



washington state university **EXTENSION** 

### Protect our Pollinators from the Effects of Climate Change

The Resilient Yard Presentation Series

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## <u>G</u>oals

- Climate Change Effects on Pollinators
- Flower Anatomy
- Pollination Biology
- Types of Winged Pollinators
- Providing Food and Forage for Pollinators
- Protecting Pollinators



https://pollinators.psu.edu/landscaping-for-pollinators/what-to-plant/plants-for-bees

Climate change is a fact of life for us now. This talk focuses on what we can do to help our pollinators weather the effects of a changing climate. In the process, we will cover how flowers and pollination works so we understand how the pollinators do their job.



### What is Climate Change?



https://www.epa.gov/ghgemissions/overview-greenhouse-gases



<u>Presenter's Notes</u>: Explain the graphic. Note that in the comparison nature also emits greenhouse gasses and we need some of them to keep the planet from getting too cold. But the "Human Enhanced" side of the graphic show that we're adding too much, and heating the planet.

Key point: BUT... just as we turned solids (coal & wood) & liquids (oil) into a gas, we can do the opposite: turn those gasses in our atmosphere back into a form where carbon can be stored, where they actually help the planet instead of warm it. That is called carbon capture...

There are lots of entrepreneurs out trying to find a

cost-effective way to capture and store carbon on a world-wide scale, but so far there is only one economically feasible way to do this at scale....(next slide)



.... the Technology to convert CO2 into a liquid is called Photosynthesis, and the 'machines' that do it are called plants(!)

So, back to school: photosynthesis is the process where the leaves in plants, when watered and exposed to sunlight grab CO2 from the air and turn it into the oxygen we breathe and they create a liquid substance (aka plant sugars, carbohydrates, 'exudates') that they use to both feed themselves (~70%) and also to 'exude' these carbs into the soil through their roots (~30%)as a food source for the microorganisms in the soil.

So, that's step one: the plants through their growth store carbon in solid form in their leaves, branches and trunks. And pollinators need plants for nectar! Step two is....(next slide)



... The Soil Food Web....

Those root 'exudates' deposited by plants are an important food source for soil organisms. And there are billions upon billions of them. Almost 60% of all life on earth is either in or just on top of our soils (another UW Prof David Montgomery reference. This one from an earlier book "Growing a Revolution"). And once fed, these organisms do what living things do, they poop, multiply, attract predators and die.... All these activities return carbon to the soil where it can stay for hundreds of years.



USDA has just updated the plant hardiness zones to adjust for climate change. One can see the colder regions (purple, dark blue) are smaller and the warmer regions (tan, brown) are larger.



The light brown areas of the map show areas of the country that have increased temperatures averaging 5 degrees. This is affecting much of the southeast, east and a little less in the northwest. The few green areas show a decrease in average temperatures by 5 degrees, but this may be due to modeling methods. It is the vast brown areas that should concern us. Changes in climate can decrease the quality of nectar for some species. Also, stressed plants can change their scent, which will confuse some pollinators who use chemical cues rather than color or flower shape to guide them the nectar.

On the plus side, an increase in temperature allows PNW gardeners to grow new flower species/varieties which may attract a wider range of pollinators or benefit the pollinators we already have.



Washington State plant hardiness map updated 2023. I used to consider myself in Clark County at 700' elevation to be in zone 7b or 8a in a mild winter. I used to regularly lose zone 8 plants. Now I'm thinking I can give some zone 8 plants another try. The gardener part of me is thrilled to have new options for my plant palette, but the environmentalist part of me worries about all the other consequences that will affect not only pollinators, but other wildlife, plant life, food production, etc.

### Climate Change Impact on Pollinators



- Plants bloom sooner, limiting pollinator food
- Drought causes less nectar, so pollinators get fewer calories
- Extreme rainfall reduces flight time for pollinators



Source: www.climatehubs.USDA.gov

How is it that a few degrees can affect something as little as a bee or butterfly? It is more than a slightly warmer climate. Our seasons are shifting also. Plants and insects evolved to emerge at the same time for their mutual benefit. But now plants are blooming sooner so a butterfly that depended on that specific flower is now emerging from its cocoon and the flower is done. No food for the butterfly! The butterflies may eventually change their timing but in the meantime their population will suffer. Drought stricken plants produce less nectar so there are fewer calories for the pollinators. Extreme weather events, like heavy rain, make it difficult for the pollinators to move around so it is harder to get to their food sources. When you live on nectar, you need to visit a lot of flowers!



