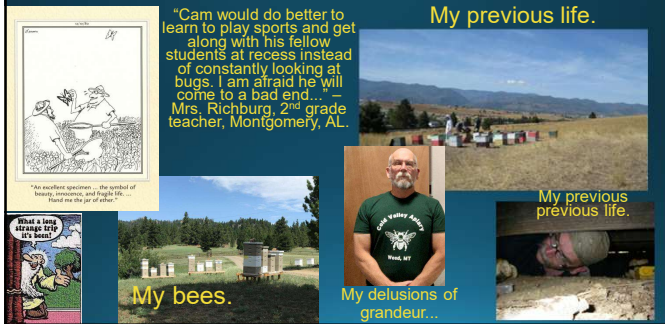


(Who is this guy, anyway...?)



61 Slides, lots of pictures

(not much organization...)

- How to get started.
 - Stuff and where to get it.
 - Bees, ditto.
 - What to do with it once you've got everything.
 - Regulations –wait, what?
- What to expect, and why.
 - How they live, who does what, what makes them sick and what keeps them well.
 - What you should do, have to do, and might want to do.
- Paydays and pink slips.
 - Honey, wax, pollen, and entertainment.
 - And yes, sometimes they just die.
- Ask 10 beekeepers a question, get 12 answers...
 - A few random notes about how I do things.

Disclosures

- I was the Montana State Apiarist from 2010 into 2016.
- I was the "Executive Secretary" for the commercial beekeepers' association for several years.
- I did testify at the Legislature, as a hobby beekeeper, in favor of hobbyist registration.
- I wish we could all live in a laissez faire anarcho-capitalist libertarian paradise that ran on enlightened self-interest, but after 30+ years as a regulatory official in 3 states I don't think there would be any common resources left if we did.

Things We Could but are Not Scheduled to Talk About

- Africanized bees, because they don't survive in Montana.
- Why the regulations are the way they are. Invite MDAg for that...
- Bees and pesticides, because we would be here all day.
- Colony Collapse Disorder, because there has not been a confirmed case since 2009.
- Ask if you are interested.

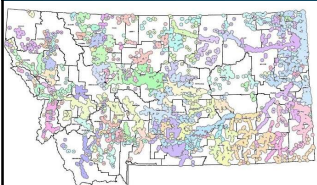
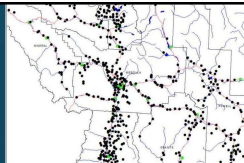
Beekeeping by the Numbers.

- Honeybees are the 3rd largest livestock-based agricultural industry in Montana.
 - \$51M in 2019.
 - (Cows #1, hogs and dairy usually #2.)
- 180,000 to 200,000 beehives in the state.
- 5,000-6,000 registered sites.
- Registration is mandatory, including hobbyists.
- 60-70 commercial beekeepers.
- A few dozen landowners.
- Hobbyists?



Where Are the Bees?

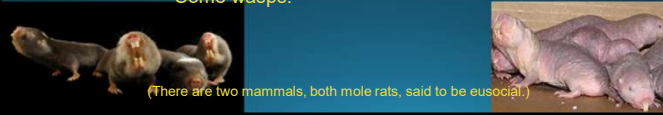
(Commercial sites.)



- Everywhere.
- Just over 42% of the land area of Montana is occupied by commercial apiary sites.

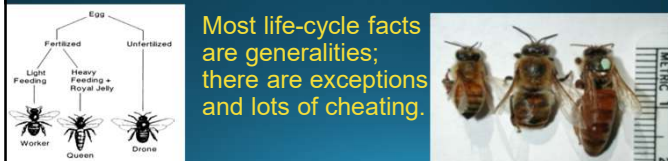
The Basics of Bee Biology

- Honey bees are social insects.
 - Technically "eusocial."
 - Overlapping generations.
 - Cooperative care of young.
 - Division of labor.
 - Most individuals are non-reproductive.
 - The hive is a "super-organism..."
- Other social insects.
 - All ants and termites.
 - Some wasps.



Biology and Life Cycle

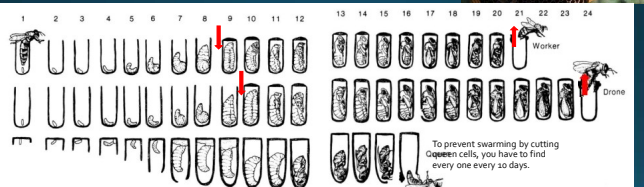
- Queen – one per hive, lays all the eggs.
- Drones – males. Exist only to mate.
- Workers – non-reproductive (normally).



