

# Digital Photography 101: Camera Basics 4.0: Image files: Size, Pixels, Resolution and Type



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File size – measure of computer processor storage

1 Byte = 8 bits

Kilobytes (KB) thousand: 1000 bytes

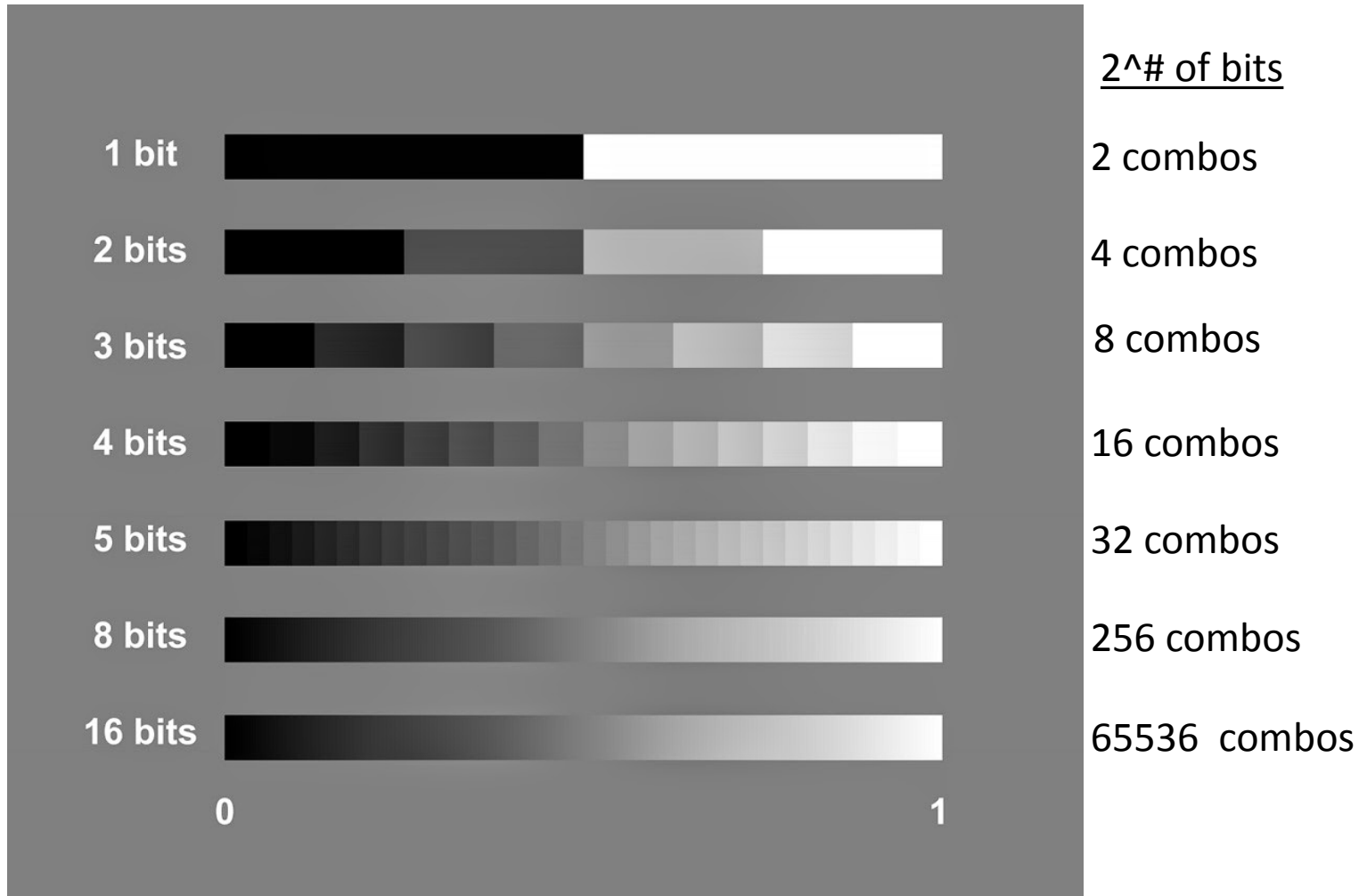
Megabyte (MB) million: 1,000,000 bytes

Gigabyte (GB) billion: 1,000,000,000 bytes

Terabyte (TB) trillion: 1,000,000,000,000 bytes

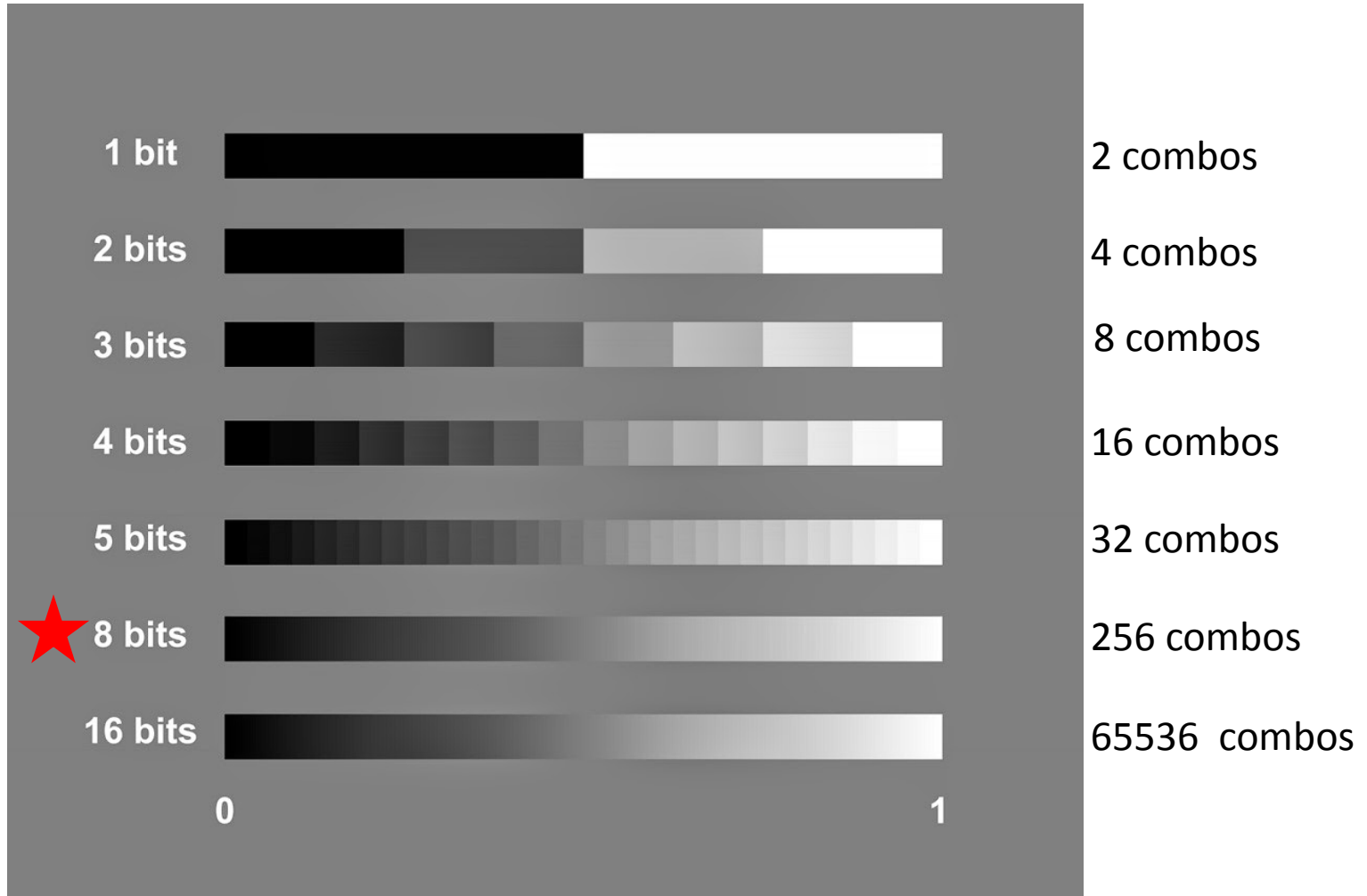
# Digital storage

- **Bit**: Binary digit (0 or 1), basic unit of storing digital information



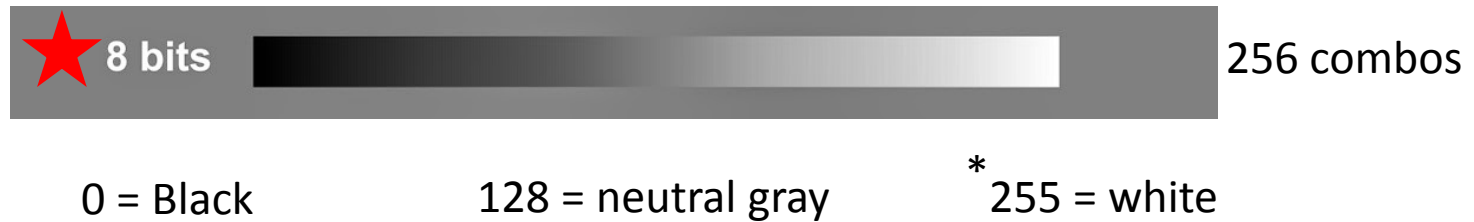
