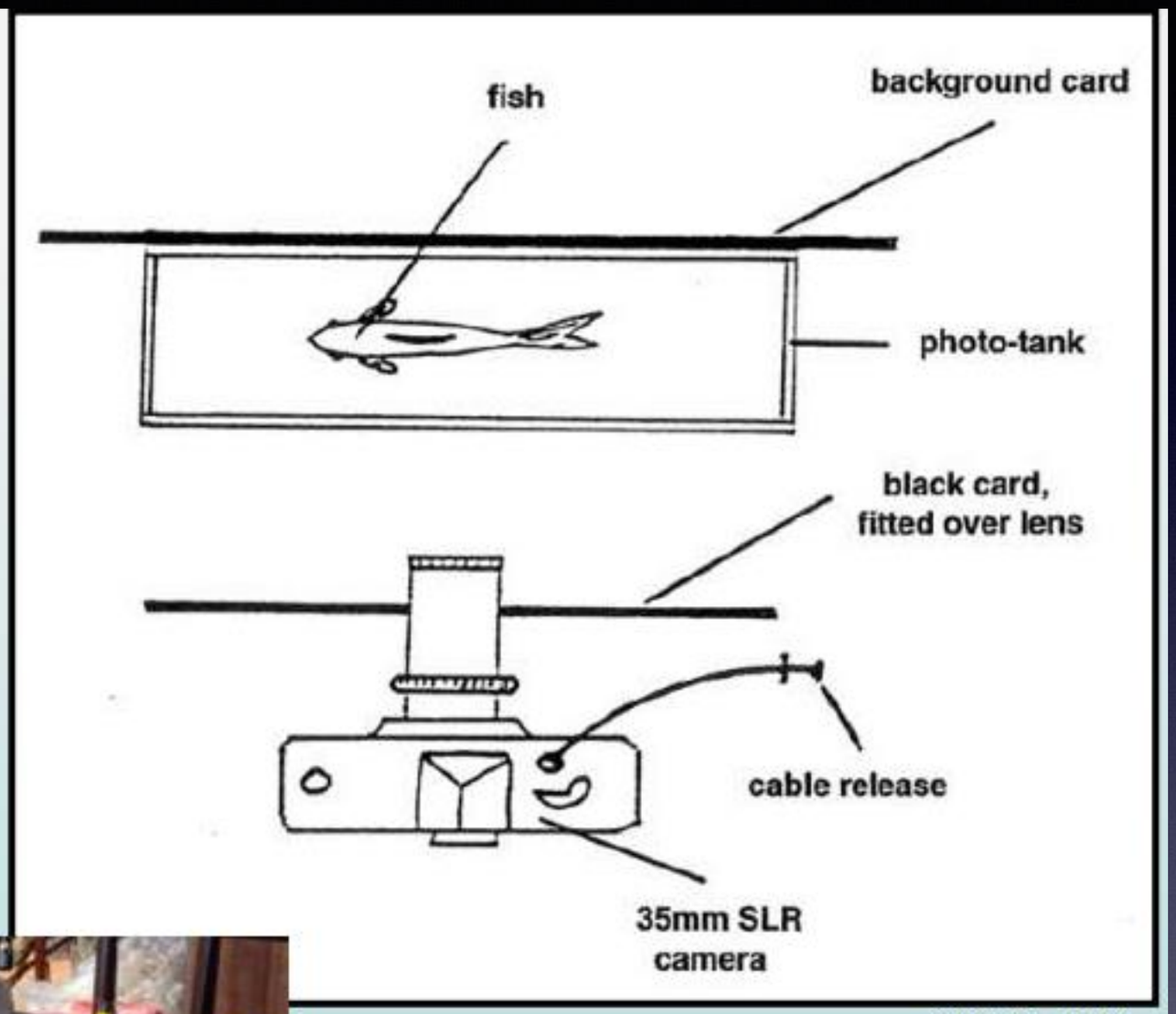

