Digital Photography for Plant Identification and Problem Diagnosis

by Lena Struwe and Peter Nitzsche

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shortened version, only select slides

lena.struwe@rutgers.edu
nitzsche@njaes.rutgers.edu

Ranunculus (buttercup) (cc) Lena Struwe

RUTGERS
New Jersey Agricultural Experiment Station

RUTGERS
School of Environmental and Biological Sciences

Biodocumentation photos should be :

- **INFORMATIVE and CONTENT-RICH**
- **CLEAR and NOT MESSY**
- **IN FOCUS**
- **ZOOMED IN/CROPPED** (if needed)

PHOTO GOALS

and should have:

- **GOOD RESOLUTION**
- **RIGHT EXPOSURE (ENOUGH LIGHT/TIME)**
- **A SENSE OF SCALE AND SIZE**

The basics of photography – digital cameras

- DSLR – digital single lens reflex camera with removable lenses
- Point-and-shoot and compact cameras (various models)

Photos (cc) Lena Struwe

DSLR with combo zoom and macro lens

Compact digital cameras, some with macro

The basics of photography – smartphone cameras

- Samsung, iPhone, other brands.
- Camera quality varies, better each year.
- Fewer settings before you take your photo.
- Editing after you take the photo.

The best camera is the one you carry with you at most times. Think about weight and size and what you can put in your pocket.

Photo (cc) Lena Struwe

The basics of photography – tripods: tall, medium, mini

Usually not necessary for everyday photos

Tripod adapter screws into bottom of camera

Attachments for smartphones available

Photos (cc) Lena Struwe

Clean your lens!

- It is dirtier than you think.
- Use professional tools for cleaning if you can.
- Lens paper, cloth, brush, compressed air.
- Clean your smartphone lens at regular intervals too.
- DSLR – occasionally clean your sensor.

Check your battery!

(Carry an extra?)

Traveling lens cloth, washable and stuffable into its own little pocket.

Photo (cc) Lena Struwe

Exposure: F-STOP, Shutter Speed, and ISO

- **F-stop (F-number)** regulates the aperture (sliding opening to the lens), which regulates how much LIGHT comes in through the lens.
- **Shutter speed** is how long the shutter is open, which also regulates how much LIGHT comes in through the lens (**Exposure Speed**).
- ISO is the light sensitivity of film or digital sensor.
- They work in combination to create the **Exposure** – must be set right on a DSLR camera to not get an **underexposed** (too little light) or **overexposed** (too much light) photo.
- If you set it on **Auto**, it will calculate automatically – you can 'add to exposure' by increasing (marked with +) light, or 'remove light' (marked with -) usually using a rolling button on your camera.

All this is irrelevant if you only use a smartphone.

Depth of Field

- The size of the aperture affects **depth of field** a lot.
- Smaller aperture is a higher f-stop number (like 16) – longer depth of field, but less light comes in, so you need a longer shutter speed.
- Larger aperture (lower f-stop number like 2) lets more light in (= you can have a shorter shutter speed) but has a shorter depth of field.

Depth of field: the distance between the nearest and the furthest objects that are in focus in a camera. Depends on aperture and lens.

All this is irrelevant if you only use a smartphone.

Depth of Field

Photos (cc) Lena Struwe

Smaller aperture = Larger depth of field

Larger aperture = Shorter depth of field

Note the difference in the focus in the background – these photos are taken with fixed ISO 600. If you use Auto ISO you will get less of an effect on the depth of field because the camera might adjust the ISO automatically.

Exposure and Light

- Make sure the object you try to photo gets the right amount of light in your camera.
- Be aware of dark/light issues on your photos.
- Do not photograph against the sun or a bright light.
- Watch out for silhouettes, don’t face the sun with your camera.
- Morning and evening light is best.
- Try out different exposure times and F-stops (adjustment is usually +0.3, +0.7, -0.3, etc.). This will also affect depth of field, brightness, and contrast.

Light: overexposed

The white flowers are actually pink, color is washed out due to overexposure.

Photo (cc) Lena Struwe

Light: underexposed

Fungi's color and details are too dark, due to under-exposure of fungus because of too bright sky in the background.

Photo (cc) Lena Struwe

Resolution

- Digital images are made up of pixels.
- The more pixels the sharper the image; fewer pixels = pixelated.
- The resolution is determined by your camera and can often be changed.
- Usually: larger file size = better resolution = less pixelated when you zoom in (set for largest possible resolution if you want to zoom in later).
- Higher ISO = more ‘grainy’ photos.
- Low light = more ‘grainy’ photos.
- Texting photos vs. e-mail (file size); texted photos often lower resolution than original.
- Dpi = Dots per inch, for computer files and printing.

Examples of resolution

Same image

High resolution

Low resolution

Photos © Peter Nitzsche

Clear and not messy

- Avoid lots of other ‘green things’
- Have a uniform background
- Center your plant in the middle of your photo

Not a great photo.

Photo (cc) Lena Struwe

Overall composition

Not good photo:
plant is too far away, can’t see individual plants, characteristics, or which plant you are asking about

Photo (cc) Lena Struwe

Photo (cc) Lena Struwe

Background: BAD ➔ SLIGHTLY BETTER

messy background, plant out of focus

even background, plant out of focus

Photos (cc) Lena Struwe

Background: BAD ➔ BETTER

Background interferes with plant in forefront ⬇

Evenly colored background, easy to see leaf shapes➔

Photos (cc) Lena Struwe

How to get things in focus

- Be aware of what your camera focuses on
- Don’t get too close with the camera (know the focal distance)
- Know the focal depth of your camera at various settings
- Do not focus on the background
- Small parts: hold them in your hand to help with focus
- Set your camera to point-focus, in the center
- Avoid shaky hands which leads to blurry photos (turn on image stabilizer)
- Moving things will usually be blurry (need short shutter speed)
- Auto-focus can mess things up or be wonderful
- Lucky you if you have a touch screen with focus touch

Focus: BAD → BETTER

Focus is on background.

Focus is on plant.

Photos (cc) Lena Struwe

Focus: BAD ➔ BETTER

Fruit not centered, out of focus.

Centered hand for scale, fruits in focus.

Focus: NOT GOOD ➔ BETTER

Flowers too close, the camera cannot focus at that short distance.

Flowers are in focus, but smaller (use macro setting or crop your photo later).

A good photo

Most of plant in focus, many parts of the plant visible, details clear, hand included for scale, background not too disturbing.