# Digital storage

- Standard for digital operation is 8 bits = 1 byte = 256 possible values



# Digital storage

- Grayscale image: 1 byte = 8 bits = 256 possible values = **1 pixel**

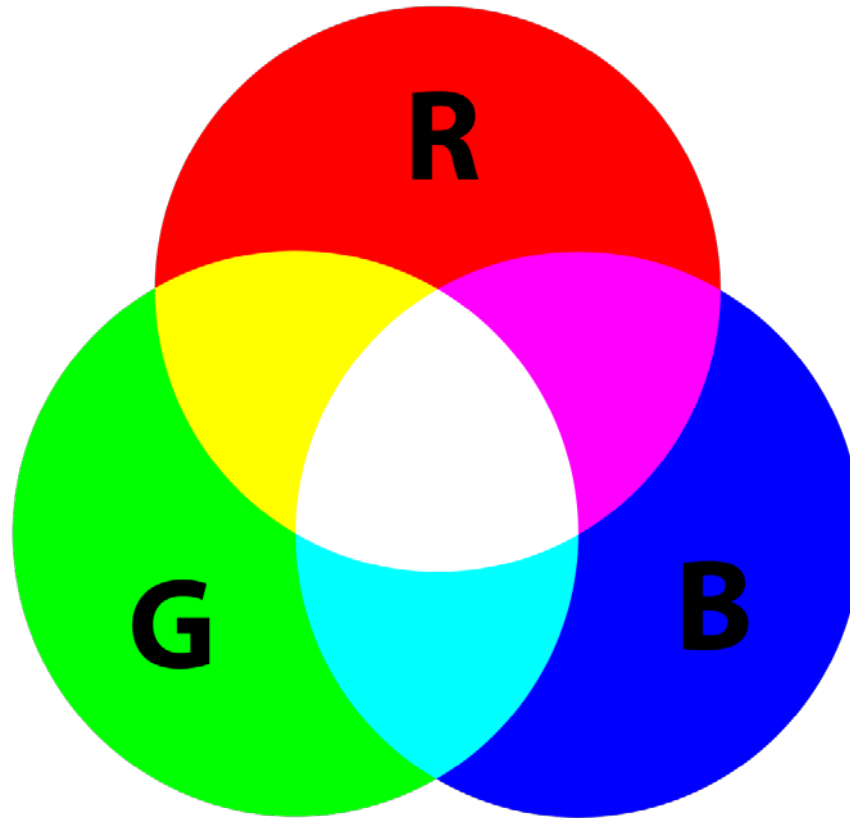


Each number represents the tonal value captured

\*  
White color calculated as possible shades (-) 1

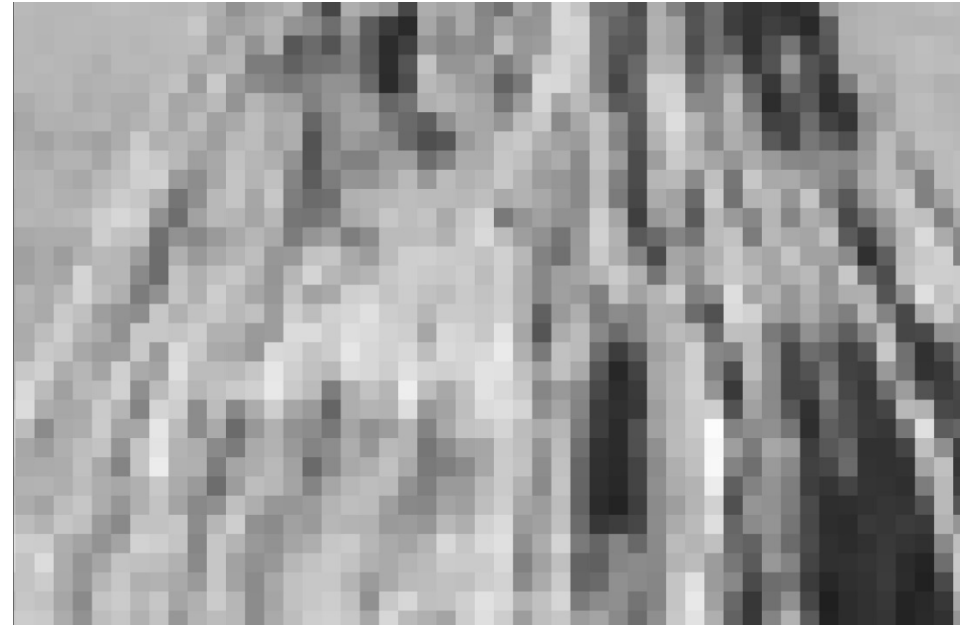
# Digital storage

- Color image:
  - 3 bytes (1 byte per color channel RGB)
  - = 24 bits ( or three 8-bit)
  - =  $256 \times 256 \times 256 = 16,777,216$  possible color definitions!
  - = **1 pixel**