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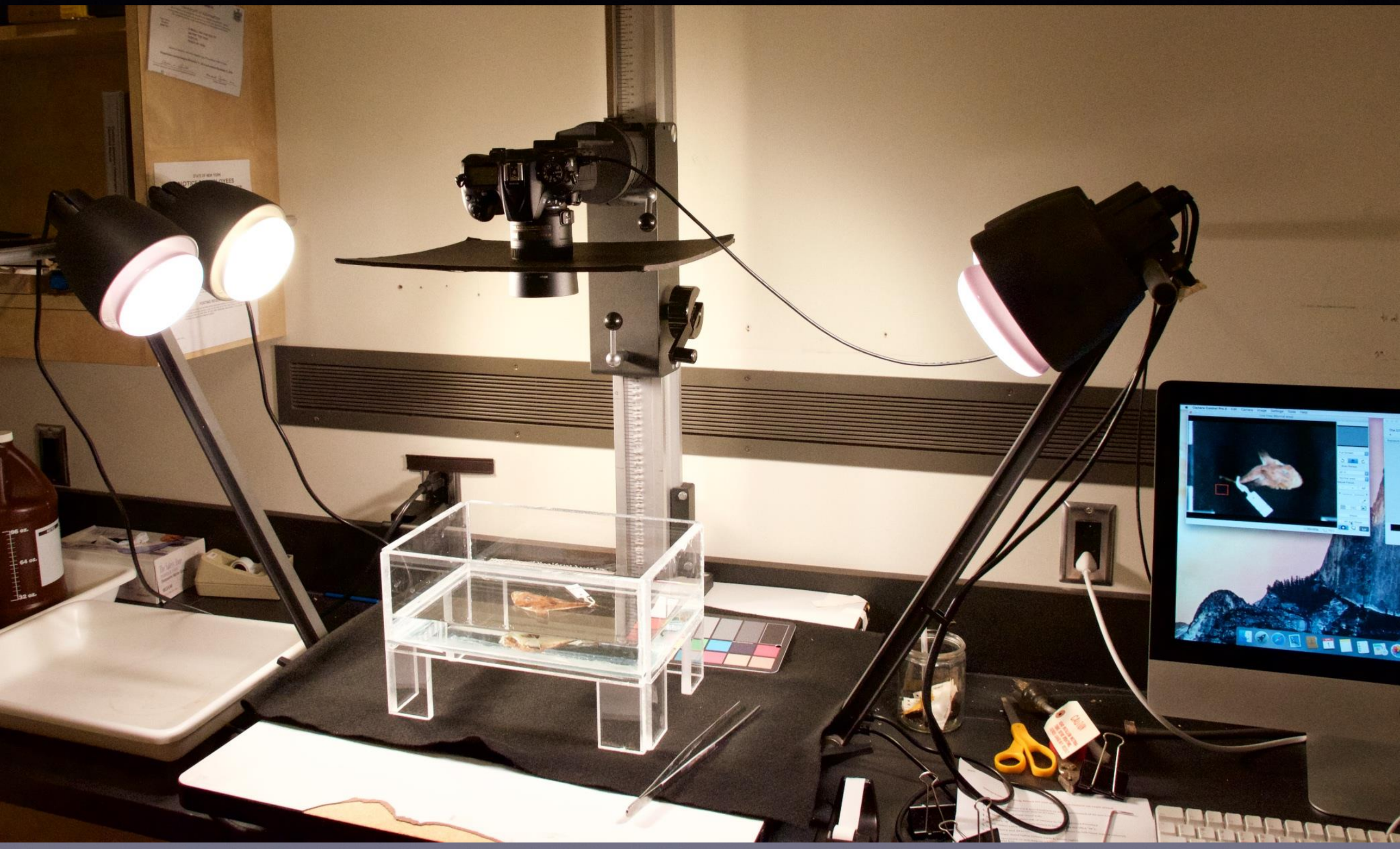