Biology and Life Cycle

- Development times.
- Red arrows = *Varroa* entry.
- *Varroa* mites are the #1 cause of death for beehives.

Queens are fast, drones are slow.



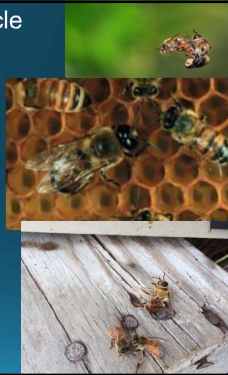
Biology and Life Cycle Queens

- One per colony, live 2-5 years.
- Young queens can lay up to 1,500 eggs per day.
- Queens mate with multiple drones.
- Cell size determines whether she lays a fertilized (worker) or unfertilized egg (drone).
- Her pheromones regulate colony behavior.
- She is not "in charge." Workers will replace failing queens.
- Management implications – replace, don't raise. (Tomorrow vs a month from now.)



Biology and Life Cycle Drones

- Their contribution is purely genetic – they do not work.
- Drones are all haploid brothers.
 - Share at least 50% of their genes.
 - 100% related to the queen – all their genes come from her.
- Mate with virgin queens in flight in "drone congregation areas."
- Die immediately afterwards.
- Drones are ejected from the hive to starve at the beginning of winter.



A Brief Digression: Haploidy in Drones.

- Drones have one set of chromosomes, so every gene is expressed.
- Queens (and workers) are diploid – two sets of chromosomes. Only dominant genes are expressed.
- In queens and workers the effect of the defective "white eye" gene is masked by the normal gene on the other chromosome. This also "hides" the defective gene from natural selection.
- Every now and then one of those larvae with the defect becomes a queen.
- Half of her drones are blind, can't navigate or reproduce.



Biology and Life Cycle Workers

- Young bees are "nurse bees" and "house bees."
- Colony will have 20,000 -70,000+ workers.
- "Summer bees" live 4-6 weeks; "winter bees" live 4-5 months. Winter losses are normally 30%-40% of the colony.
- Worker population is several lines of half-sisters.
 - 75% relatedness within lines.
 - 50% relatedness between lines.
 - 25% related to the drones.



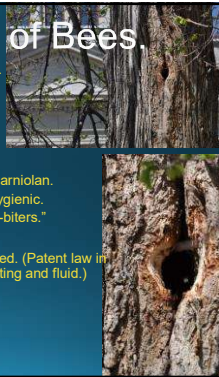
Varieties and Sources of Bees.

- Commercial Stock.
 - Italians, Carniolans, Russian.
 - Packages and "nucs"
 - Usually regional, usually mixes.
 - Local suppliers and mail-order.
- Other sources.
 - Swarms.
 - Splits.
- "Survivor stock" usually isn't. ("Furnished apartment.")
- We generally take what we can get, queen as necessary.

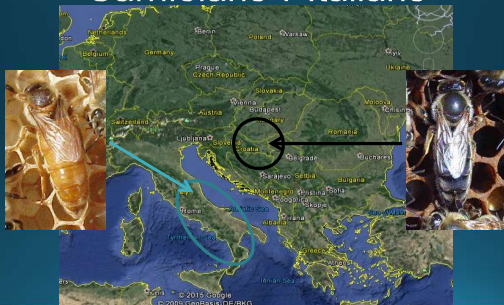
Proprietary Lines.

- Russian
- Buckfast.
- Starline.
- Midnight.
- Saskatraz.
- New World Carniolan.
- Minnesota Hygienic.
- Purdue "mite-biters."
- Others...

• Not all are patented. (Patent law in biology is fascinating and fluid.)



Carniolans v Italians





Swarms

("Yay! Free bees!")

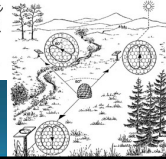
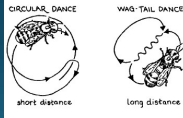
- How the colony reproduces itself.
- Old queen leaves with about half the work force.
- New queen, daughter of the old, stays and builds up the hive again.
- Swarms occur when the hive is "full."
- Swarming is adaptive – it takes a lot to stop it.
- But bees are not smart (they're bugs)...
 - "A swarm in May is a load of hay. A swarm in June is worth a silver spoon. But a swarm in July is not worth a fly..."

Where Does a Swarm Go?

Rarely anywhere that's good for them...

Biology and Life Cycle Foraging

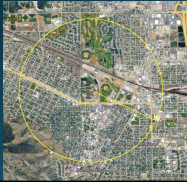
- We know "how," but not so much about "how far."
- Bee "dances."
 - Round: nearby, usually less than 150m.
 - Waggle: distant target.
- Olfactory cues brought back on cuticle or in nectar sample.
- Foragers compensate for the movement of the sun during their travels.
- Exploit near and "good" sources first.
- Maximum is around 6-7 miles.