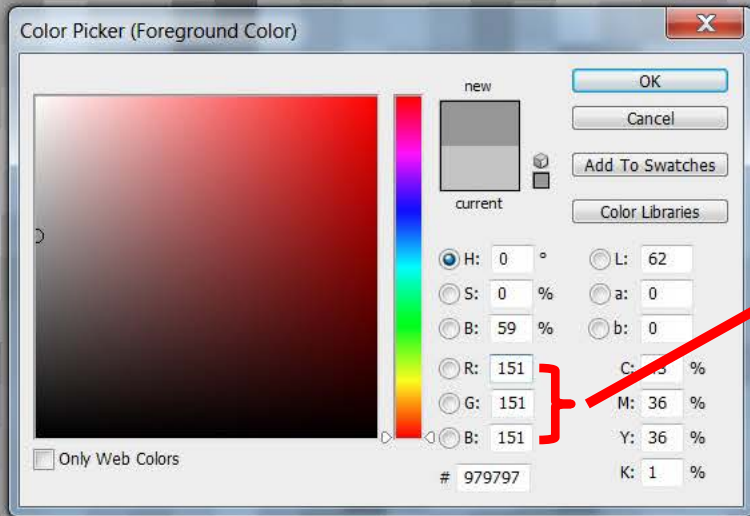
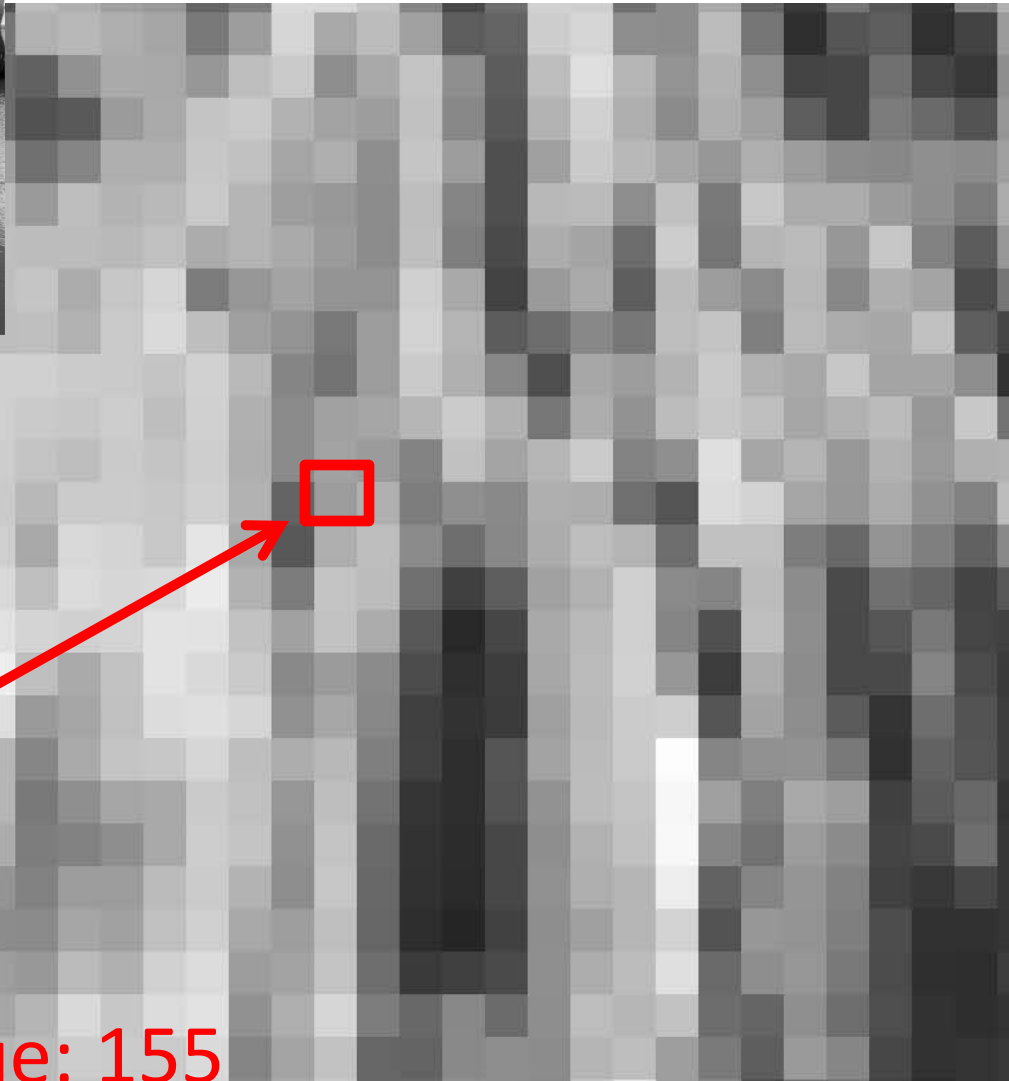
Each number represents the tonal value captured

**Pixels** - Smallest unit of information that makes up a digital picture



- Number of pixels is equivalent to number of photo sites on camera sensor
- Corresponds to any one value (e.g., 8-bit gray, tonal value between 0-255)
- Value corresponds to the light photon intensity that strikes the sensor

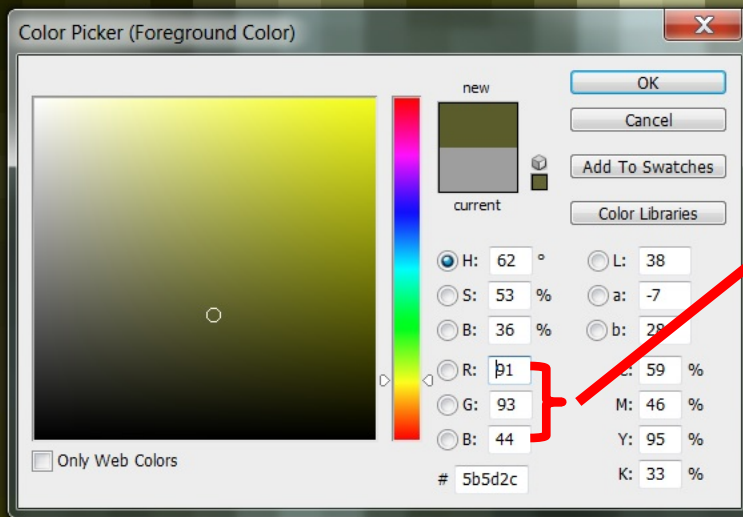
8-bit gray, single value per pixel  
0-255



Value: 155



24-bit color, 3 RGB values per pixel  
256x256x256



Value:  
R: 91  
G: 93  
B: 44

# Pixels

- Total number of pixels = coordinate pair of rows and columns in the sensor
- E.g., pixel value of (0)

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

How many pixels?