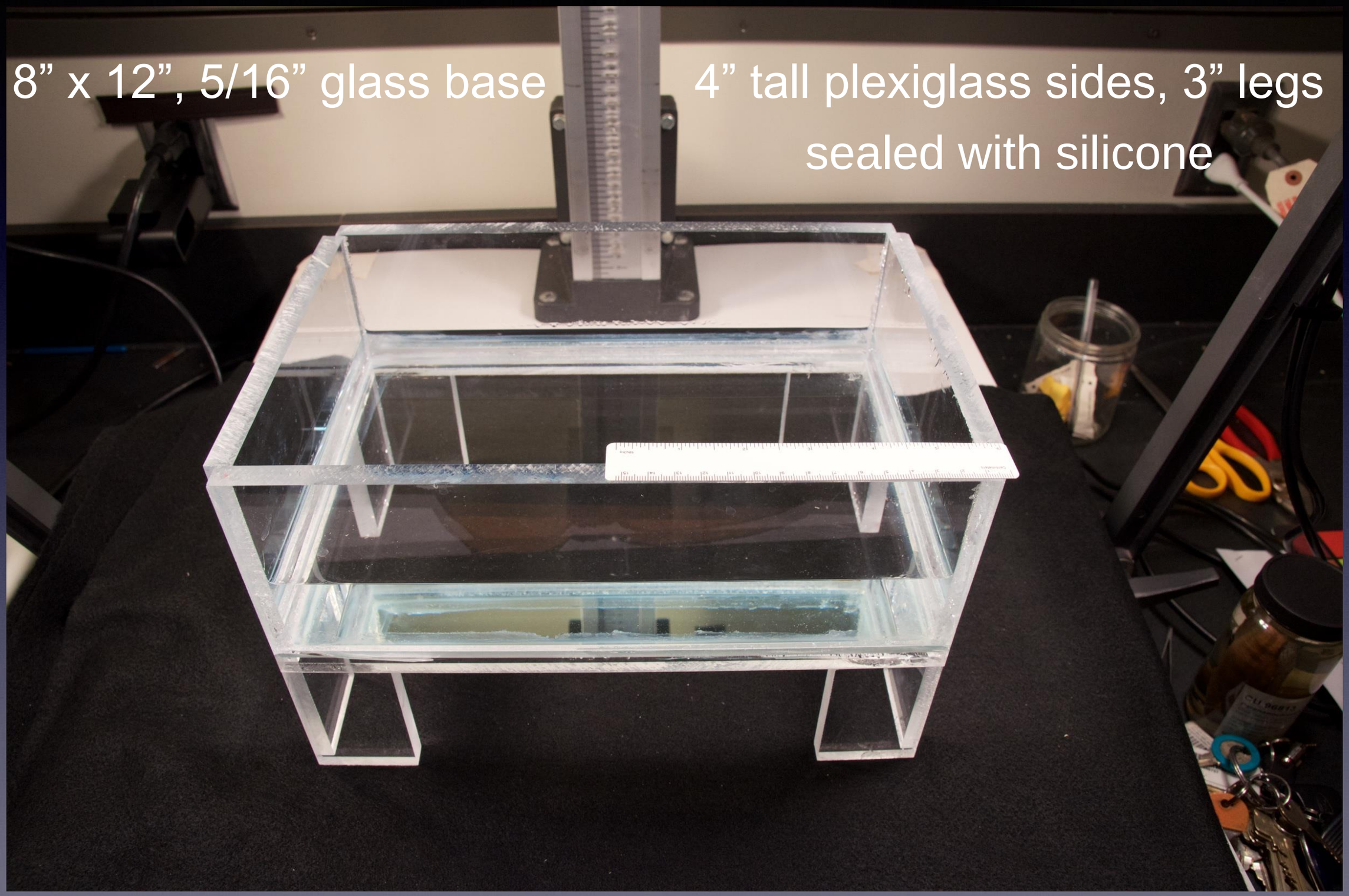
Amphilius sp.