Photo (cc) Lena Struwe

Optical zoom on DSLR

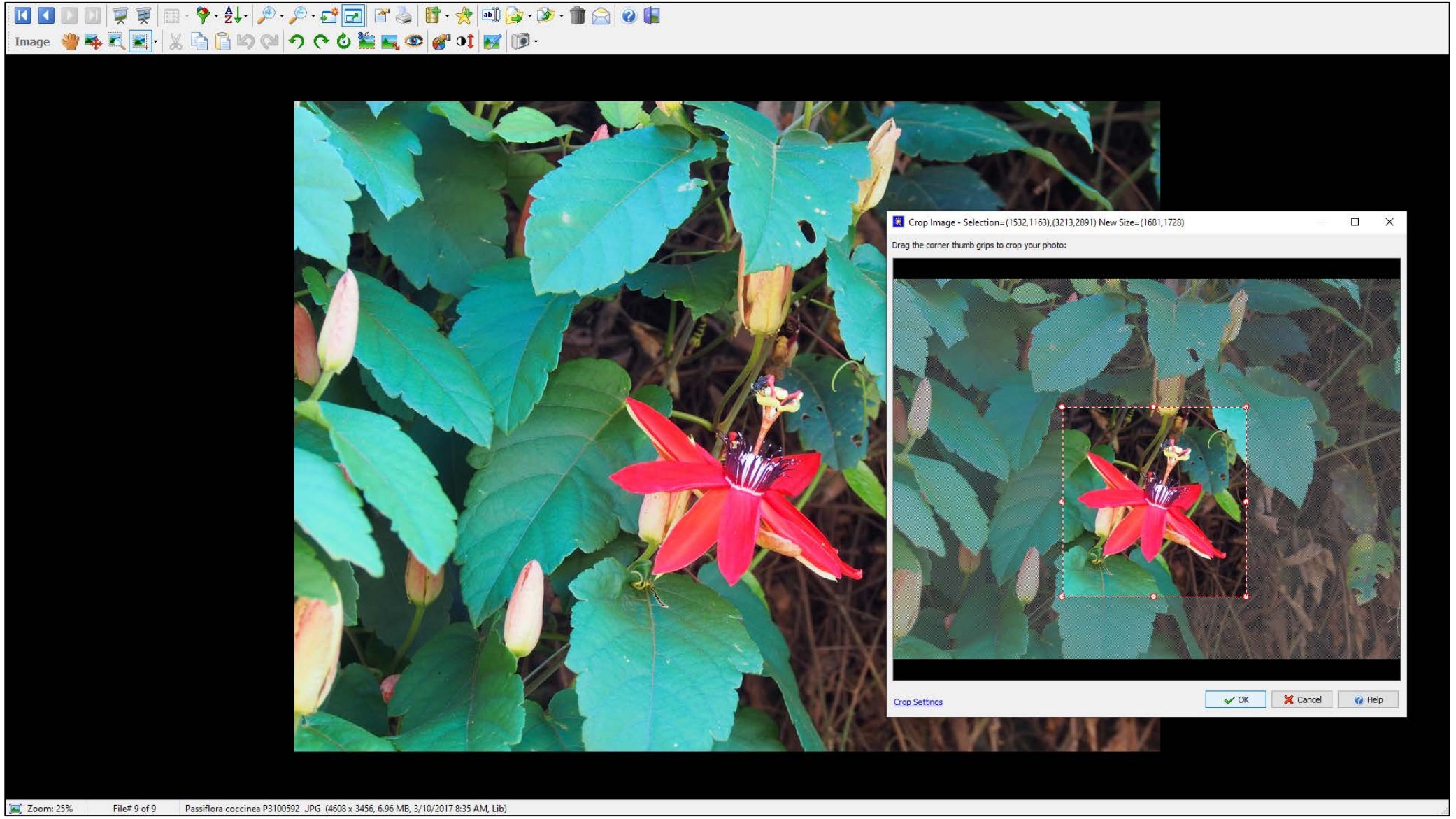
25 mm wide angle lens

100 mm tele lens

Macro zoom lens, ca 50 mm

Veronica persica (cc) Lena Struwe

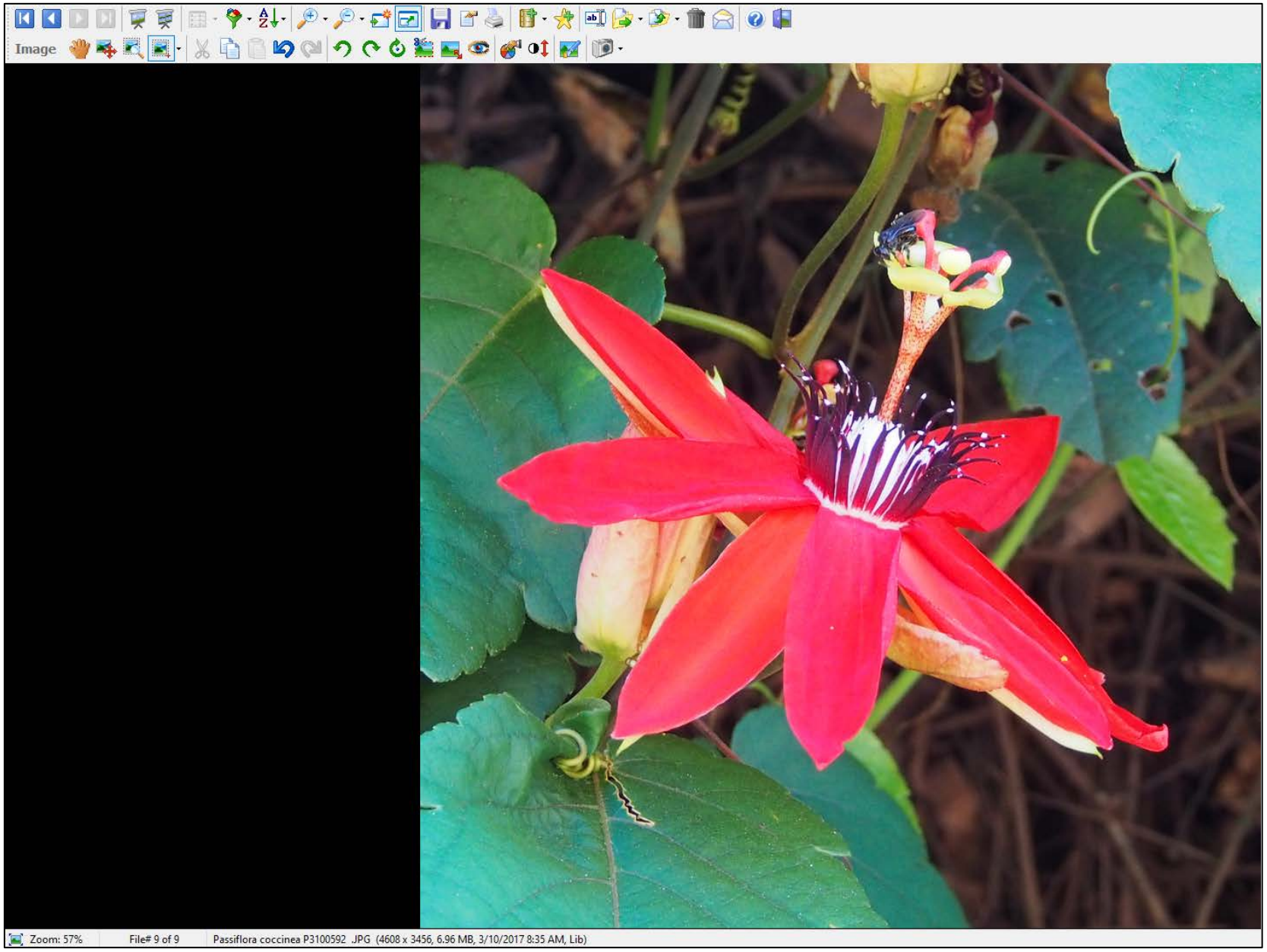
Cropping using software, zoom in and set new borders



Result of cropping

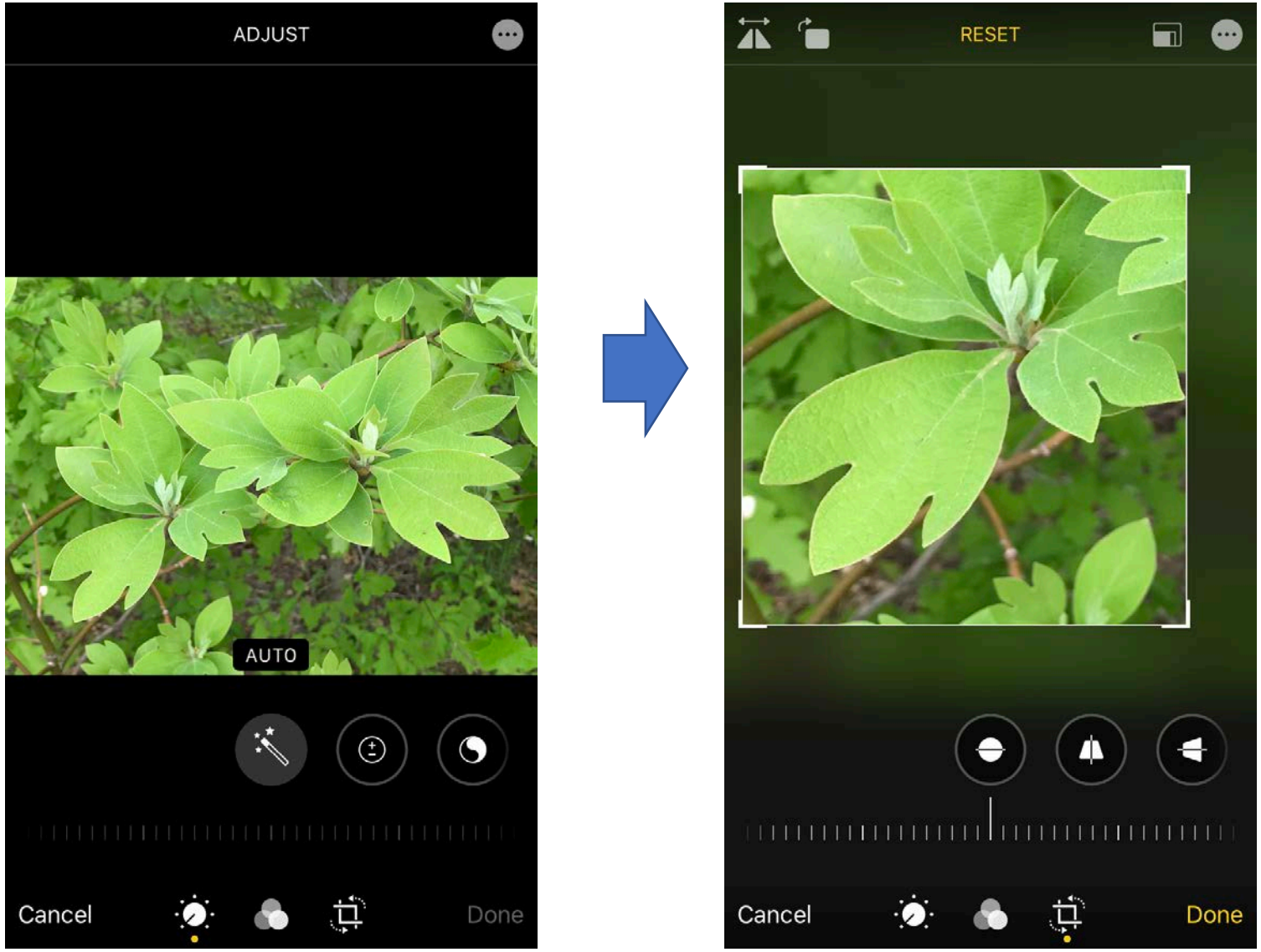
Save as new image with new name
(do not delete original by accident, you might need it later)

If pixelated or out of focus – sorry, can't be fixed, resolution is reduced with cropping.