Detailed experimental studies of the effects of drought conditions on flowers quantify that while plants may produce the same number and size of flowers, the nectar production of individual flowers is dramatically reduced. The sugar content, which is what the pollinator insects need, is cut almost in half. Some plants emit more floral scent when drought stressed while some produce more floral scent. It is unknown if the scent difference affects bee visits, but it was observed that some bee species changed their visitation between drought stressed and unstressed flowers in a controlled environment.



I know – a lot of people are not fond of bugs. But since you are here, I will assume you like them. Even for those who don't like bugs, I bet they do like to eat. Looking at crop productions world wide and those that depend on pollinators, it is determined that every third bite of our food depended on those pollinators. That number probably goes up for vegetarians.

### Flower Anatomy

- Sepals protect the flower bud and attract pollinators
- Pistil is the female part; consists of stigma, style, ovule
- Stamen is the male part; consists of anther, filament
- Pollen sticks in stigma; provides food for pollinators and produces new seedling University of Florida: gardeningsolutions.ifas.ufl.edu



Flowers on all plants, both food producing and ornamentals, are important to produce seeds that become the fruit we eat. The female pistil is usually in the center of the flower with a sticky stigma at the top. The female style is a long tubular structure that leads to the ovary, which contains the eggs cells (ovules). The male anther produces pollen, which are the male reproductive cells. The male filament simply holds up the anther. The petals attract the pollinators.



### Pollination Biology

- Pollen lands on stigma
- Male cells follow down the tube, providing fertilization
- Fertilized ovule becomes seed
- Ovary becomes the fruit



https://web.extension.illinois.edu/gpe/case1/c1facts2d.html

As the pollinator insect flits from flower to flower (attracted by the flower petals), they are gathering pollen. When they visit another flower, some of that pollen is deposited on the stigma, which is sticky. That pollen containing male cells travels down the style into the ovary where the female egg cells (ovules) are waiting. The ovules become fertilized and become the seed.





Pollinators have co-evolved with plants for the specific purposes of feeding the pollinator and pollinating the plant. Open flowers with easy landing pads attract beetles, which are not agile in flight, and non-hovering pollinators. Plants with long nectar spurs (like the mint family) attract butterflies and hummingbirds, which have a long proboscis. Visual cues (color, ultraviolet reflectance) also play a role.

### **Plant Fertilization**





- Flowering plants are divided into two major groups.
  - Monoecious: Plants contain both male and female flowers.
- Dioecious: Require female and male plants for pollination.

A note on plant biology. Flowering plants are either monoecious or dioecious. The major difference is whether more than one plant is needed for pollination. Both usually still require some type of pollination to transfer the pollen from a male flower to a female flower, whether on the same plant or different plants.

### **Monoecious Plants** pollen tassel The same plant produces both male and female flowers silks Often called the "perfect" plant. • Only one plant is needed for • ear production. Examples: cucumber, corn, fig, apple https://blogs.ifas.ufl.edu/pascoco/2017/12/29/monoecious-vsdioecious-self-pollinating-vs-cross-pollinating-plants/ https://passel2.unl.edu/view/lesson/bf87afd5be26/4

**Complete flowers** on a monoecious plant contain both male and female reproductive parts. Examples are tomatoes or peppers. **Incomplete flowers** (on the same plant) have only male or female reproductive parts. Examples are squash, corn or apples. Each still requires pollination, either by insect or wind.

### **Dioecious** Plants





University of Waikato: www.sciencelearn.org.nz/images/63-kiwifruit-flowers

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- Each plant has only male or female flowers. It is critical to have both for fruit production.
- Kiwi is one example. Important to plant both a male kiwi and a female kiwi.
- Other examples are spinach and asparagus.

Since dioecious plants contain only male or female flowers, you must plant at least one of each to get fruit production. Kiwis are the most common example of the conscious choice you must make when planting. You need one male kiwi plant to provide pollen for up to 8 female plants (and no individual homeowner needs that many!). Other dioecious plants are spinach and asparagus but since you only want to eat the leaves or stalks of those plants, you don't really care if you get seed production (unless you are trying to save seeds).