wet box



wet box


8” x 12”, 5/16” glass base
4” tall plexiglass sides, 3” legs
sealed with silicone

wet box

Wet Box

Mormyridae

CU 91223 11 Fluid Specimen(s)

Campylomormyrus mirus

Africa; Zambia; Northern;
Drainage: Chambeshi River
Samfa Rapids at pontoon on Chambeshsi River

Lat.:-10.8521° Long.:31.1673°
Date: 11/Oct/2005
Coll: Bills, Chilala & Friel

Field #: JPF 05-047
Determiner: Friel, JP

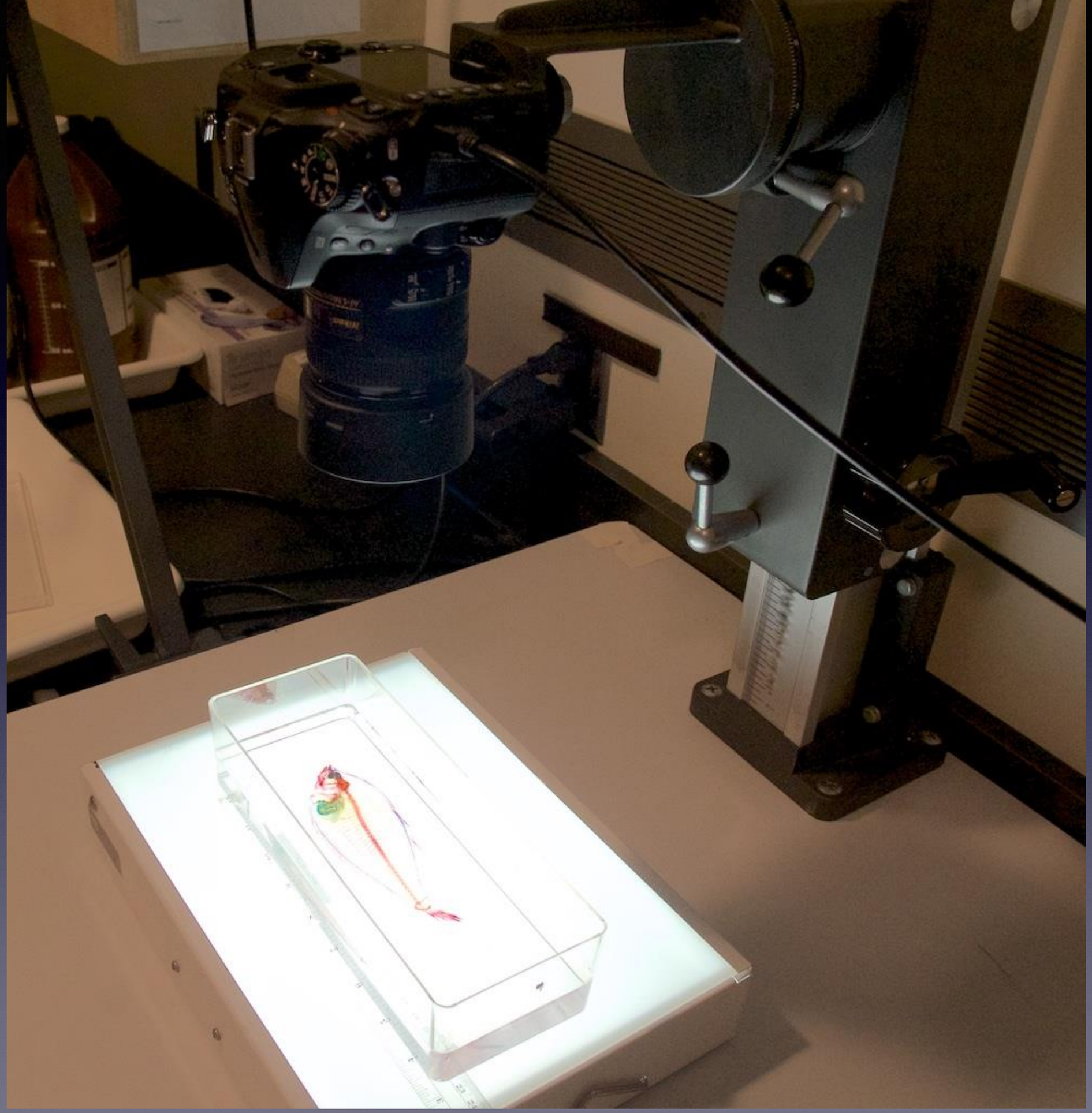
Cornell University Museum of Vertebrates - Ichthyology
Storage: ETOH
Printed: 01/02/06

wet box

squeeze tank

wet box

squeeze tank

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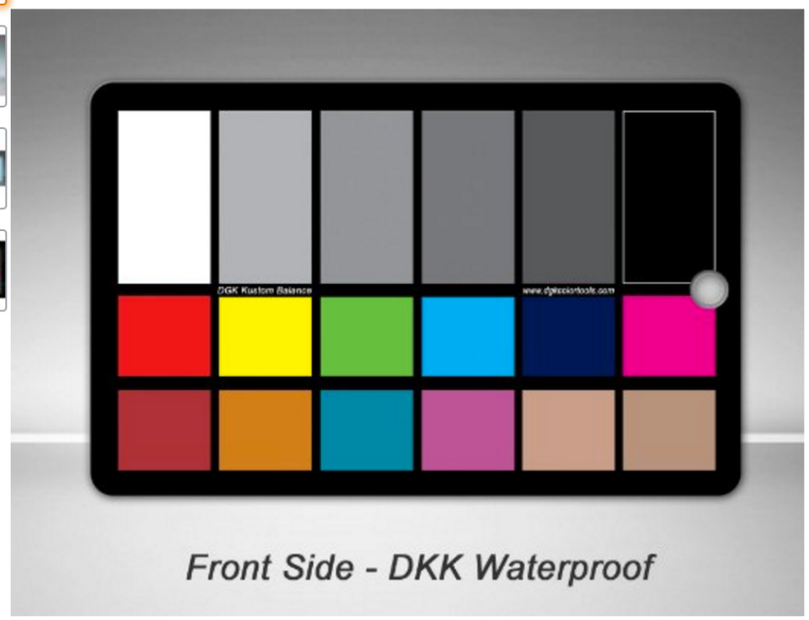
cheaper alternative