What would the image look like?

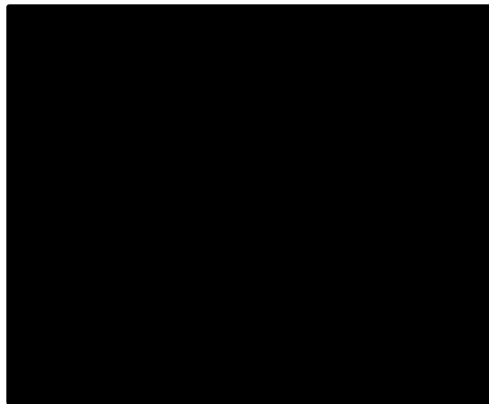
4 columns

4 rows

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

**16 pixels**

**0 = black**



# Pixels

Horizontal dimension (W) x  
Vertical dimension (H)

=

3456W x 5184H

=

17,915,904 pixels

=

18 Megapixels (MP)

5184  
pixels

3456 pixels



# Pixels

- Do not have a fixed size only a fixed number

5184  
pixels



3456 pixels

5184  
pixels



3456 pixels

Resolution = Amount of detail (information)  
an image contains

- Camera resolution = Megapixels
- Image file resolution = Pixel dimensions and PPI
- Monitor resolution = Pixel dimensions and/or PPI
- Printer resolution = DPI

Resolution = Amount of detail (information)  
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- Camera resolution = Megapixels
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- Monitor resolution = Pixel dimensions and/or PPI
- Printer resolution = DPI

# Image file resolution How large an image can be reproduced

- **Pixel dimensions – original number of pixels in image**

H: 2090  
pixels

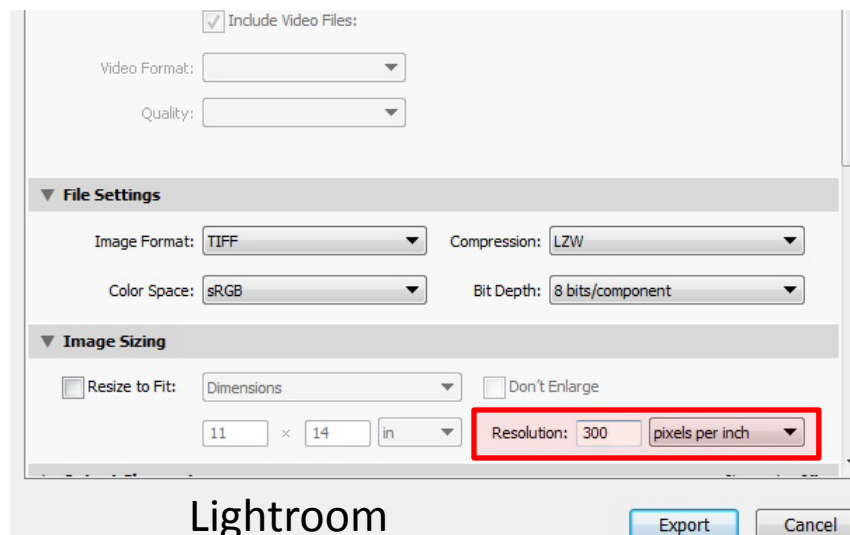
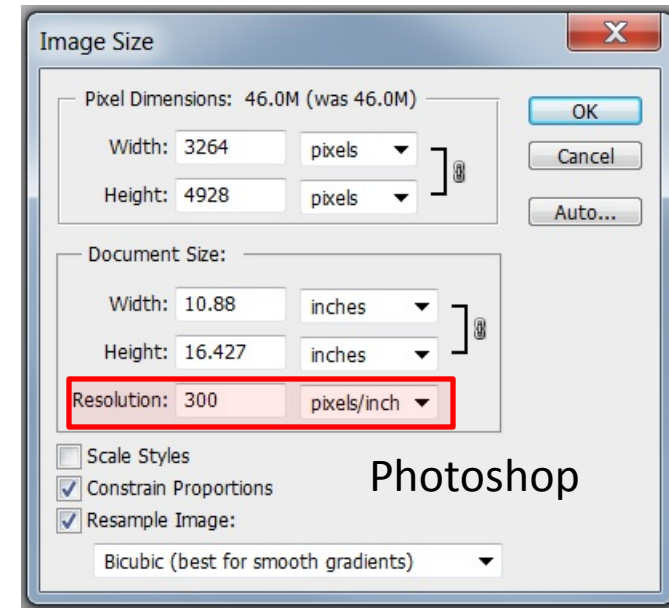


W: 5070 pixels



# PPI – Pixels per Inch

- Measurement of Pixel density
- Digital camera or display device
- Not the same as DPI, although used interchangeably
- Can be changed in Photoshop, Lightroom, Digital Photo Professional etc.



# Image file resolution

- **Pixel dimensions in image / PPI = Document size**

300 PPI

H: 2090  
pixels /  
300 PPI  
  
= 6.97" H



W: 5070 pixels / 300 PPI = 16.9" W

# Image file resolution

- **Pixel dimensions in image / PPI = Document size**

10 PPI

H: 2090  
pixels /  
10 PPI

= 507" H



W: 5070 pixels / 10 PPI = 209" W

10 PPI



300 PPI



# 5070W x 2090H Pixels

PPI only effects printing size



10 PPI

Resulting print  
size:

209" W

507" H



300 PPI

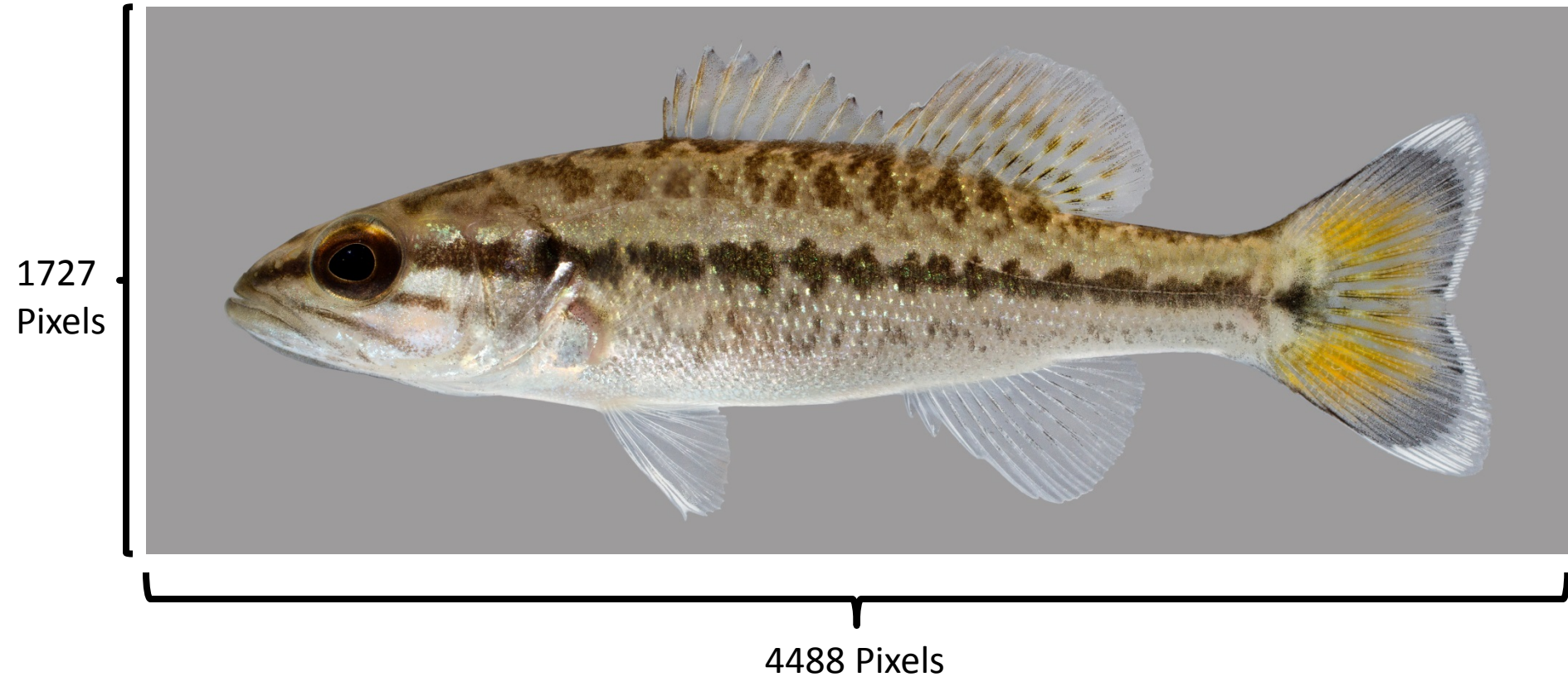
Resulting print  
size:

16.9" W

6.97" H

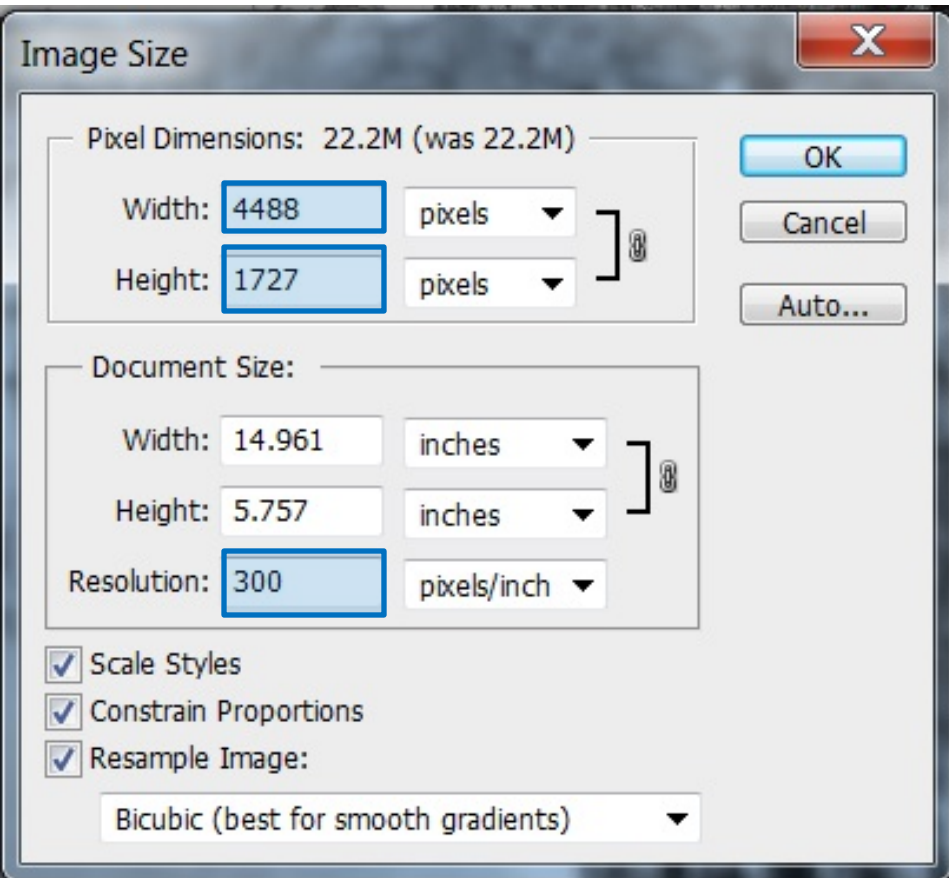
# Changing pixel count

Resolution comes down to pixel count!