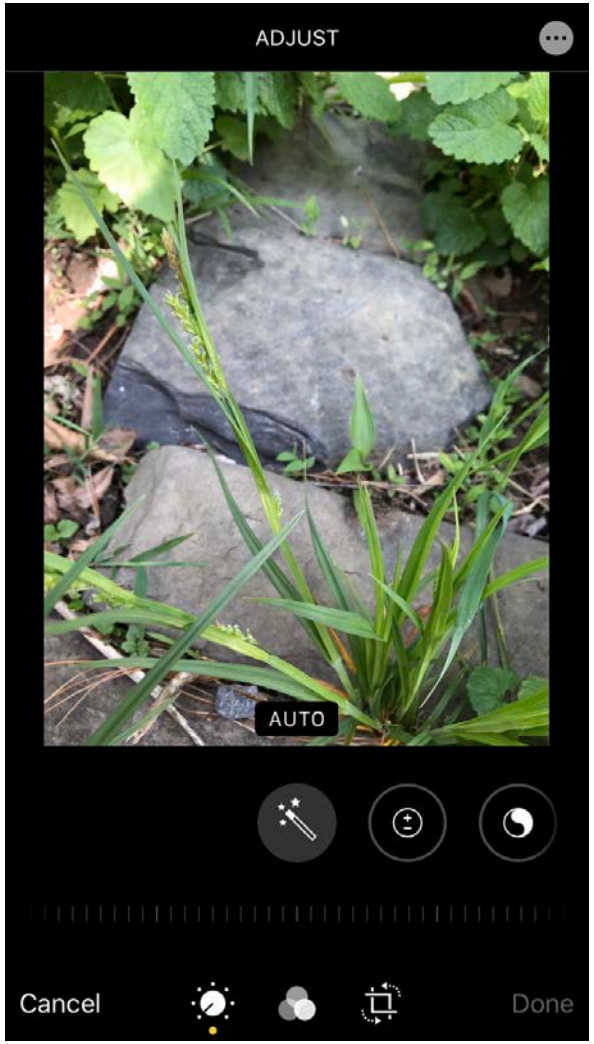


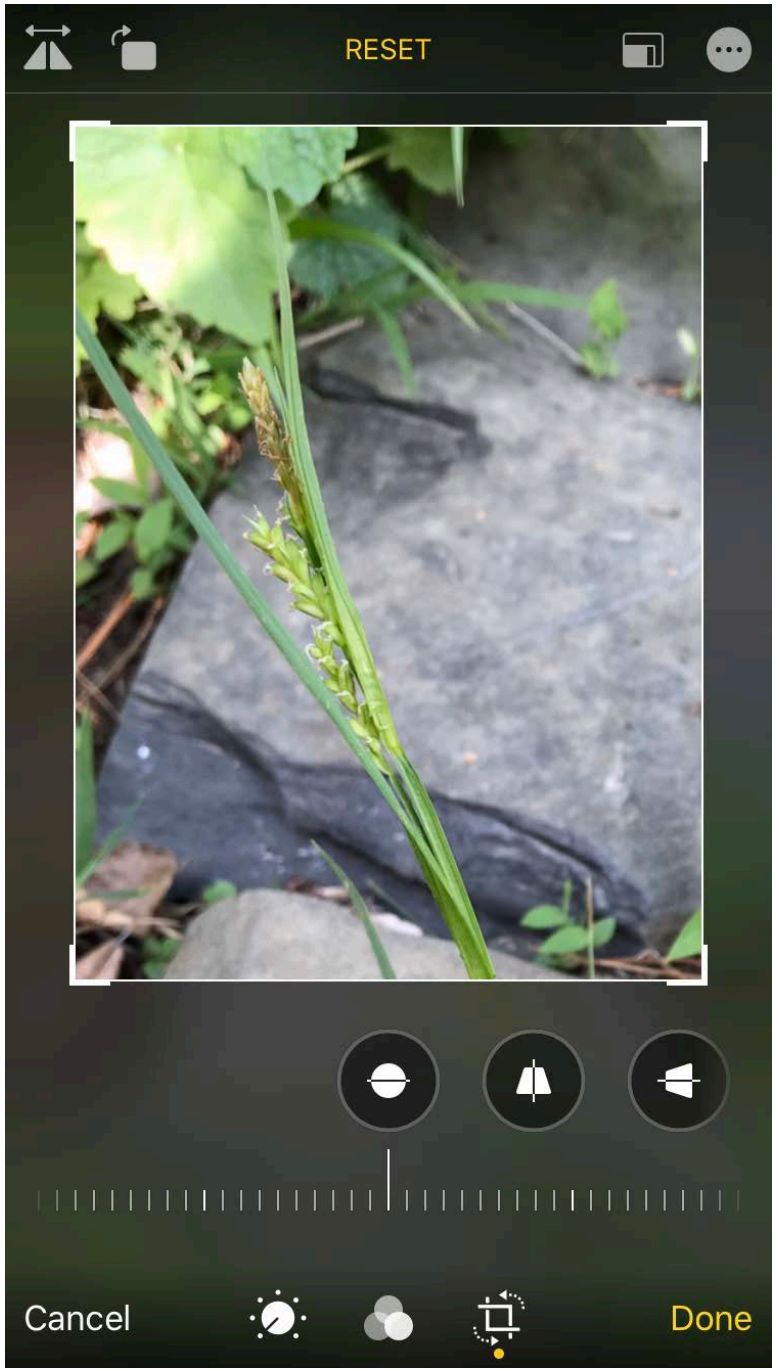
Cropping on a smartphone

Use editing functions to change borders and zoom in (crop) – new photo often overwrites original photo.



Zooming in after the fact – cropping photos in software





Photos (cc) Lena Struwe

CROPPING: Original ➔ Cropped

Focus is on plant, but flowers too small to see well.

Shows detailed characters, but low resolution makes it unsharp.

Photos (cc) Lena Struwe

CROPPING: Original ➔ Cropped

Berries centered, in focus.

Berries larger with more details.

Photos (cc) Lena Struwe

CROPPING: Original ➔ Cropped

In focus, hand for scale.

Centered on what is in focus.

Optical zoom in smartphones

- Lucky you if you have it – several cameras and lenses that are used for different purposes (landscape, portrait, macro close-ups)

[several cameras visible on the back of phone]

Digital zoom in smart phones

- The image is being automatically cropped in size by the phone, resolution gets worse

[one camera visible on the back of phone]

Photo by Daniel Romero on Unsplash

USB Digital Microscopes

Photos (cc) Lena Struwe

Wired to computer

Mixed image quality

Often very short depth of field

Photo (c) Peter Nitzsche

Smartphone mounting kit for dissecting microscopes, spotting scopes, and binoculars

a little tricky to use, and better than just holding phone up to microscope to take a photo. Several brands and price ranges.

Adjusts to many sizes and types of smartphones.

Circular mount attaches to various sizes of eye pieces.

Sense of Scale and Size

- (top) Ruler, grayscale, and color indicator to provide scale and white and color balance information.
- (middle) Homemade weatherproof business card-sized ruler made in lamination machine, easy to carry with you.
- (bottom) Cheap plastic ruler.

Photo (cc) Lena Struwe

Examples of included scales

Ruler as scale

Finger as scale

Photos (cc) Lena Struwe

Using mm-paper as background for scale

Need to be flat, will get dirty, can be laminated, may reflect light
Use mm, not inches.
If you photocopy paper, make sure the lines get copied at right scale.

Photos (cc) Lena Struwe

Now I have great photos, so now what do I do?

What plant is this? I have no idea.

I have some idea what this plant might be. At least its family.

I know what genus it is, I think.

I am sure what it is, but I am happily proven wrong.

Resources: Books, Internet search engines, online keys, Facebook groups for plant ID and plant problems, iNaturalist, and other resources (like experts).

Do you want a quick ID that is maybe a bit uncertain, or a thorough ID that is certain? What about quality control of your answers?