### **Composite Flowers**





https://en.wikipedia.org/wiki/Asteraceae

- Many flowers are Composite plants
- Contain many smaller florets
- Examples: yarrow, coreopsis, dahlia, zinnia, goldenrod, fleabane, aster, cosmos, Blackeyed Susan, sunflower, lettuce
- Ideal landing pads for bees!

Flowers in the Aster family (think daisies) are composite plants. This means that each flower contains many small florets. Each of these florets contains a nectar source. So bees absolutely love these flowers. There is a nice wide landing pad for them to sit on and they can get a lot of nectar from one spot.

### **Bees = Pollination**



- Without bees, we don't eat
- Without bees, our yards would be dreary



https://en.wikipedia.org/wiki/Bee



Pixabay.com

Bees are excellent pollinators. They spend their life feeding on pollen, and in the process pollinate much of our food crops and ornamental flora. A bee's mouth parts are perfect for dipping into a flower's pistil to collect pollen and in the process shake off pollen from a previously visited flower. There are over 4,000 species of native bees.

### Honey Bee

- Colonies live year-round
- Generalist foragers
- Colors seen: ultra-violet patches on flowers: blue, purple, white
- A few of their favorite flowers: Russian sage, zinnia, oregano, borage, lavender, rhododendron



Western honey bee: Apis mellifera

https://en.wikipedia.org/wiki/Honey\_bee

Honey bees and humans share a connection. Some homeowners keep honeybee hives on their property for pollination, honey production, and just as a hobby. Honey bees are in decline around the world so help maintain honey bee populations by reducing use of pesticides. The varroa mite is also a major source of honey bee decimation; much research is ongoing on ways to combat this disease.



### Bumble Bee

- Generalist foragers
- Food crops: tomatoes, watermelon, blueberries
- Practice buzz pollination (cause vibrations to release pollen)
- A few of their favorite flowers: Lavender, blue blossom, sunflower, columbine, salvia, blueberry



**Bombus** Photo by Karen Palmer, Clark County MG, 2023

There are over 250 species in the Bombus genus. They form colonies with a single queen. Tip of their long tongue acts as a suction cup to lap up the nectar. The name Bumble comes from the fact that they buzz. Some bumble bees nest in the ground so it is beneficial to leave some leaf litter during the winter to protect their nests. Bumble bees will often sleep in flowers overnight, which brings a smile to my face.



### Orchard Mason Bee



- Short active foraging time when fruit trees bloom
- Travel only about 200 feet
- Require water and mud
- Food crops: fruit trees
- A few of their favorite flowers: Oregon grape, apples, plums, pears, peaches, cherry, rose, salvia, thyme



Osmia lignaria https://en.wikipedia.org/wiki/Osmia\_lignaria

Mason bees are critical for orchardists, to pollinate fruit trees. Their life cycle is geared to the same temperature range of blooming apples, pears, plums, etc. Their life span is very short – they emerge from their nest, mate, collect nectar and mud to knead into a ball, lay an egg, seal it off, and do it again, until the hole is full. Mason bee nest boxes are easy to build or purchase and install in your own garden. Mason bees are not aggressive at all.

### Small Carpenter Bee



- Generalist forager
- Nests in pithy vertical stems
- Found in woodlands, gardens, meadows, prairies
- A few of their favorite flowers: Morning glory, salvia, sorrel, sunflowers, caneberries



Xylocopa virginica

https://en.wikipedia.org/wiki/Carpenter\_bee

Carpenter bees sometimes have a bad name because they build their nests in wood. Understandably, some people object to critters drilling into their deck or house eaves. They do not feed on wood, just excavate to make a nest. Useful fact: they do not like painted or varnished wood! Carpenter bees look similar to bumble bees and serve a useful pollination service.

### Bee "Vision"

- Bees see colors
- Bees see ultra-violet color
- Bees see motion
- Bees see brokenness



BUT.... https://news.ncsu.edu/2011/07/wms-what-bees-see/

Photo by Karen Palmer, Clark County MG, 2023

Many flowers have unique ultraviolet color patterns to attract bees. These patterns also outline landing zones for the bees, where the nectar and pollen resides. These ultraviolet colors are not visible to humans. Bees also see distinctions between light and dark colors, which helps them identify shapes.