Front Side - DKK Waterproof

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by DGK Color Tools

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- Versatile waterproof 18% white balance and color reference card and warm card kit includes card, stand, instructions.
- Front side has precision 12% and 18% gray reference for white balance plus 18-color patches for superior digital color correction
- Array of 18 color patches with natural, chromatic, primary and gray scale colors, arranged in three rows.
- Reverse side has warm card for fast, easy "warm" white balance improve skin tones and eliminate cold "electronic" look
- Card is 100% waterproof with permanent imbedded color for outdoor, underwater, and on-location use.

…and waterproof

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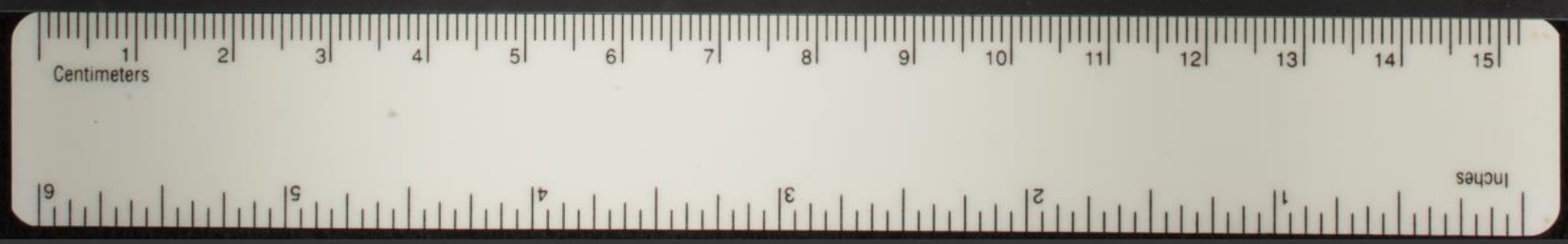
www.dgkcolortools.com



why raw?

jpeg: 8-bit
raw 12 or 14 bit

why raw?

why raw?

adjustments in Lightroom to: exposure, white balance, highlights, shadow

background: Photoshop

Camera Settings

custom white balance from gray card

lowest ISO, auto ISO off

spot metering (on specimen, usually center-spot)

Aperture Priority mode at f/11 or f/16

single focus point (usually center)