Printed floras (books)

Has the best and most detailed information.
Full of botanical terminology.
Often regional (New England, PA, VA).
No NJ flora ever published.
Some recent floras also online.

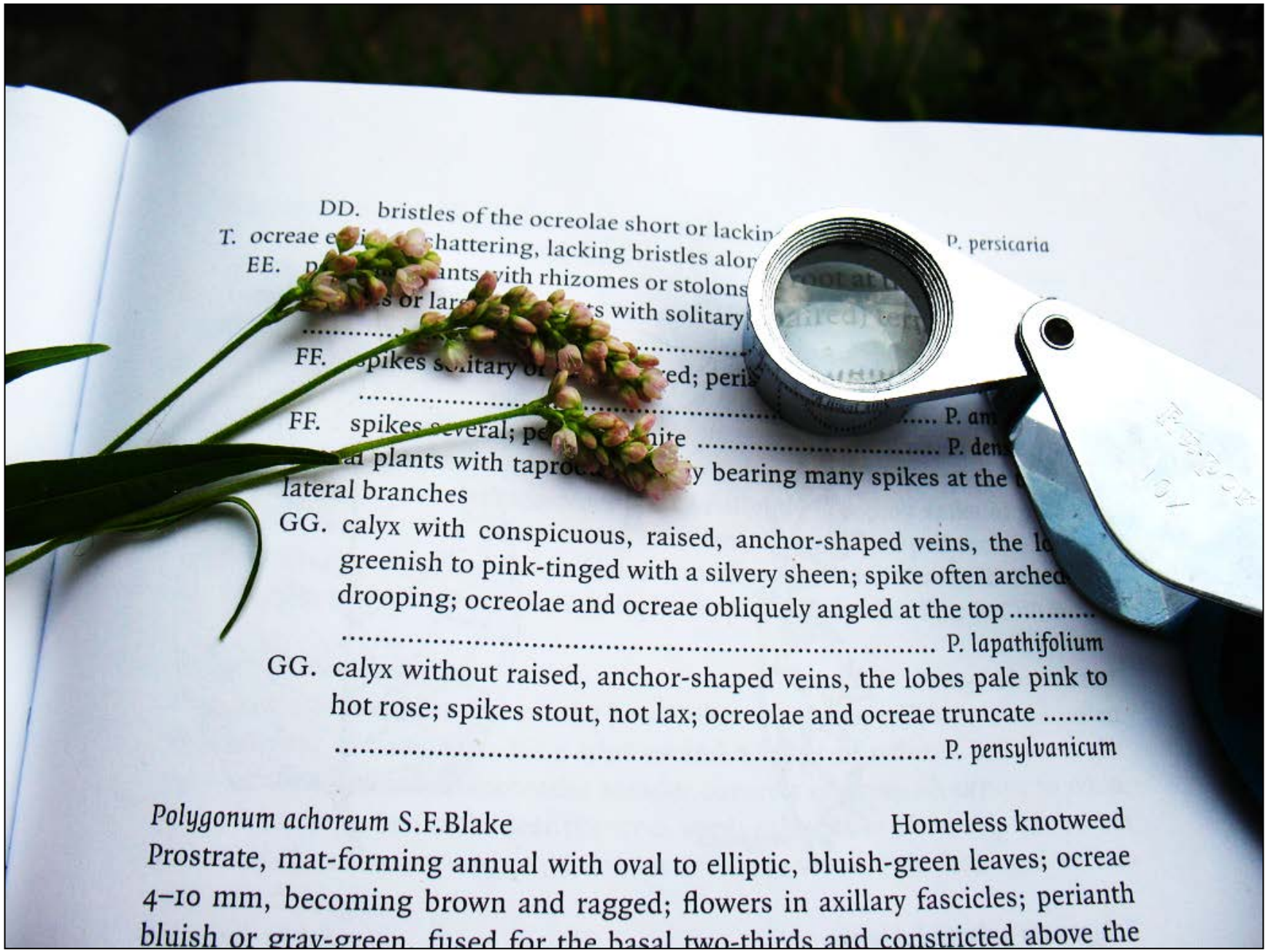


Photo (cc) Lena Struwe

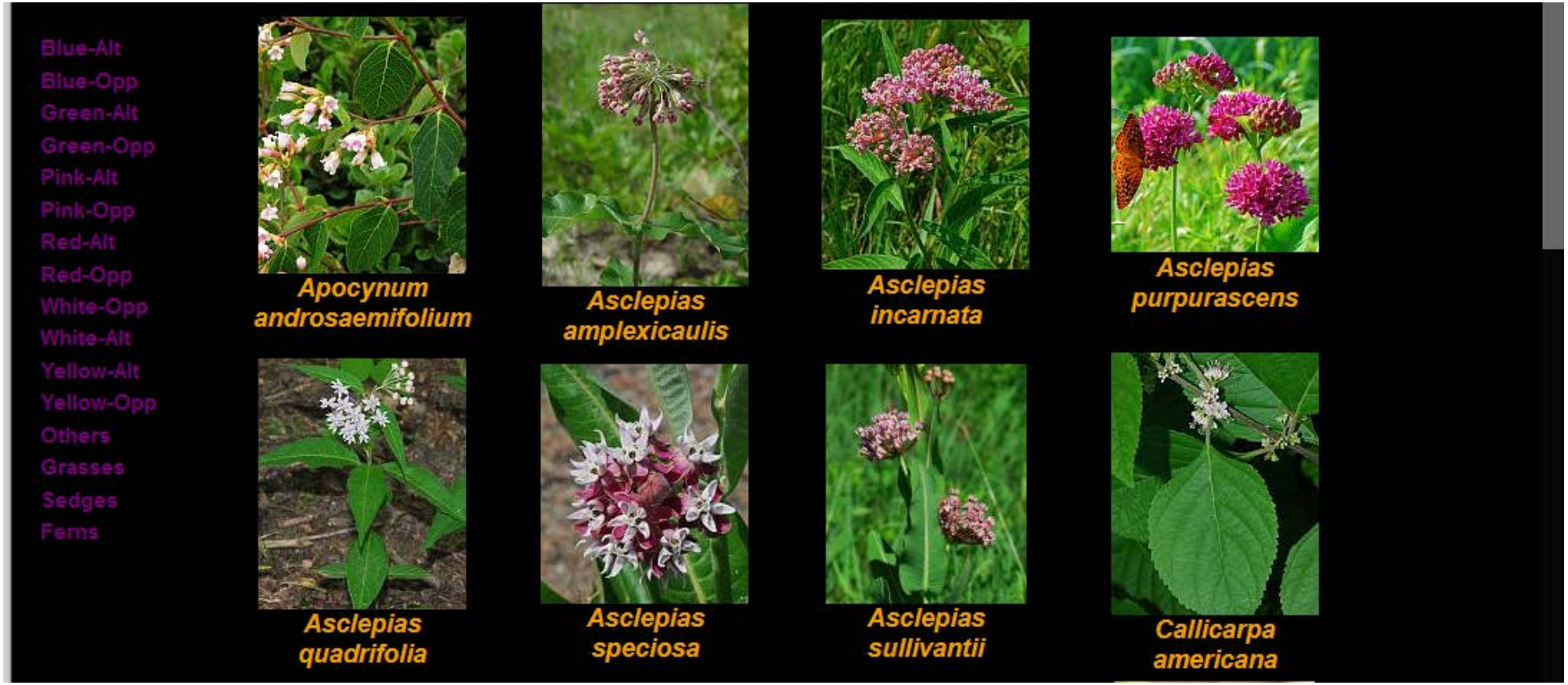
Internet searches

Caveats and advice

- Look for information published by experts, professional organizations, or universities.
- Many plant images are marked with the wrong name.
- Double-check all suggested identifications by googling the name.
- If you use common names when you search, you might end up with the wrong plant.
- Use scientific names if you can.
- There are a lot of funky things on the internet; take information with a grain of salt.
- On internet forums, people that know little sometimes act like experts.
- There are a lot of experts that are very happy to share their knowledge on the internet.

