Macro and Close-up Photography

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What is macro photography?

Macro - <Gr *macros*, long> *combining form*, long (in extent or duration), large, enlarged or elongated (in a specific part)

Macro photography (JRS) – taking big pictures of small things.

Macro Photography Math

When you read about macro photography, it is helpful to understand what people talk about when they are talking about magnification ratios such as 1:2, 1:1 and 2:1. These ratios give the magnification of the image on film/sensor compared to the magnification of the image in real life or:

Image size on film/sensor : real object size

So, a 1:2 ratio means that the size of the image on the sensor is ½ that of the size of the original object. The object has been magnified ½ X.

A ratio of 1:1 means that the size of the image on the film or sensor is the exact same size as the size of the real object. Image a postage stamp that is 1" by 1.5". This is the same size as a frame of 35mm film and the size of the frame of a full size digital sensor. This means that the postage stamp will just cover the film or sensor.

A ration of 2:1 means that the image on the film/sensor is twice that of real life. Stated another way, the image has been magnified in size two times or 2X.

Other Definitions of Macro Photography

Here are some other definitions of macro photography that I found on the web. Note that they use these magnification ratios.

Macro photography - Production of images on film that are life-size or larger. http://www.sederquist.com/clagloss.html

Macro photography - Also known as 'photomacrography', this is the process of taking photos of small objects with a regular photographic lens at reproduction rations of 1x or greater. http://www.camerahouse.com.au/newsite/glossaryk.asp

Macro photography is a type of close-up photography. The classical definition is photography in which the image on film or electronic sensor is as large or larger than the subject. Therefore, on 35mm film (for example), the camera has to have the ability to focus on an area at least as small as 24×36 mm, as this is the size of the image on the film. http://en.wikipedia.org/wiki/Macro_photography

Taking close-up pictures of small things is called "macro photography." http://www.photo.net/learn/macro/

The term "macro" is used very loosely and tends to mean any photographic situation where you get close to the subject. Real macro photography is where you are working around 1:1 ratio and closer thereby giving an image on film that is equal in size or larger than the subject being photographed. The range from life size on film (1:1) up to ten times enlargement on film (10:1) is be the strict definition of

macro photography. The range from 1:10 (1/10 life size on film) to 1:1 on film should properly be called "close-up" photography. http://homepages.ihug.com.au/~parsog/photo/macro.html

Tools for Macro Photography

Look at a normal/ 50mm lens focused (the black dot on the silver ring) at infinity (L) and at its closest distance (R.)

First of all, you will notice that this lens only focuses to about 18". This is close focus, but not close enough for macro photography. Notice also that the lens is **longer** when it is focused at its closest. That is the key to macro photography. To get close, you extend the distance between the front glass and the plane of focus. There are two ways that this is done: with an optical device that adds optical distance and with a physical object that extends the physical distance. Let's look at each.

Diopters: A diopter is a magnifying lens. Here's the Wickipedia (http://en.wikipedia.org/wiki/Dioptre) definition, "A **diopters**, or **diopters**, is a non-SI unit of measurement of the optical power of a lens or curved mirror, which is equal to the reciprocal of the focal length measured in meters (i.e. 1/meters). For example, a 3-diopter lens brings parallel rays of light to focus at 1/3 meter." Here are two:

Diopters are meant to be used with telephoto lenses. They can be used with either fixed focal length or zoom lenses. Be aware that they are not all the same quality. Avoid less expensive the single- element lenses. Both Nikon and Canon make high quality two-element diopters. Nikon's are the 3T, 4T, 5T, and 6T. The 3T and 4T have 52mm threads and the 5T and 6T have 62mm threads. The 3T and 5T are +1.5 diopters. The 4T and 6T are +2.9 diopters. Canon makes the 250D and the 500D. The 250D comes in 52 and 58mm threads and the 500D comes in 52, 58, 72, and 77mm threads. The 250D is to

be used with lenses of 30 to 135mm focal length and the 500D is to be used with lenses of 70 to 300mm focal length.

Extension Tubes and Bellows: We have already seen that physical extension of a lens allows it to focus more closely. One way to do this is with extension tubes. Here are some of Nikon's:

Extension tubes are added between the camera body and the lens. They contain no glass, so they do not degrade image quality. The do, however, result in light loss. Bellows do the same, except that they allow greater extension and a variable length of extension.

Reversing Rings: A reversing ring mounts between your camera body and a lens. As the name says, these are used to reverse a lens.

Teleconverters: A teleconverter adds magnification to a lens. Typical magnifications are 1.4X and 2.0X. These allow you to gain working distance from your subject.

Macro Lens: The easiest way to do photography is with a macro lens. Unfortunately, this is also the most expensive way to do so. Macro lenses are built so that they have great extension already built into the lens. Older Nikon macro lenses would focus down to 1:2 by themselves and to 1:1 with an added extension tube. Newer lenses focus to 1:1 by themselves.

Stacked Lens: It is possible to go beyond 1:1 magnification by reversing one lens on the end of another. Here is an example:

Typically a 100mm to 200mm lens is attached to the camera body. The magnification is determined by dividing the focal length of the lens that is attached to the body (the "near lens) by the focal length of the lens that is reversed (the "end" lens.) In the picture above:

105mm/50mm = 2.1 magnification

Folks, that's a lot of magnification! One problem with this setup is vignetting. Be sure that the aperture of the "end" lens is open fully. Stop the "near" lens down and check the corner of the frames.

In my experiences, zoom lenses don't work well for this technique.

Combinations: It is often possible to combine the different magnification techniques. For example, diopters can be added to your macro lens. Teleconverters and extension tubes can be used together. Try a combination and see if it works!