shoot in raw mode

cable release, software control, or timer


EPSON
Epson Perfection V850 Pro
ICE
CU 91854
CU 91854


CU 91854
Centimeters
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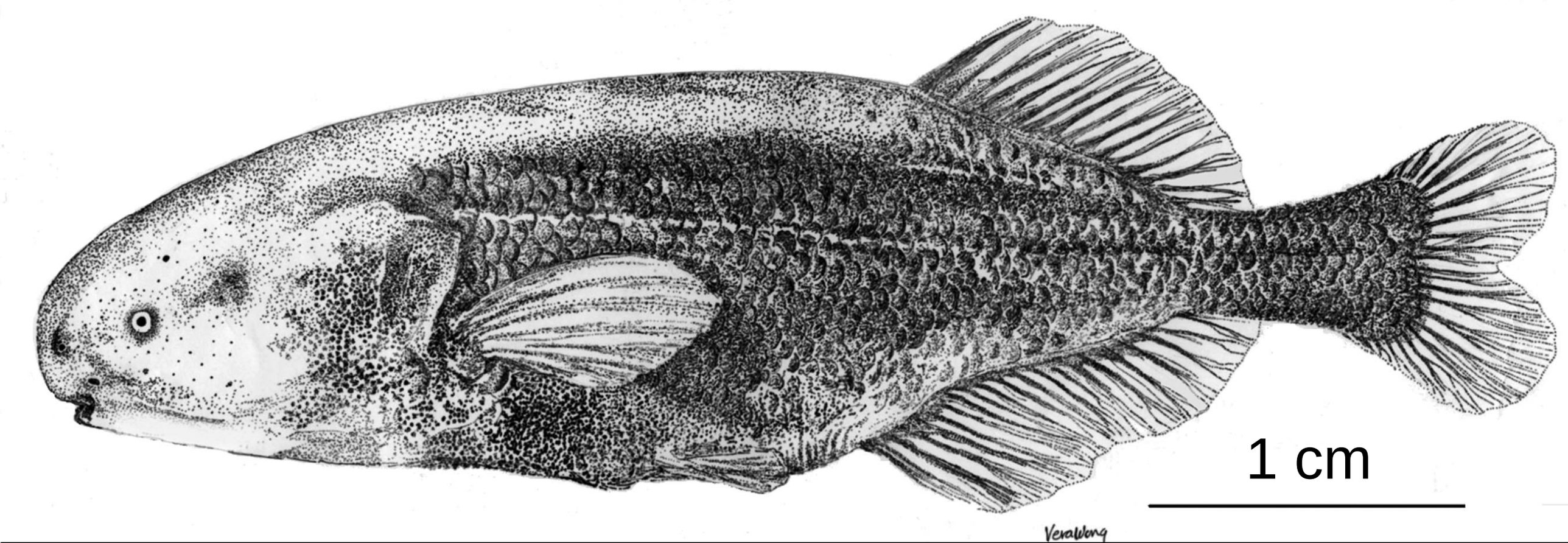

Stomatorhinus ivindoensis Sullivan & Hopkins 2004 holotype

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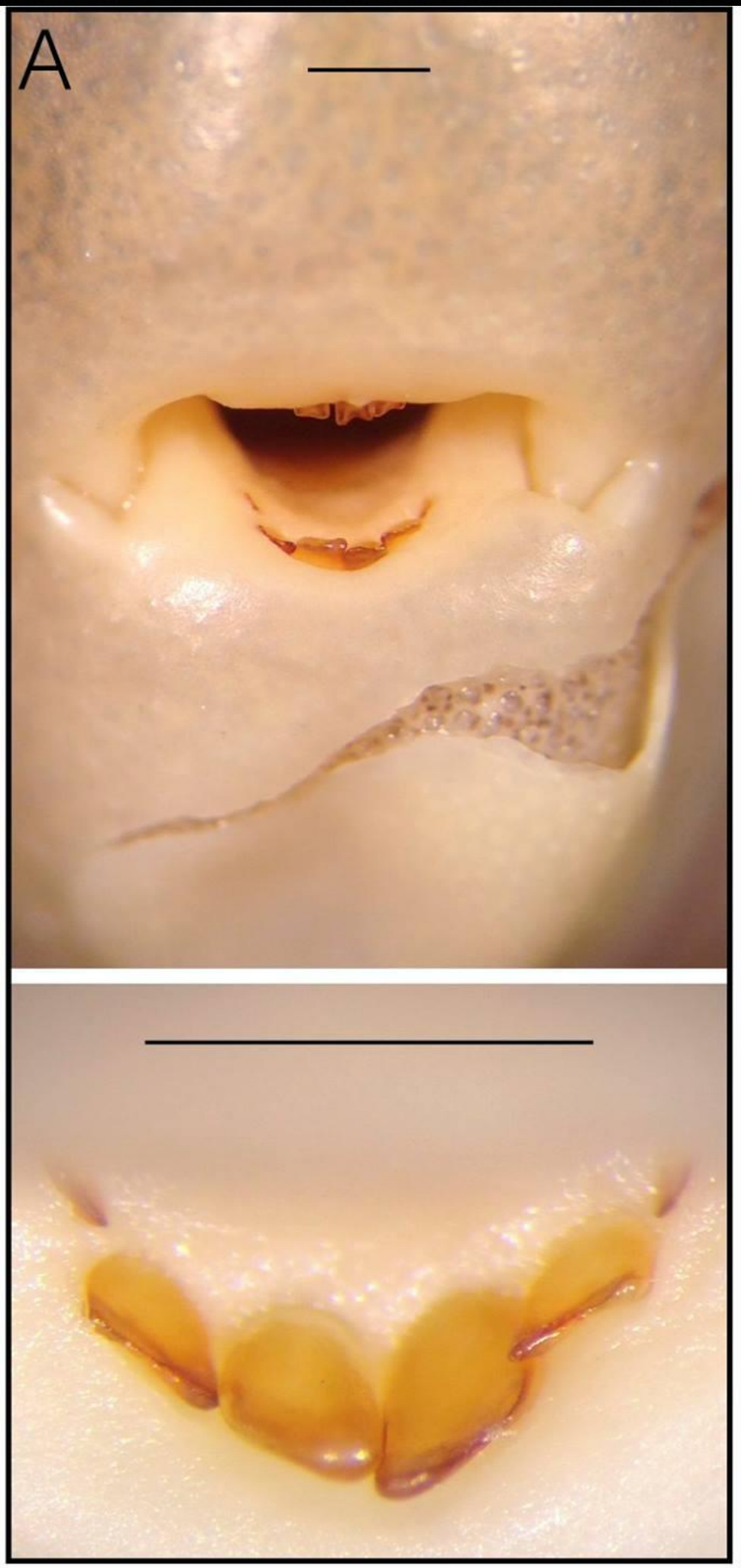
HEERBRUGG