Online identification keys and tools

Keys, photo similarity, computer matching, community forums, and social media – some examples…

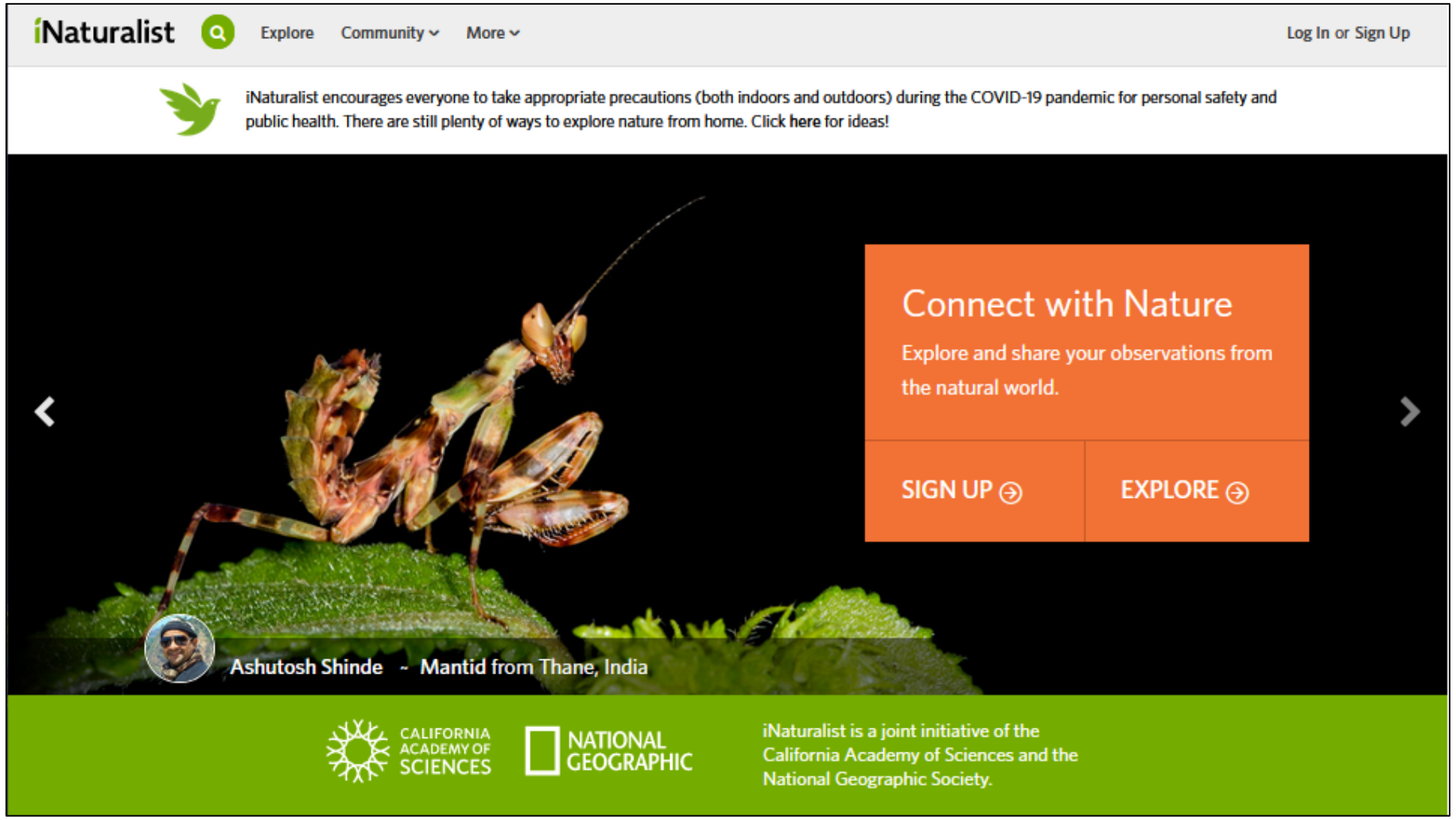


MissouriPlants.com

Screenshot © Missouri Native Plant Society, 2020

iNaturalist on the web

https://www.inaturalist.org/



Screenshot © iNaturalist

iNaturalist

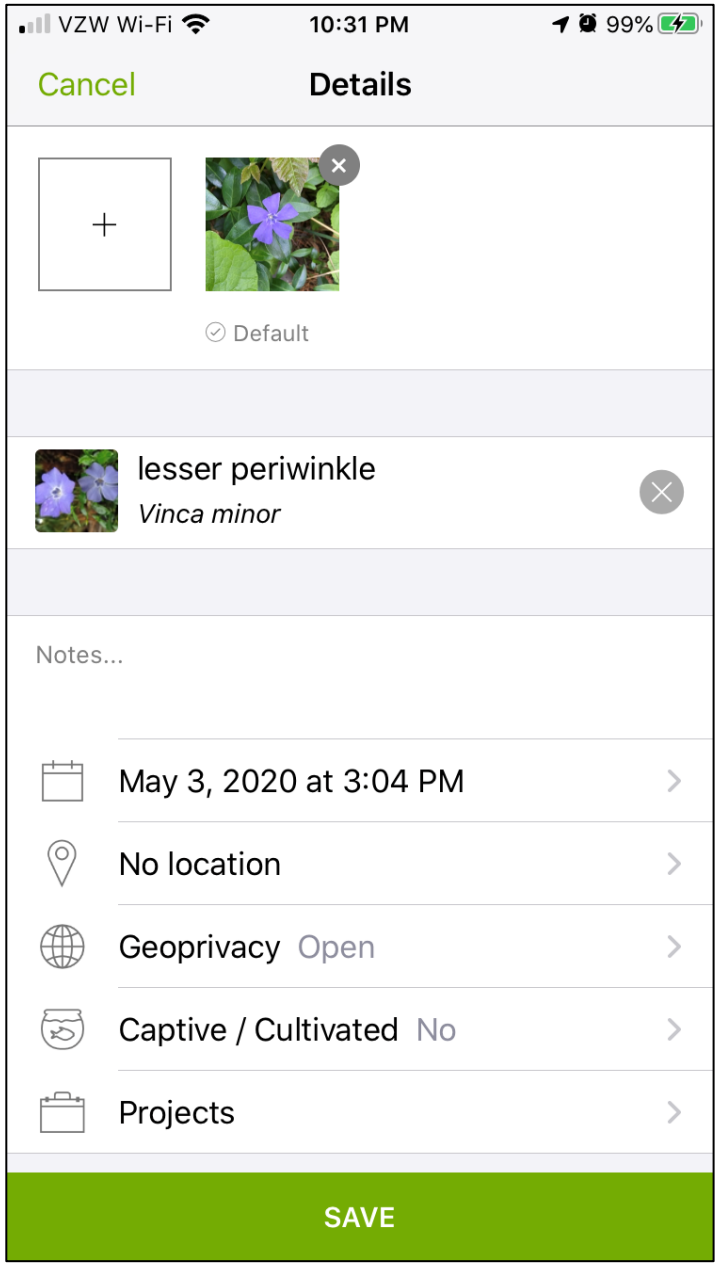
online community of experts and naturalists alike – highly recommended

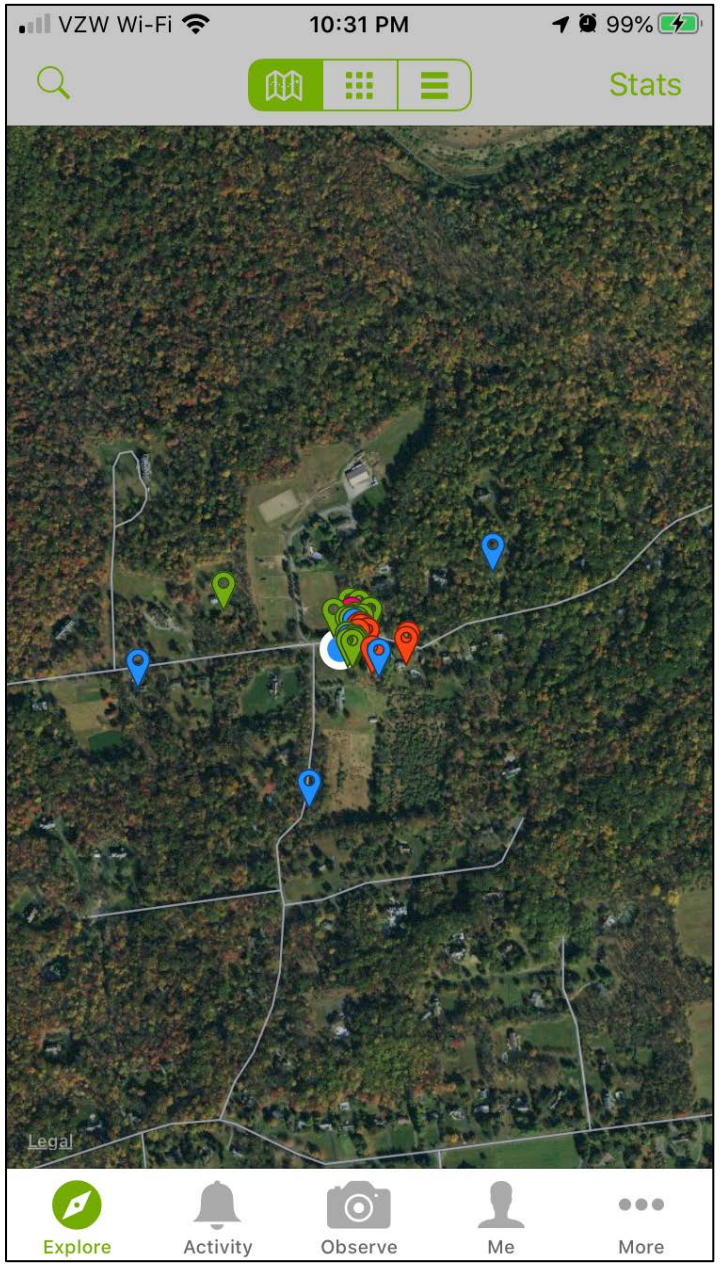
– free

– many active taxonomic experts

iNaturalist app

- use it on your phone or tablet
- free
- take photos and upload within app
- upload on wifi to save data costs on your cell phone plan