# CHIMATE CHIMA

### Bees don't see red!

- Yellow portion of catalpa tree flower will change color to red only after the flower is pollinated
- Crimson clover has white center to be visible to bees
- Isn't nature amazing?



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https://en.wikipedia.org/wiki/Trifolium_incarnatum
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Research concludes that bees see colors on a spectrum wavelength between about 300 and 650 nm. Red is 650nm and above so that explains it. While bees can use odor instead of sight to guide them to a flower, they have to already be pretty close to detect the odor. So sight is their best bet.

### It's Not Just Bees

- Butterflies and moths are eye-catching and they also pollinate flowers
- Beetles pollinate Magnolia, sweetshrub and paw paws
- Flies pollinate members of the carrot family
- Hummingbirds pollinate bright tubular flowers (and they see red!)



Most of us think of bees as our primary pollinators. But there are many other living creatures that pollinate. Flies, beetles, birds, bats. Pollinators add 217 billion dollars to the global economy (Pollinator Partnership). Pollution, chemicals, disease, and climate change are contributing to pollinator decline.

### Light Pollution

- Some pollinators do their work at night: moths, bats
- Artificial light deters these pollinators
- Artificial light causes 62% fewer insect visits
- Also increases predator vulnerability



A white lined sphinx moth pollinating a shrub with bright yellow flowers. Credit: Tom Koerner/USFWS.

https://www.fws.gov/story/2023-07/dim-lights-pollinators-and-plantsnight#:~:text=The%20researchers%20found%20that%20approximately,pollinators%20from%20their%20nightly%20routine.

This is not related specifically to climate change but it does affect pollinators. Be mindful and take practical actions. Use outdoor lights only as needed for safety concerns, control via motion detectors or timers. Use warmer colored light bulbs, shield outdoor lights to eliminate light pollution drifting into the sky. Plant a moon garden for nighttime pollinators!





### Washington State Major Food Crops



https://agr.wa.gov/washington-agriculture

Top 10: Apples, Milk, Wheat, Cattle, Potatoes, Hay, Eggs, Hops, Cherries, Grapes

- Pollinator Dependent: Apples, Cherries, Grapes, Berries, Onions
- Okay, we could still grow potatoes, wheat, and hay...
- Beer (hops) is good but...
- 70% of all other produce needs pollination – the brewery may not care but the community SHOULD\*McFleshman's Brewing Company www.mcfleshmans.com (2023)

Not all Washington State crops rely on pollinators but our diet would be pretty dreary (and unhealthy) with just wheat, potatoes, beef, hops. The state economy would surely suffer without this rich variety of agriculture.

### What Can A Homeowner Do?





Current locations pledged to protect pollinators

Xerces Society, www.xerces.org

- 1. Avoid pesticides (*eliminate* the use of neonicotinoids)
- 2. Plant more pollinatorfriendly flowers
- 3. Provide nesting sites
- 4. Spread the word
- 5. Be on lookout for new invasive species

Neonicotinoids kill indiscriminately bees, butterflies, other wildlife. Different pollinators require different flower shapes, colors, and sizes so a diversity of flowers provides habitat for a larger number of pollinators. Don't forget that pollinators also need to forage. Caterpillars that become butterflies or moths need food sources to feed. Pollinators also need nesting sites preserved. Most don't need us to build their nesting site – just leave it be! Agricultural pests are already expanding their over-wintering range due to climate change. Be a good citizen scientist: look out for them, capture, and report to your local extension agent.

### Avoid Pesticides

- Insecticides are harmful to pollinators
- Herbicides reduce food sources
- Fungicides can have synergistic effects on bees
- Search for ecological pest management strategies
- Always follow label directions, even when using organic products



Pixabay.com

Neonicotinoids kill indiscriminately bees, butterflies, other wildlife. Even organic insecticides, like Captain Jack Deadbug, have a period of time, measured in hours, where it is toxic to bees. So time of application is very important.