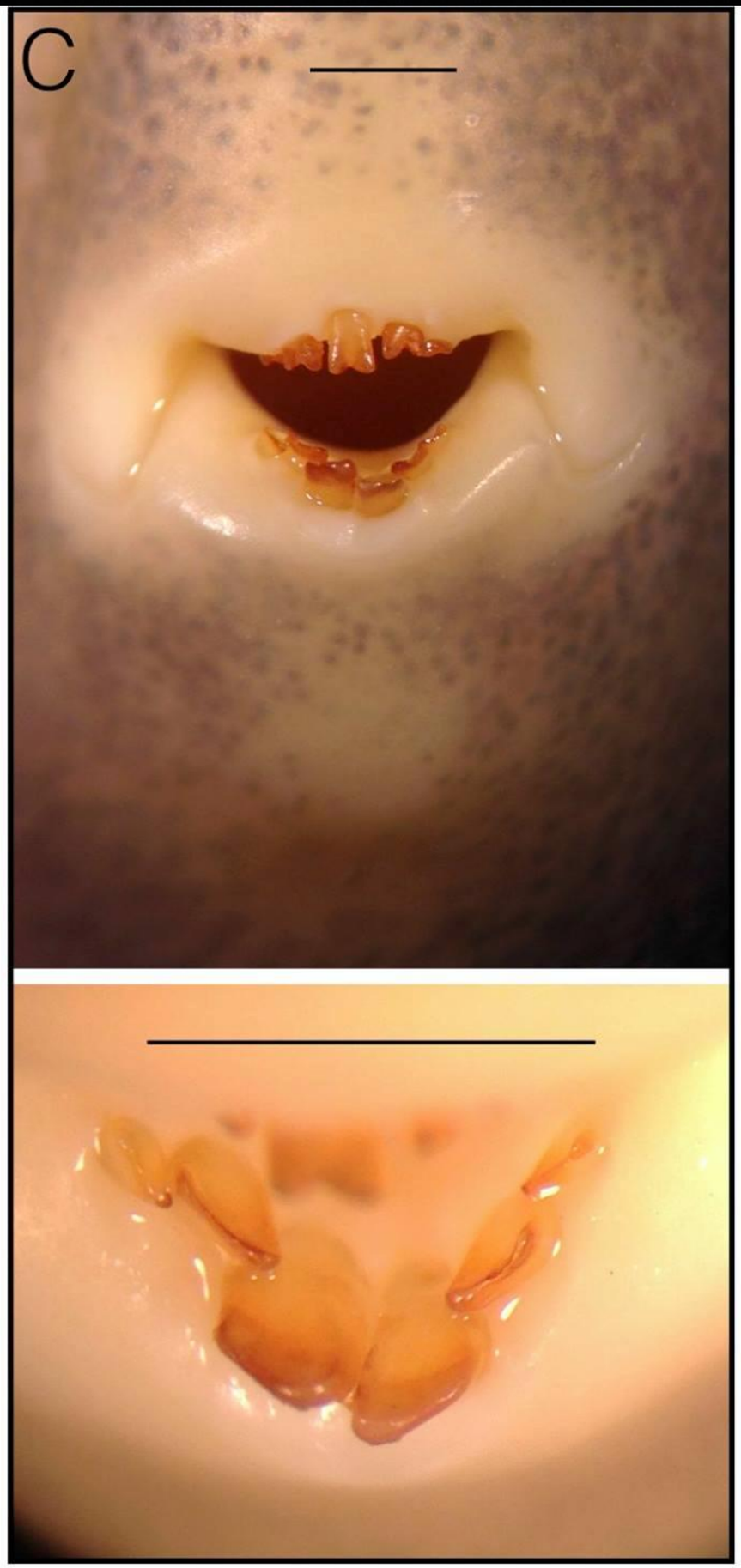
The Procamera app

- full manual control of camera
- uncompressed TIFF files
- separate positionable metering and focus points

http://www.procamera-app.com/


A


B


C

Manfrotto magic arm


Nikon

Magic Arm

amazon Prime

All | manfrotto magic arm

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Roll over image to zoom in

Manfrotto 143 Magic Arm Kit with Umbrella Bracket Super Clamp and Backlite Base

by Manfrotto

16 customer reviews

List Price: $176.49
Price: $153.88 Prime
You Save: $22.61 (13%)

Only 12 left in stock.

Want it Tuesday, March 22? Order within **27 hrs 40 mins** and choose **One-Day Shipping** at checkout. Details

Sold by Focus Camera and Fulfilled by Amazon. Gift-wrap available.

- Gives great flexibility in positioning a camera or small light.
- SuperClamp allows attachment to many different poles and surfaces.