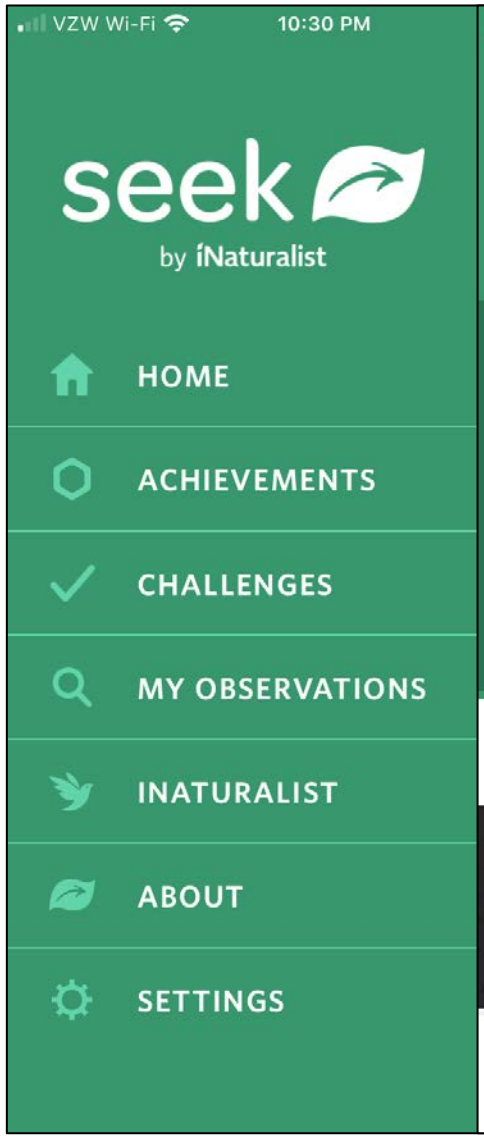


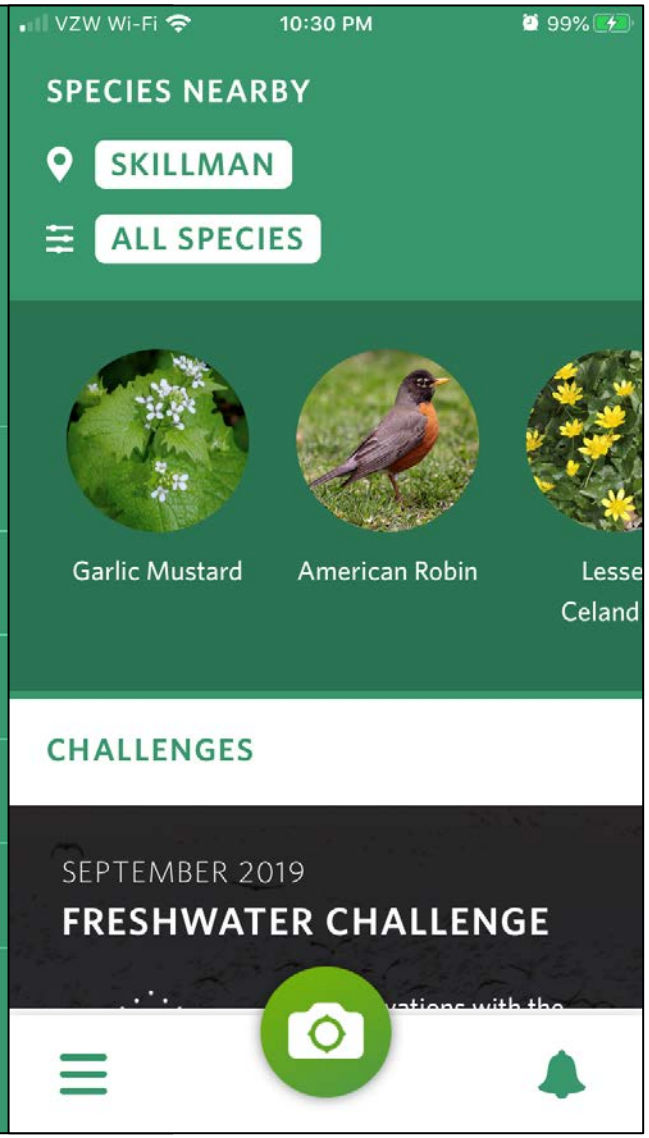


Screenshot © iNaturalist

SEEK app (from iNaturalist)

Look at something with your smartphone camera and it suggests what species it is. Can be linked to iNaturalist account. Appropriate for kids and adults. Free.





Facebook, is it great for plant identification?

Common questions:

“Is it a weed or a flower?”

“Is it a weed or a plant?”

“Is it edible?”

“What is this?” (a blurry photo).

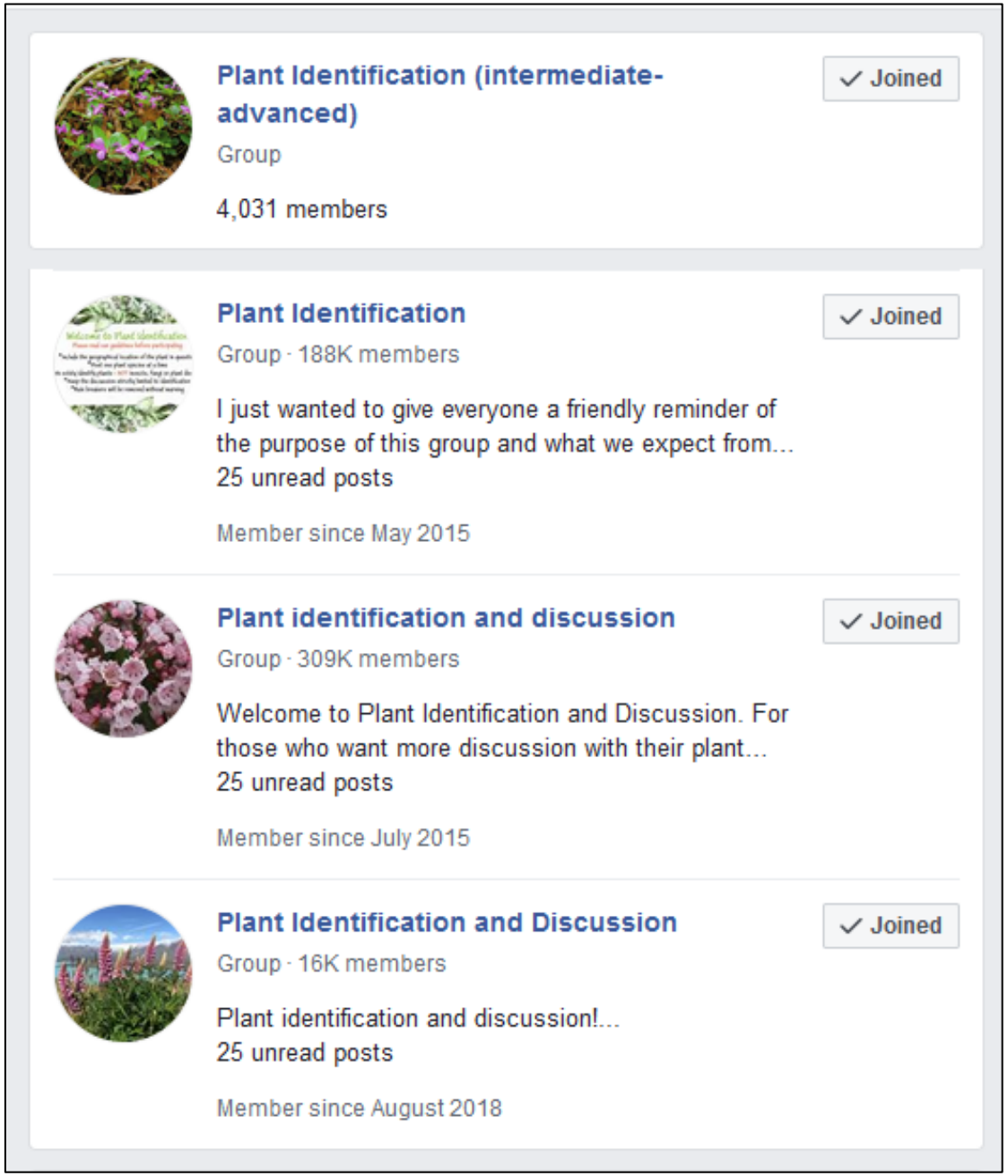
“What is this?” (with no geographic information)

Many available Facebook groups for plant identification

Thousands of members

Different posting rules – always follow the rules

Good moderators are important



“What plant is this?”