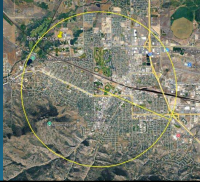
Foraging

- How far will they go?
 - Average is about 2-3 miles.
 - Up to 7 miles in some references.
- Tend to focus on the closest high-value sources first.
- What do they eat?
 - Agricultural crops.
 - Flowering trees.
 - Weeds.
 - Any other source of sugar.
- Water.
 - Major neighborhood complaint.
 - Your bees must have water nearby.
 - Do not prefer clean water.

1 mile; 3.14 sq miles.



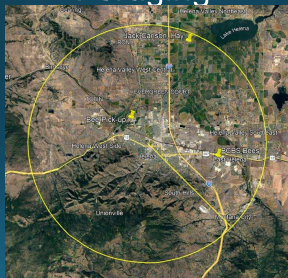
2 miles; 12.5 sq miles.



3 miles; 28.26 sq miles.



Biology and Life Cycle Foraging



7 miles
153.86 square miles

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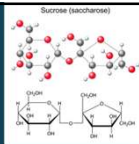
Another Brief Digression: does this make any sense...?



Product of Brazil.
Product of Canada.
Product of Brazil and Canada.

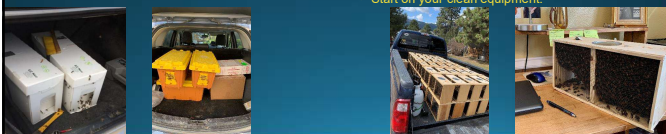
Biology: Nutrition

- Nectar provides carbohydrates.
 - Glucose, fructose, and sucrose.
 - Some carbohydrates are converted to lipids for storage.
 - Other sugars, depending on plant species.
- Pollen provides proteins, vitamins, lipids, sterols, and micronutrients.
 - Most pollen is not a complete source of amino acids.
 - Lipids and sterols are hormone precursors.
 - 10 essential dietary amino acids. "Building blocks" of proteins.
- "Atypical foraging" or "puddling" for minerals.
- Bees winter better on honey than on sugar syrups. (They do winter OK on syrup.)



Getting Started: "Nucs" and "packages."

- "Nuc" or "nucleus."
 - Five frames with an established laying queen.
 - Three frames of brood plus two frames of stores.
 - Faster start, but available later.
 - Easier to store.
 - More expensive.
 - Always local and can't be shipped.
 - Existing frames (condition, mites, pathogens, chemicals).
- Package bees.
 - Three pounds of bees in a box with a separate queen and about a quart of sugar water.
 - Queen has to be introduced and accepted.
 - Slower to develop, but available earlier.
 - Cheaper.
 - Can be mail-ordered; more choices of types of bees (allegedly).
 - Must be installed within a few days.
 - Start on your clean equipment.



Getting Started: Installation.

- Nucs.
 - Place the frames in your equipment.
 - Fill in with new frames.
 - Feed and treat.
- Packages.
 - Remove the feed and set the queen aside.
 - Dump and shake bees into hive.
 - Fill in frames.
 - Wedge queen cage between frames, carefully.
 - Feed; treat only when established.



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A Few Local Suppliers

- Arlee Apiaries, Arlee, MT. Jherianne Fluke, 406-560-1307 (Nucs)
- Bald Mountain Apiary, Whitehall, MT. Scott Steinfeldt, 406-494-4683 (Nucs and Queens)
- Drange Apiary, Laurel, MT. Jody Drange, 406-656-5557 (Nucs)
- Hazel's Honey, Livingston, MT. Andy Bauer, 406-223-6202 (Nucs and Queens)
- Country Boys Honey, Great Falls, MT. Rod Smith, 406-788-2880 (Nucs)
- Sunshine Apiaries, Columbus, MT. Patty Sundberg, 406-322-5780 (Nucs)
- Montana Honey Bee Company, Bozeman, MT. Steve Thorsen, 406-624-6446 (Supplies, Packages and Queens)
- Western Bee Supply, Polson, MT. Rick Molenda, 406-883-2918 (Supplies)
- There are probably others.
- As with everything else in life, there is no shortage of on-line scams.

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Feeding.