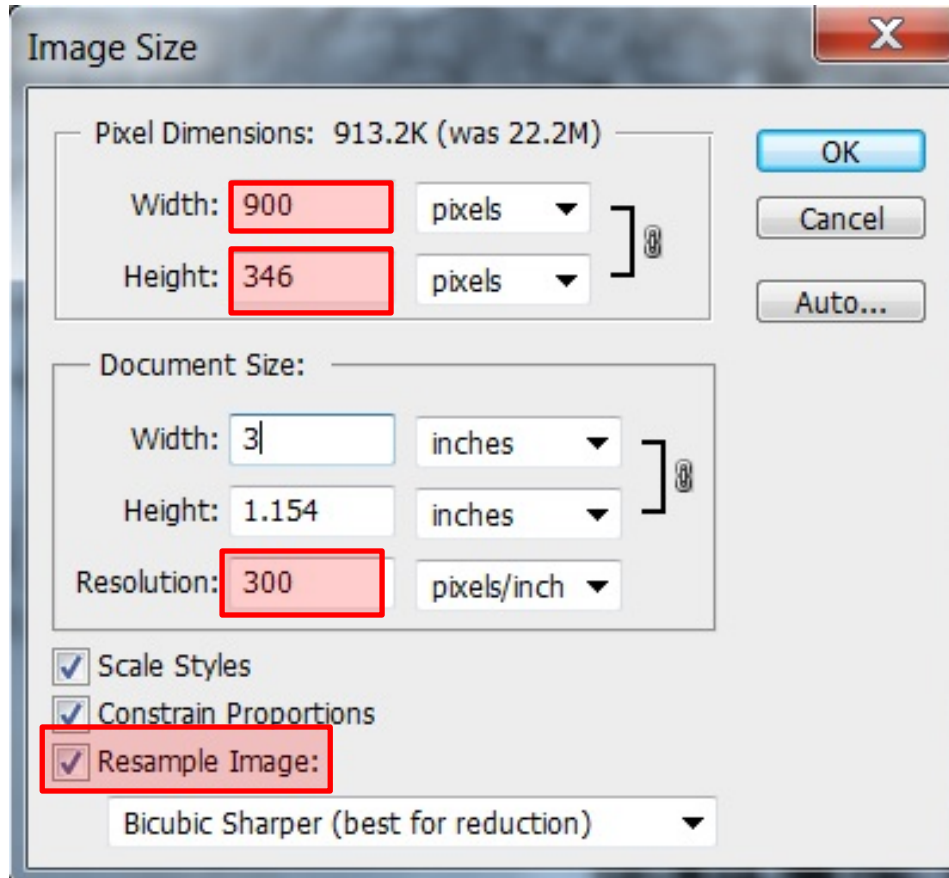


# Changing pixel count

Original image



Re-sized image to 3 inches



**Changing original width to 3" and keeping same PPI at 300 will reduce pixel dimension!**

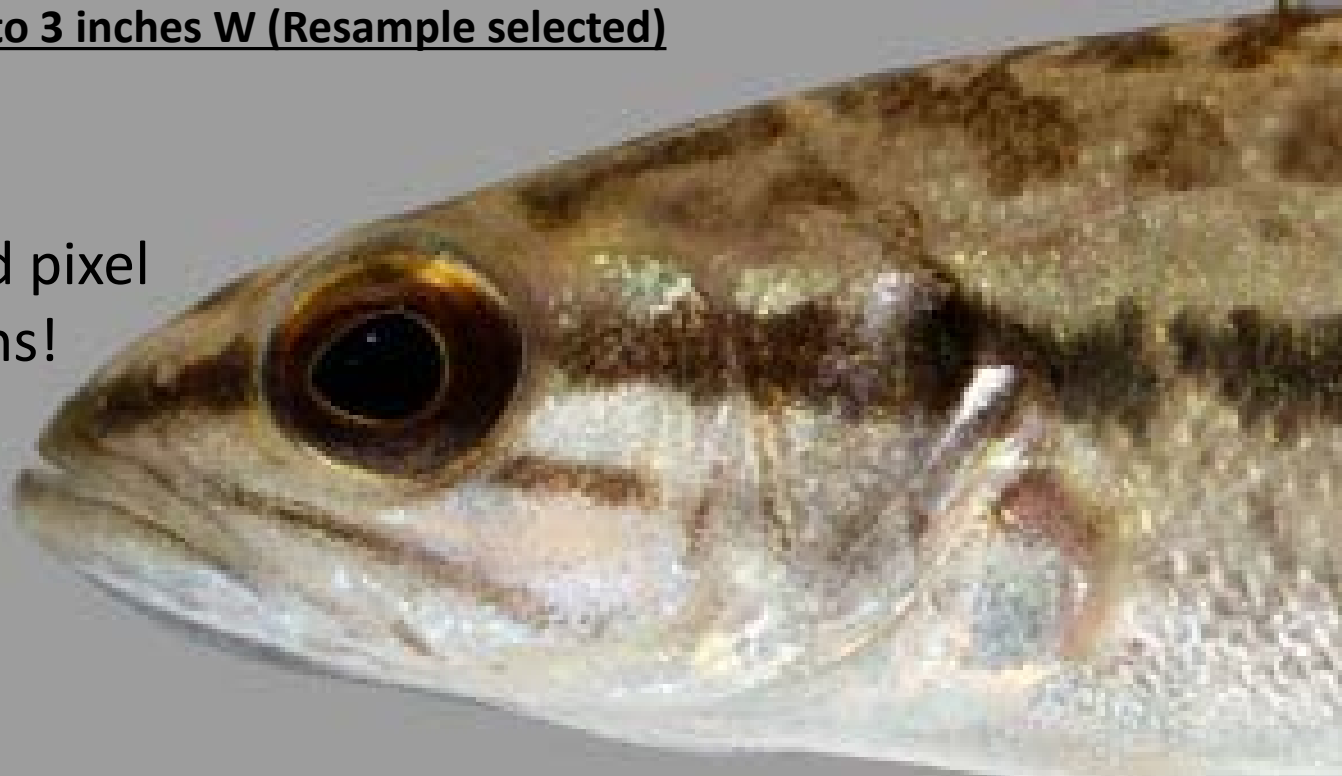
Original image 15 inches W



Re-sized image to 3 inches W (Resample selected)

Results:

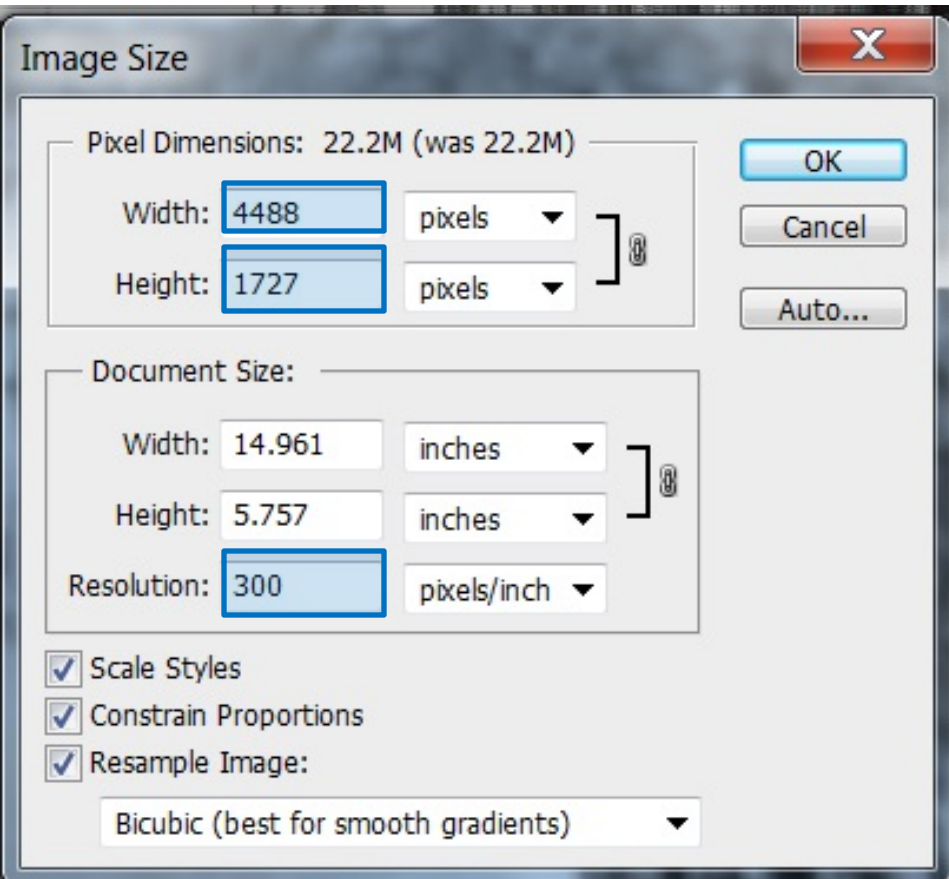
- Same PPI
- Decreased pixel dimensions!