### Plant a Pollinator Garden



- Flowers provide nectar and pollen (think food) for pollinators
- Provide different flower structures that appeal to a wide range of pollinators
- Support pollinators spring through fall by providing plants with different bloom times



Pixabay.com

Pollinators require food for themselves and their offspring. Nectar and pollen from flowers provides that food resource. In addition to providing a variety of flower structures, a range of bloom time is also helpful since different pollinators are active at different times of the year. Remember that mason bees are only active while fruit trees are blooming. Native plants are always a good idea since they have evolved with the pollinators to bloom when they need them.

### Provide nesting sites



- All stages of pollinator life cycle need support, including eggs and larvae
- Leave patches of bare ground and brush piles
- Leave a little mess in the yard for overwintering ground bees and insects
- Plant caterpillar host plants



The Bee Conservancy: thebeeconservancy.org

Ground nesting bees need some bare ground and protection with leaf litter for overwintering. Beetles often overwinter in small piles of yard debris (i.e., dead flower stalks and small twigs). Don't be such a neat freak! This doesn't mean you can't clean up your front yard but leave a little mess somewhere in the side or backyard or areas not so visible to the street or arriving guests. Also remember that mason bees need mud to build their egg nests.

### Spread the Word



- Share information via social media
- Invite your neighbors to "do the right thing"
- Get a pollinator habitat sign from Xerces Society and post it proudly



https://xerces.org/protecting-pollinators

When showing your garden to friends and neighbors, point out your pollinator friendly practices. Encourage others to take a few steps in the same direction. Be proud of what you do and toot your own horn.

### Invasive Species

- Become informed about emerging invasives
- Be on the lookout and capture if possible
- Report to your local Extension Agent
- Here are just two examples:





Northern Giant Hornet



Source and Photos: https://invasivespecies.wa.gov/find-a-priority-species/

Emerald Ash Borer

Invasive species are not only detrimental to the agriculture industry, but can also be detrimental to pollinators. When climate change creates an environment that allows in more pest species (longer growing season, warmer winters) then they may compete with bees, or become pests of bees (like the Northern giant hornet, aka 'Murder hornets') If homeowners look for, and report invasive species before they get established, we might limit their impact, and reduce the amount of pesticides used in agriculture to combat them if they do get established.



## Planning a Pollinator Garden

- Starting from scratch or adding to existing bed?
- Sun? Shade?
- Even natives need a little water to get started!
- A sketch can be useful.
- A list of possible plants is crucial before going to the nursery.

otanical Name	Common Name	Color	Height	Flower Season	Sun	Soil	Visitation by Pollinators	lso a host plant. See pgs 20-21
		P	erennial	Flowers	continued			
Erythronium	fawnliily	white, pink, yellow	0.1 - 0.3	March - August	sun to shade		bees	
Eschscholzia californica	California poppy	yellow to orange	0.1 - 0.5	May - Sept	sun	dry, well drained	bees	
Hydrophyllum	waterleaf	white, blue, purple	0.2 - 0.8	April - July	sun to shade	moist	bees	
Iris	iris	white, yellow to purple	0.1 - 0.4	April - July	sun to partial shade		bees	
Lilium	lily	white to pinkish, orange	0.2 - 1	June - July	sun to partial shade	moist	hummingbirds	
Lupinus	lupine	blue to purple	0.1 - 1	April - August	sun to partial shade	dry to moist	bees	х
Mentha	mint	white to pink or purpleq	0.2 - 0.8	July - Sept	sun to partial shade	moist	bees	
Penstemon	penstemon	white to purple or red	0.1 - 0.6	May - August	sun to partial shade	dry, well drained	bees	х
Phacelia	scorpion weed	white	0.2 - 1	May - August	sun	dry, well drained	bees	
Sedum	stonecrop	white, pink, yellow	0.1 - 0.3	May - August	sun	dry, well drained	bees	x
Solidago	goldenrod	yellow	0.3 - 2	July - October	sun to partial shade	moist	bees, butterflies, beetles, wasps	х
Trillium	trillium	white to purple	0.1 - 0.3	March - June	partial shade to shade		beetles, flies, bees	
				Vines				
Lonicera hispidula	hairy honeysuckle	pink, yellowish pink	< 6	June - August	partial shade to shade	dry to moist	hummingbirds	

https://www.pollinator.org/pollinator.org/assets/generalFiles/PacificLowlandrx 8\_171017\_090207.pdf

Whether you are starting with a brand new landscape or redoing part of an existing landscape or just adding plants to your garden, think about pollinator friendly plants. Also remember the "right plant, right place" adage and consider light requirements, soil drainage, wind, extreme sun exposure when selecting pollinator plants. A drawing and observations of the planting area throughout the day are helpful.