- Backlight base lets you set up on the floor.
- Articulated arm allows infinite positioning capabilities.

17 new from $153.88

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Focus stacking

Helicon Focus 6.6.1 - Trial (16 days left)

Render

Rendering | Retouching | Text/Scale | Saving

Focus parameters

Source images (7):

- Img0108.jpg 2016-04-01 11:03 AM
- Img0109.jpg 2016-04-01 11:03 AM
- Img0110.jpg 2016-04-01 11:03 AM
- Img0111.jpg 2016-04-01 11:03 AM
- Img0112.jpg 2016-04-01 11:03 AM

Rendering method:

- Method A (weighted average)
- Method B (depth map)
- Method C (pyramid)

Downscaling: Full resolution (100%)

Radius: 8

Smoothing: 4

Reset | Render

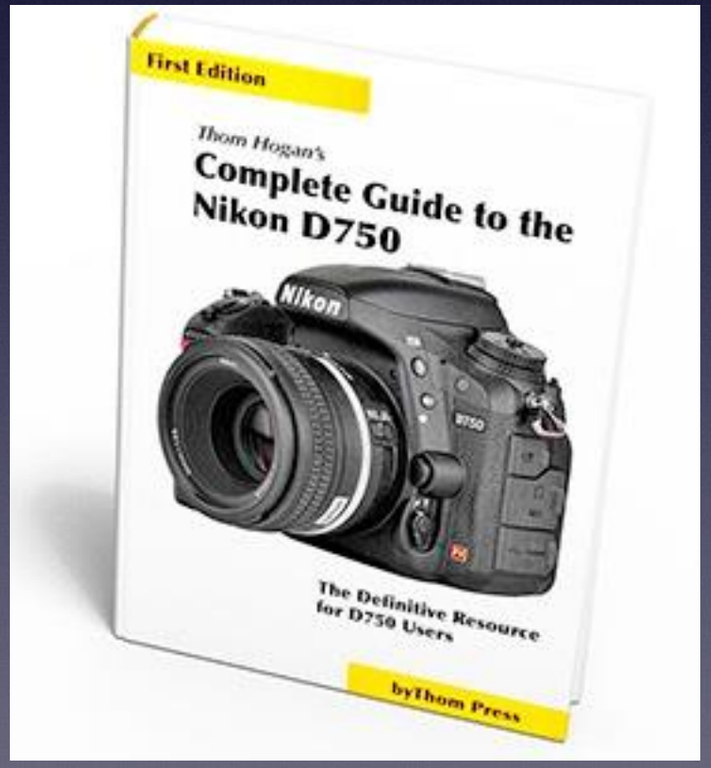
Outputs

post-processing in Helicon Focus

Recommended guides to Nikon cameras

Thom Hogan

http://www.bythom.com/



MK Digital PhotoBox Plus

$1300

worth it? not for fishes

Thanks!