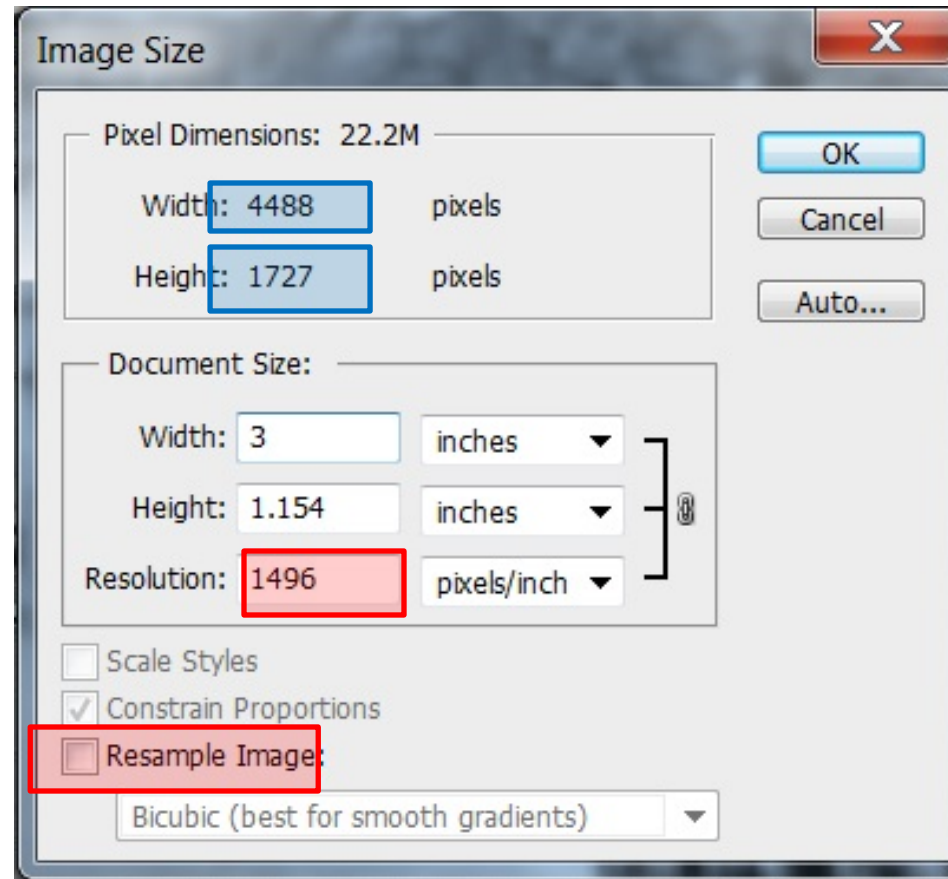


# Changing pixel count

Original image



Re-sized image to 3 inches



Changing original width to 3" with "Resample image" selected will keep the original pixel dimensions, increasing the PPI.

Original image 15 inches W



Re-sized image to 3 inches W (Resample **unselected**)

Results:

- Larger PPI
- Original pixel dimensions!



# DPI – Dots Per Inch = Physical dot density

- Only recognized in software applications designed for preparing print material
- Measurement of the image on the printed page
- 1 to 1 ratio (1 pixel per printer dot) only applicable to scanners. Modern printers use a blended dot.

# Image Requests

- When someone request an image to be 300 DPI they mean PPI!!
- Request largest pixel dimension possible
- Always save an original archival copy when choosing to downsize an image!
- Resize image by unselecting “resample image” in Photoshop



Plate 227.tif



Plate 228.tif



Plate 229.tif



Plate 230.tif



Plate 205.tif Date taken: 3/1/2017 11:26 AM

TIF File

Tags: Add a tag

Rating: ☆☆☆☆☆

Dimensions: 4725 x 4900

Size: 106 MB

Title: Add a title

# Image resolution and quality

**Doesn't only depend on sensor size (i.e. pixel dimensions)**

- Proper exposure
- Lens quality
- Image file format and post processing

# Lossless & Lossy compression

**Lossless compression** – algorithm that preserves a perfect copy of an original image while reducing file size (e.g., Tiff)

**Lossy compression** – algorithm that doesn't preserve a perfect copy of original image while reducing file size (e.g., JPEG)

- Smaller file size than lossless compression

# Image File Formats - JPEG

- **JPEG** – Joint Photographic Experts Group
  - Lossy format - Reduces file size by removing information from the file (e.g., blending image pixels)
  - Small file size, universal file and easy to handle
  - In camera can set quality (pixel dimensions)
    - E.g., 5184x3456 (18MP) or 3456x2304 (10MP) or 2592x1728 (4.5MP)
  - Image file (post processing) can select image quality (size)
    - Low quality = high compression
    - Medium quality = moderate compression
    - High quality = low compression