Benefits and Drawbacks of Macro Photography Tools: This table shows some benefits and drawbacks to each of the macro techniques.

Tool:	Diopters	Extension Tubes and Bellows	Reversing Rings	Teleconverters	Macro lens
Benefits:	• Low cost • Ease of use • Low quality loss with double-element diopters	• Low cost • Ease of use • No image degradation • Can be used with long lenses (300mm +) to gain closer working distance.	• Low cost • Ease of use • No image degradation	• Ease of use • Increases working distance	• Ease of use • Focuses to 1:1 by itself • No image degradation
Drawbacks:	• Single-element diopters cause loss of image quality	• Light loss • Loss of infinity focus • Loss of electrical contact with modern camera bodies with older tubes.	• Loss of electrical contact with modern camera bodies • The rear element is exposed • Loss of infinity focus • Very close working distances	• Moderate cost • Light loss of 1 stop with 1.4x and of 2 stops with 2x • Image degradation at 2x and higher magnification	• High cost • As with any form of extension, causes light loss at higher lengths

Additional Considerations

- **Amount of Light:** One of concerns with macro photography is lighting. When you take an image of a very small object, well … a small amount of light is available. The solution is often to use additional light in the form of one or more flashes. Use TTL flash connected to your camera body with your manufacturer's cables.

- **Quality of Light:** Photography is about light. As with any other type of photography, the quality of light affects the quality of your images. A sunny day is usually the worst time of day to do nature

macro photography. If you find that the light is harsh, then use a diffuser to soften it. Consider also using one or more reflectors.

- **Cross-Polarization:** Many objects are reflective. If you add a flash to illuminate a subject, you often get unwanted specular highlights. While a polarizer may cut out some of those highlights, it will not eliminate them. Enter cross-polarization! (To do this technique, you'll have to get some polarizing screen. I bought mine at Edmond Scientific. You will also need two high output flashes and the equipment to connect them to your camera.) Normal light has rays that are directed in all directions. A polarizer stops all of these except for light that is directed in a single plane. Using cross polarization, you use two polarizers that are oriented at right angles to one another. To find how to orient the two polarizers, you hold your lens polarizer up to the polarizer screen. Look through both of these towards a bright light source. Turn the lens polarizer until you see the light go black. Mark this orientation for future reference. Mount the polarizer screen on your two flashes and your lens polarizer on your lens. You're now ready to shoot away.

- **Lens Focal Length:** A lens' focal length is related to its angle of coverage. Wider focal lengths cover greater angles than longer focal lengths. This creates with the picture background in macro photography. In general, a simple "poster board" background will isolate your subject. Use a long focal length lens to limit the background cover. In general, a 100-105mm, 180-200mm, or 300mm lens will give you a much nicer background than a 50-55mm lens.

- **Subject and/or Camera Movement:** Everything is enlarged when you do macro photography. This includes not only the size of your subject, but any movement associated with it. This can be a particular problem in the field. Here are some solutions to this problem:

  - **Hold that camera rock-solid:** This is done by using a quality tripod and head. Don't skimp here. John Shaw says that you should spend as much for a tripod as you would on a good quality lens. If you do, you will find that you change camera bodies and lenses over your career, but you'll still be able to use the same tripod. While we're talking about tripods, forget about using the center column. It changes your tripod into a wiggly monopod.

  - **Watch your shutter speed:** The camera's mirror causes some vibration as it flips up and returns to position. This effect is particularly evident around 1/15 – 1/8 sec. Some cameras have a shutter lockup feature that is very helpful here.

  - **Use a cable release or a self-timer:** The camera moves when the shutter is pressed. After a few seconds, this vibration is dampened. To avoid it, use a cable release or use the self-timer feature of your camera.

- **Depth of Field:** Each camera lens focuses on one plane of focus. On either side of this plane of focus is an area that our eyes perceive as having acceptable focus. This is the depth of field. One of the difficulties of macro photography relates to the fact that depth of field is very narrow at close focus. The higher the magnification, the less depth of field you have! Unless you want shallow depth of field for creative reasons, the way to increase your apparent depth of field is to stop down your aperture. Try settings such as f/11 or f/16 or f/22. You also want to stay away from the smallest apertures where diffraction will lower your image sharpness.

- **Put the Film Plane Parallel to the Important Part of the Subject:** One important trick to maximize your depth of field is to make the film plane of your camera parallel to the most important aspect of your subject. If, for example, you are photographing a butterfly, then you will want to keep your lens plane parallel to the butterfly's wings. When I take pictures of butterflies, I purposely wait until they either open their wings all the way or until they shut their wings to get the shot that I want.

- **Composition:** Lighting and composition may well be the two most important aspects of photography. This rule is as true for macro photography as it is for any other type of photography. In general, you want to SIMPLIFY! Decide what your picture is about. Express it verbally. Say, "This is a picture of _____" where you fill in the blank. Once you have done that, you have gone a long way to improve your photography. Make your picture simple. While you are doing so, be sure to inspect our background carefully. This is where a longer focal length lens really helps.

References

Lepp, George. 1993. Beyond the Basics: Innovative Techniques for Nature Photography. Lepp and Associates, Los Osos, CA

Lepp, George. 1997. Beyond the Basics II: More Innovative Techniques for Nature Photography. Lepp and Associates, Los Osos, CA

Martin, Gilles. 2003. Macrophotography: Learning from a Master. Harry N. Abrams, Inc., N.Y., NY

Shaw, John. 1987. John Shaw's Closeups in Nature. Amphoto, N.Y., NY