What happened to this photo? Suggestions?

If you want a good answer to your identification question, you need to provide a good photo.

Photo (cc) Lena Struwe

Leaf straight-on, please.

Photos (cc) Lena Struwe

BAD: leaf at an angle, other plants in front

GOOD: whole leaf, centered

Don’t forget to photograph the tiny things

Fruit shape and pubescence in *Veronica* are species-specific.

Pappus morphology in Asteraceae fruits are important.

Photos (cc) Lena Struwe

Example of a full set of photos: Garlic Mustard (*Alliaria petiolata*)

Habitat

Environment

Microclimate

Cultivated / Wild / Naturalized ?

Photo (cc) Lena Struwe

Example:
Garlic Mustard (*Alliaria petiolata*)

Whole plant – individual plant is better than many, easier to see on photo.

Photos (cc) Lena Struwe

Example: Garlic Mustard (*Alliaria petiolata*)

Leaf arrangement on stem

(Avoid leaves with disease or unusual features unless you specifically want them documented)

Example: Garlic Mustard (*Alliaria petiolata*)

Both sides of an individual leaf.

UPPER

LOWER

Example: Garlic Mustard (*Alliaria petiolata*)

Close up of inflorescence with flowers (or fruits).

Don’t get too close with the camera (= might get out of focus).

Photos (cc) Lena Struwe

Example: Garlic Mustard (*Alliaria petiolata*)

Take close-ups of flowers from above and from side – all in perfect focus so you can zoom in on your photos later.

Photos (cc) Lena Struwe

Example: Garlic Mustard (*Alliaria petiolata*)

Cropped photo from previous page's photo shows:

- Flower bud aestivation
- Sepals (out of focus)
- Petals
- Stamens
- Style and stigma
- (pollen grains)
- Developing fruit (out of focus)

Photo (cc) Lena Struwe

Photographing for grass species identification

Grasses are hard to identify in real life, even harder by photo.

- **Ligule** (presence-absence, general shape, size in relation to the blade, texture, fringe pubescence)
- Presence or absence of **trichomes** at the base of the blade
- **Auricle** (presence or absence, shape if present)
- **Sheath** (split, overlap, fused)
- **Vernation** (rolled or folded)
- **Blade** (pubescence, trichome size and density, mid-vein)
- **Stem type** (round, elliptical, flat, pubescence?)
- **Seed head** (spike, raceme, panicle)
- **Nodes**
- **Root** system, rhizomes or stolons, if present

Photo (cc) Lena Struwe

Photographing for grass species identification

Photos (cc) Lena Struwe

Photographing for grass species identification

Photographing fungi

Always photograph **whole**, from **top**, from **side**, from **bottom** for ALL fungi. Include scale.

Plant Problem Photography Basics

- Identify the plant species with the problem
- Take multiple images to capture the situation
  - Whole field/landscape and surroundings
  - Whole plant(s) with the problem/symptoms
  - Macro/close ups of plant parts (leaves, stems, roots, etc.)
  - Macro/close ups of damage
- Problem might be bigger than just the detailed photo: could be insect and other animal damage, bacterial, fungi, viruses, physiological

Whole Situation

Whole Plant

Photos (c) Peter Nitzsche

Close Ups of Plant Parts

Photos
(c) Peter
Nitzsche

Close Up of Symptoms/Signs

Symptoms:
Wilting
Die back
Spots
Holes
Yellowing/chlorosis
Distortion

Signs:
Spores
Mycelium
Bacterial Streaming
Insects
Insect frass

“What is this insect, please?”

Blurry due to movement of insect, too close to lens, or wind, or shaky hand?

Do you think this wasp is oriented in a way that helps identification to species?

Photo (cc) Lena Struwe

Straight-on is better, sideways or from above.

Caterpillars often have distinct patterns on their sides.

Tomato hornworm

Photo (c) Peter Nitzsche

Rotate photos to head up for easier identification.

Use software for rotation without distortions, do not do this in Powerpoint. Rotate first, then crop.

Make sure to have large area around your insect so you can rotate your file and have enough margin around the insect to crop.

Or just turn your camera so it is upright when you photograph it.

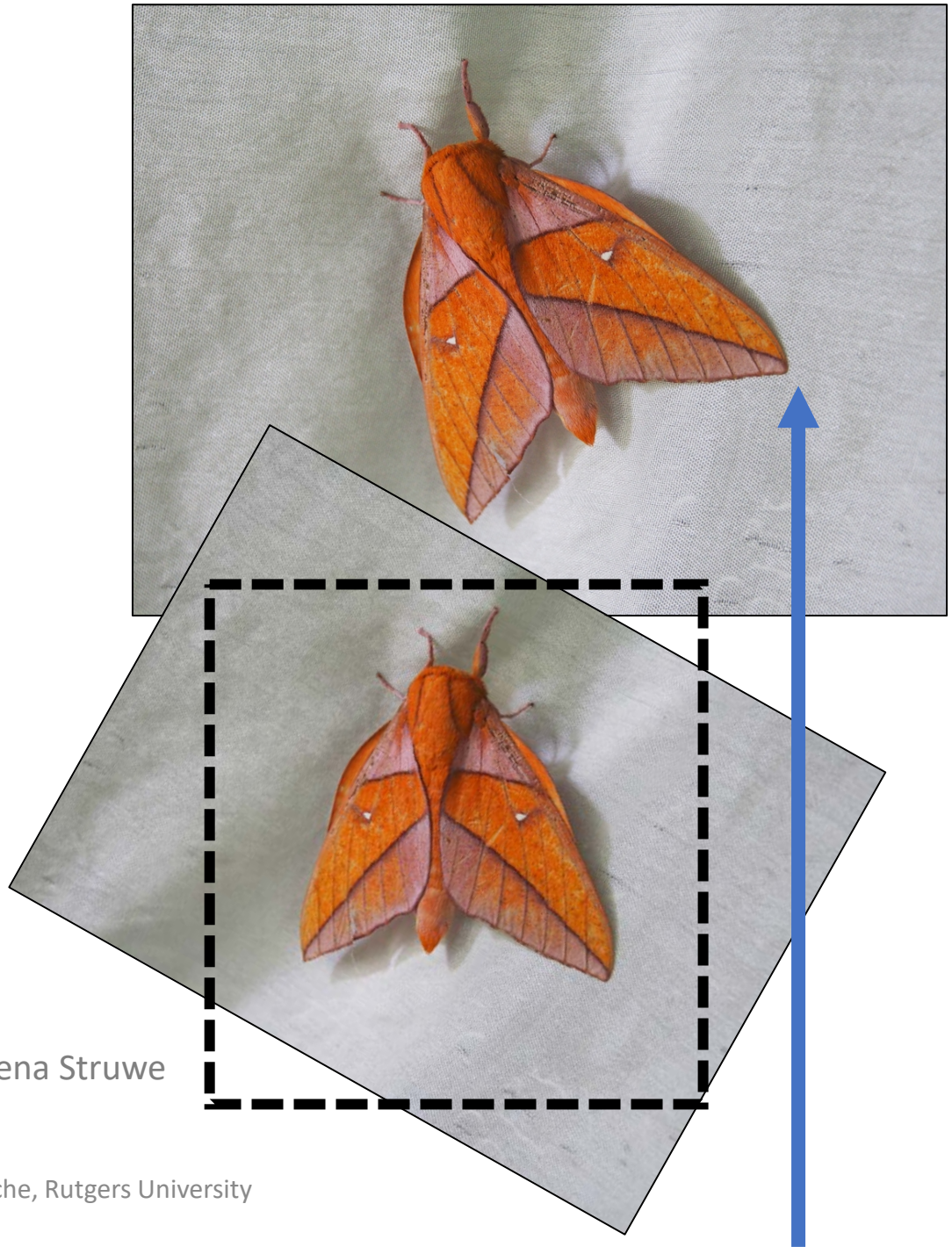
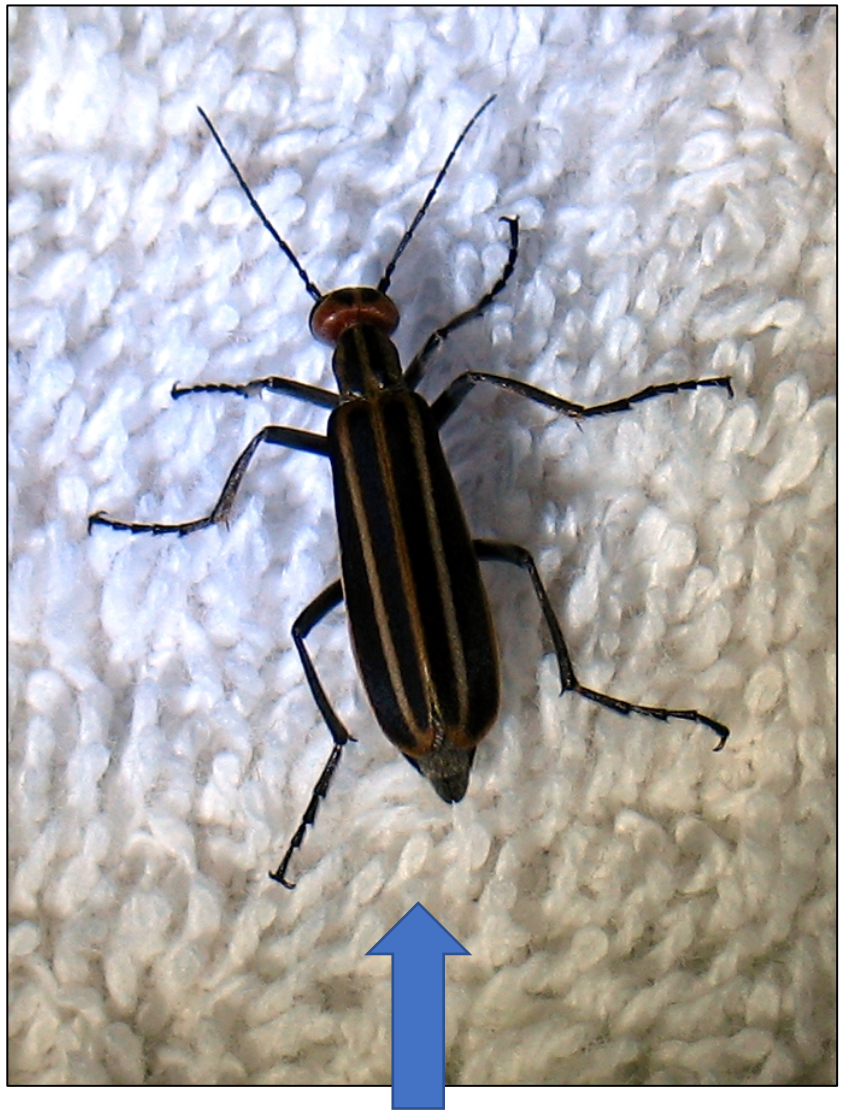