### Shop for Plants

Keep in mind...

- Sun exposure
- Pollinator-friendly plants
- Natives
- Water and soil preference
- Bloom time



Pixabay.com

- From Borage to Zinnia, there are dozens of options
- Visit <u>www.xerces.org/publications/plant-lists</u> for options in your growing environment

Once you have an idea of the number of plants you need, your growing environment (sun/shade, moisture, etc) and a list of options, it is time to spend a little time shopping in nurseries. If you have multiple options, it is a good idea to visit several nurseries. Look for specialty nurseries that may focus on natives or drought tolerance. In the Pacific NW, we are blessed with many options. It is probably a good idea to have a budget in mind so you know whether to reach for the 4" pot or the 2 gallon pot. Remember, you can stagger your planting over a few years.



# Planting for Honey Bees



- Go native
- Plant in clusters and clumps
- Use blues, purples, whites
- Umbra shaped and daisy shaped flowers for landing
- Plant to attract and support the bees throughout the whole season
  - Spring: Oregon grape, elderberry, snowberry, yarrow
  - Summer: California poppies, iris, lupine, oregano
  - Fall: Goldenrod, Joe Pye weed, purple asters, pineapple sage, black-eyed Susan
  - Winter: Hellebores, crocus, loquat

You don't have to manage bee boxes to keep honey bees around your yard. Choose the types of flowers they like year-round to both attract and support them. They need all the help we can give them.

### **Beneficials**





- All these tactics will also aid beneficial insects
- Lady beetles, lacewings, parasitic wasps, etc. control many pest insects naturally
- Pollinate your food and take care of aphids with four easy steps!

Beneficial insects are most useful for controlling pest insects. They are not primarily pollinators. However, controlling your pests (think small like aphids) naturally helps you reduce or eliminate pesticides, which greatly benefits our pollinators.

# Pixabay.com

Any new endeavor is easier to achieve when you start small. So start with these. Once you feel like these are accomplished, do some research and broaden your pollinator friendly efforts. Keep adding flowers that pollinators like and watch them flock to your garden. Get into your stress-free zen.

### **Five Easy Steps**

- 1. Reduce use of pesticides (less work for you)
- 2. Plant pollinator-friendly flowers (enjoy the beauty)
- 3. Provide nesting sites (let some leaves stay on the ground – less work for you)
- 4. Toot your own horn (we all love to brag)
- 5. Watch for those invasives



### **Questions?**

Clark County: mganswerclinic@clark.wa.gov

WSU Extension Master Gardener Volunteer Contact info <u>http://mastergardener.wsu.edu/</u> <u>https://www.facebook.com/WSUMGProgram</u>





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### Resources:



Book: Botany in a Day, by Thomas J. Elpel, Published in 2018 by HOPS Press LLC. ISBN: 978-1-892784-35-3

Book: RHS Botany for Gardeners, Published in 2013 by Quid Publishing. ISBN: 978-1-845338336

Book: Encyclopedia of Northwest Native Plants, by Kathleen A. Robson, Alice Richter, and Marianne Filbert, Published in 2008 by Timber Press. ISBN-13: 978-0-88192-863-1

Pollinator Friendly Alliance: www.pollinatorfriendly.org

### **US Forest Service:**

https://www.fs.usda.gov/wildflowers/pollinator s/Plant\_Strategies/visualcues.shtml, 2024

Xerces Society for Invertebrate Conservation: www.xerces.org, 2024

**Pollinator Partnership:** <u>www.pollinator.org</u>, 2024

Pollinator Partnership: Selecting Plants for Pollinators

https://www.nwcb.wa.gov/pdfs/PacificLowlan drx8.pdf, 2024

U.S. Fish and Wildlife Service: How You Can Help Pollinators https://www.fws.gov/initiative/pollinators/how-

you-can-help, 2024