High compression = 138 KB

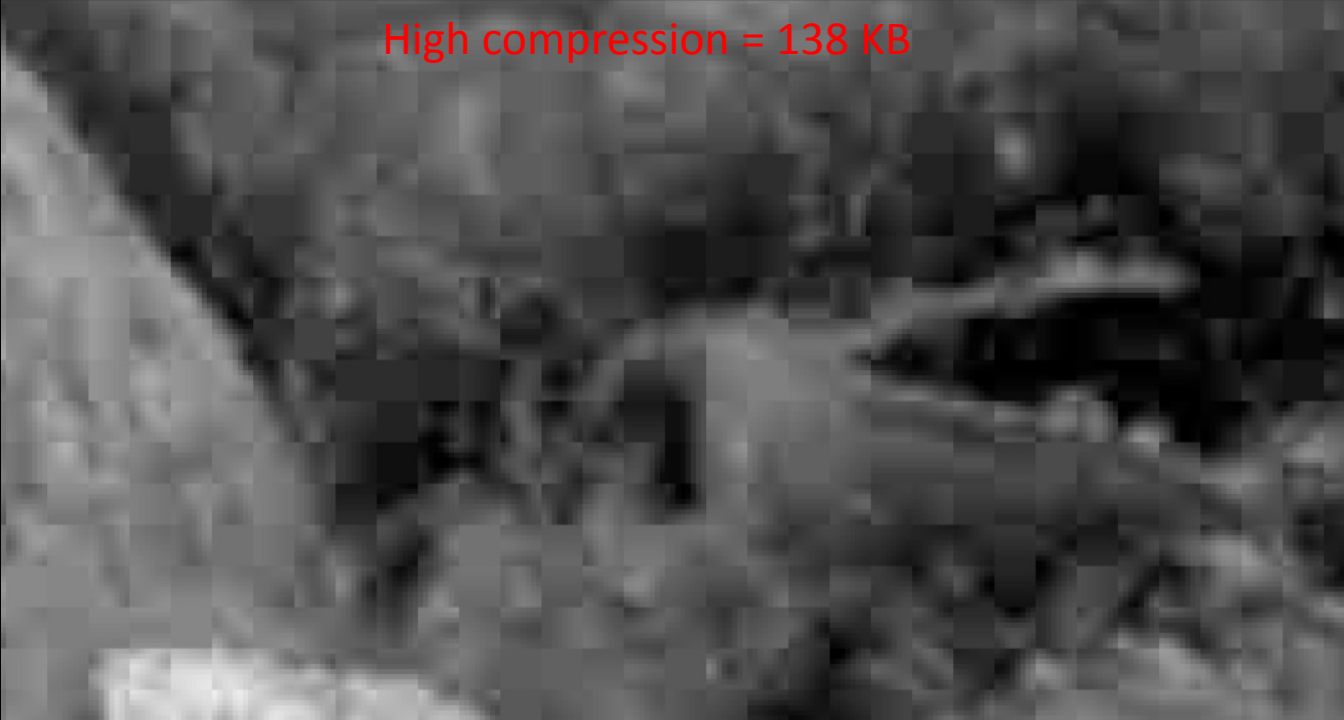
Low compression = 368 KB





High compression = 138 KB

JPEG



Low compression = 368 KB



# Lossy format in action

- Resaving JPEG images result in degradation of quality
- E.g. [Video of JPEG image being saved 600 times!](https://vimeo.com/3750507)

<https://vimeo.com/3750507>

# Image File Formats -TIFF

- TIFF – Tag Image File Format

- Usually lossless format - No pixels are modified in the image to reduce file size
- Large file size, Not web browser compatible
- In camera (not as common) no compression
- Image file (Post processing) can select option of compression
  - No Compression = Large file size (larger with layers)
  - LZW (lossless) = Quicker save speed, smaller files size (8-bit files, 16-bit files are larger than with no compression)
  - ZIP (lossless) = Longer save speed, smaller file size (16-bit files)
  - JPEG (lossy) = Results in smallest file size but LOSSY (avoid)!

# Image File Formats -RAW

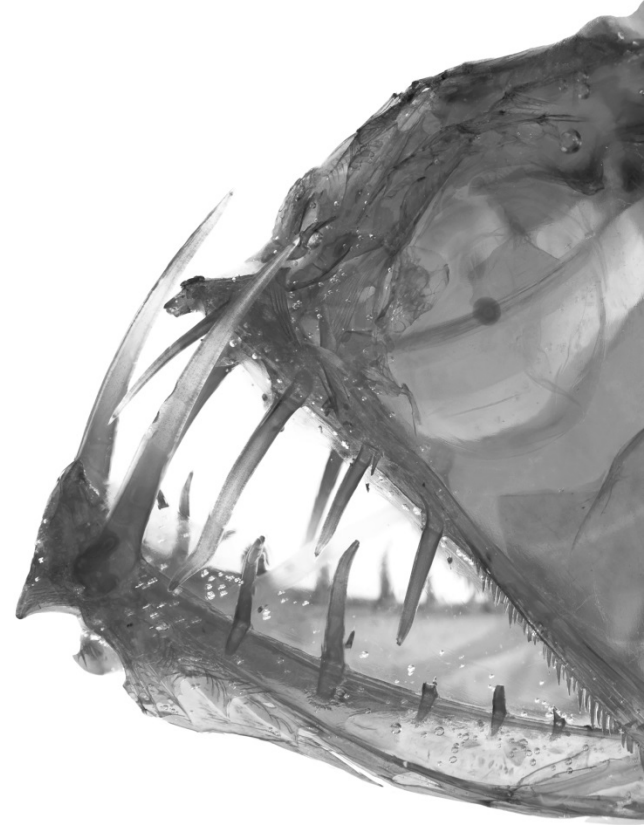
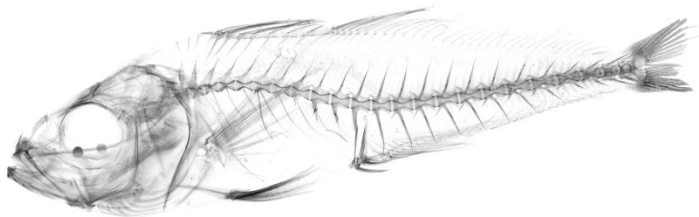
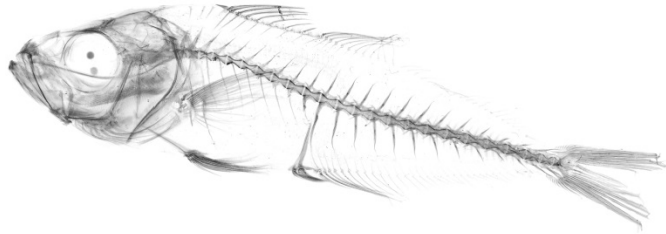
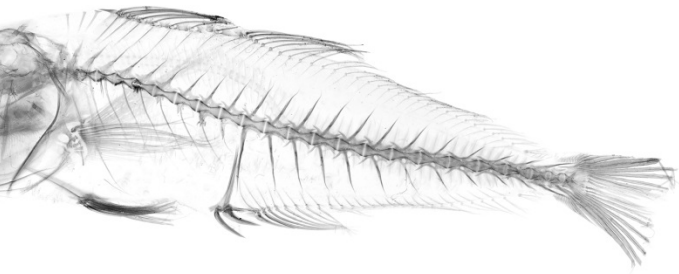
- RAW – Digital Negative
  - In camera can set quality (pixel dimensions)
    - E.g., 5184x3456 (18MP) or 3456x2304 (10MP) or 2592x1728 (4.5MP)
  - Lossless format – Preserves all of original data
  - Large file size
  - Incompatible web browser, Not all software can view files
  - In camera – Proprietary e.g., CR2 (Canon), NEF (Nikon)
  - Image file should be converted to other file type
    - DNG = An alternative raw format that is compatible with popular software, generally smaller file size
  - Requires extra step to be rendered into usable file type
    - TIFF = lossless = Editing file
    - JPEG (lossy)
  - Non-destructive editing



## Camera output:

- JPEG: Processed by camera software including sharpness, contrast, saturation, and white balance etc.
- RAW: unprocessed image captured from the sensor, all parameters added in post processing at photographers discretion (e.g., Lightroom, Digital Photo Professional)

# Questions?



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# File size trade off

In camera (8 GB card, 18 MP = 5184x3456 pixels)

- RAW: 319 images
- JPEG: 999 images

File size:

- JPEG: 3-7 MB (18MP), 1-7 MB depending on pixel dimension selected
- RAW: 25 MB (18MP), 11-17 MB depending on pixel dimension selected