Photo (cc) Lena Struwe

Beetles: photograph from above, head-up

Photos (cc) Lena Struwe

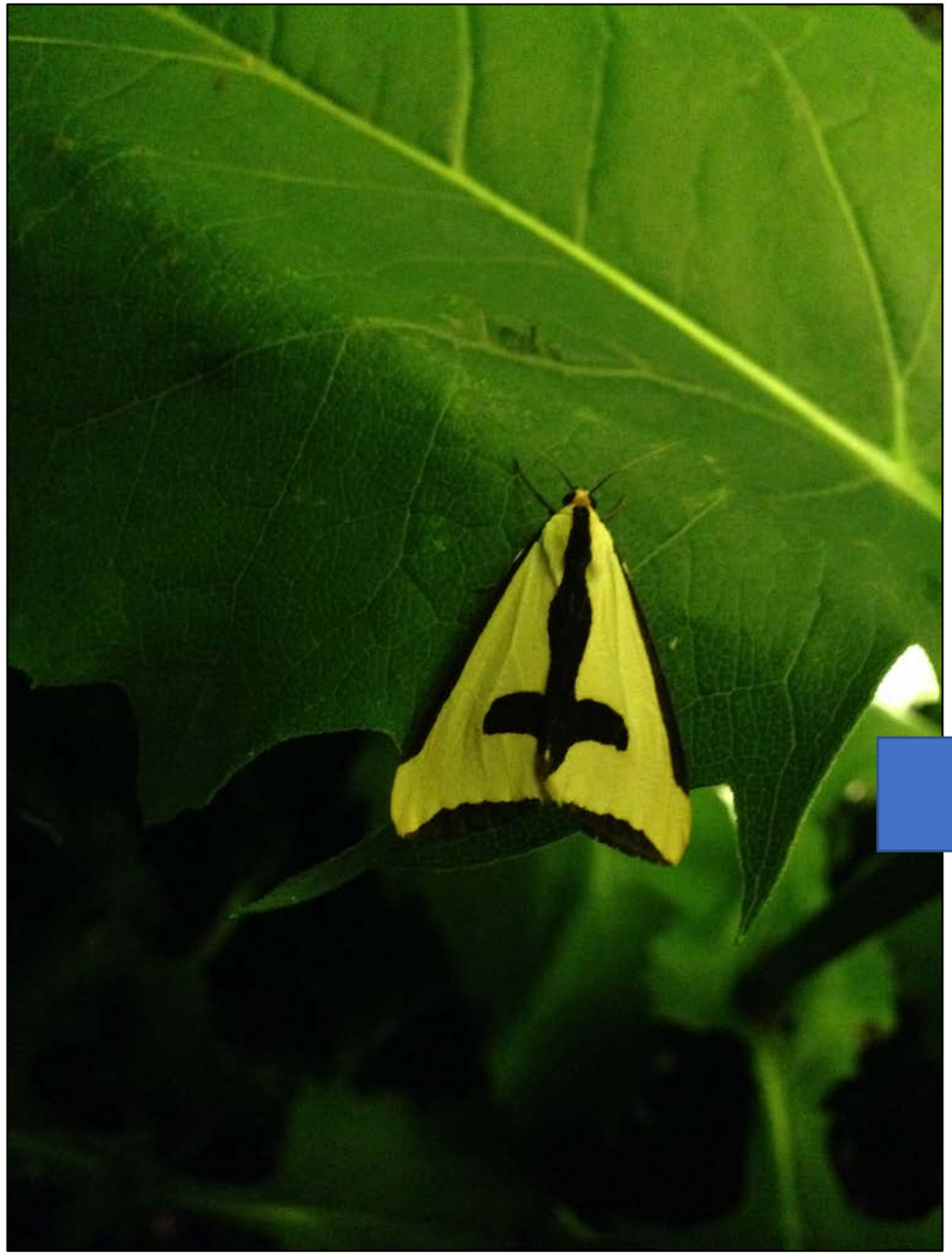


This orientation is best for species identification.

Moths: photograph all angles but mostly the experts want to see it head-up, straight down.

This is best for identification.

Photos (cc) Lena Struwe



Optical zoom (in lens)

Zoom in as long as you can keep your animal in focus.

Photos (cc) Lena Struwe

Macrophotography with cropping is wonderful – learn it.

You see things you never saw before.

(DSLR camera with 50 mm macro, then cropped in software afterwards)

Photo (cc) Lena Struwe

Cropping of image – creates focused close-ups

Photos (cc) Lena Struwe

Moving objects (are often animals)

- Blurriness (out of focus) because of movement (how to keep them still?).
- Need calm critters (if captured temporarily, you can chill some of them in the fridge for a little bit).
- Avoid photographing them unless they are somewhat still.
- They might jump or fly away, be quick.
- Need strong light.
- Need short shutter speed.
- Need large depth of field.

Photo (cc) Lena Struwe

Out of focus because of animal motion

Notice branch is in focus, caterpillar is not.

Photo (cc) Lena Struwe

In good light you can get photos of moving animals (short shutter speed)

Photo (c) Peter Nitzsche

Check your light source – against your camera or behind you?

BETTER

Get a good flashlight for night photography, often better than flash

Recommended:
LED light
Zoomable beam
Lightweight (relatively)
Rechargeable batteries
Sold as ‘tactical lights’

Photo (cc) Lena Struwe

Put them on mm-paper for easy scale

Scale and measurements are especially important for insects and other arthropods.

Photo (cc) Lena Struwe

Include a photo of the host plant

Host plant (for feeding and/or reproduction) is very important information for species identification

Tetraopes tetrophthalmus (Red Milkweed Beetle) on *Asclepias syriaca*

Photo (cc) Lena Struwe

Recommended Resources

- Photography Basics: The Complete Beginner's Guide (Photography Life): https://photographylife.com/photography-basics
- Cheat sheet: How to understand f-stops (Digital Camera World): https://www.digitalcameraworld.com/tutorials/cheat-sheet-how-to-understand-f-stops