- Pollen patties.
 - Summer: high protein, for stimulating brood production.
 - Winter: low protein, lots of sugar, for keeping them alive.
 - Medicated patties are available.
- Syrup.
 - Water and sugar are approximately equally dense.
 - Mix by weight or volume.
 - 1:1 is for normal feeding. For spring build-up.
 - 2:1 (sugar:water) is for make-up building of stored honey in the fall.
- Feeders.
 - Can also deliver medication.
 - Frame feeders.
 - Anal and Dadant.
 - Top feeders (many designs).
 - Entrance feeders.
 - "Mountain camp" winter feeders.
 - Fondant (winter feed).
- "Winter weight."
 - How much honey to get through winter.
 - Depends on bees and location.
 - Where I am, about 110 pounds.
 - Too much limits space for spring brood-rearing.
 - Too little and they starve.



Winter

- What do bees do in the winter?
 - Stay home a lot...
 - Form a cluster and generate heat.
 - Keep the queen warm.
 - They don't freeze, but they do starve.

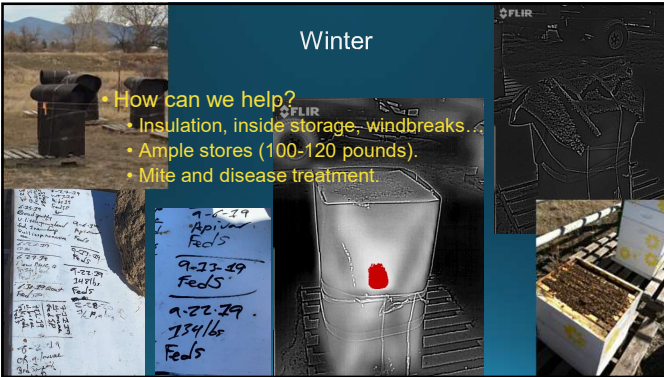


These bees ran out of food. ↑

These bees are just fine.

Winter

- How can we help?
 - Insulation, inside storage, windbreaks...
 - Ample stores (100-120 pounds).
 - Mite and disease treatment.



Diseases

- AFB – American Foul Brood.
 - Most important.
 - Bacterial, spores are very persistent.
- Nosema – “bee diarrhea.”
 - Probably a close second.
 - Microsporidian – kinda like a fungus.
- European Foul Brood.
 - Waxes and wanes year to year.
- Viruses (we'll talk about with *Varroa*.)
- Stress diseases – chalkbrood, tracheal mites...
- Pesticides.

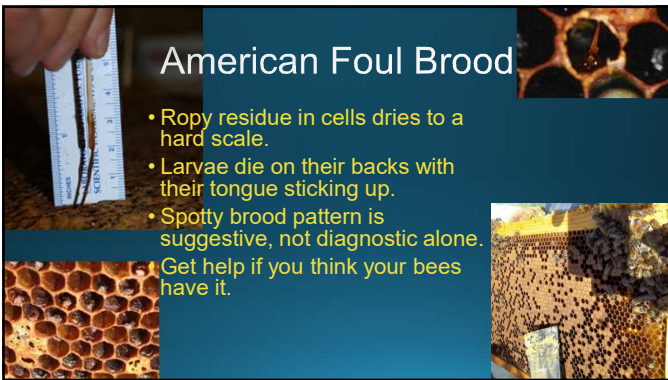
American Foul Brood

- Forms highly persistent (50+ years) bacterial spores.
- Spread by robbing, used equipment, dirty gloves and tools.
- Distinctive odor fades with time.
 - "New bicycle tires."
 - "Rancid liver and onions."
 - "Glue." (Hoof and hide glue.)
- Kills brood after capping.
- Caps are dark, oily.
- Cells have a distinctive scale.



American Foul Brood

- Ropy residue in cells dries to a hard scale.
- Larvae die on their backs with their tongue sticking up.
- Spotty brood pattern is suggestive, not diagnostic alone.
- Get help if you think your bees have it.



American Foul Brood

- Diagnosis.
 - Odor.
 - ELISA kits – very sensitive.
 - "You'll know..."
- Treatment.
 - Diesel fuel (not gasoline).
 - Antibiotics (requires VFD).
 - Foundation swapping, radiation, boiling in paraffin, essential oils, herbal preparations...
- AFB is highly contagious and persistent.
- It is a community problem.
- Don't be that guy...



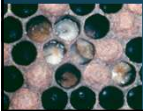
European Foul Brood

- Also bacterial.
- Moderately persistent – can persist in wax for several months.
- Spread by robbing and used equipment.
- Kills uncapped brood.
- Anecdotal reports indicate it may be increasing. (The plural of “anecdote” is not “data.”)



European Foul Brood

- Diagnosis.
 - Larvae “melt” and turn orange-ish brown, with prominent trachea. “Peeled oranges.”
 - Smell is sour and “fishy,” but not strong.
 - Not ropy.
- Treatment is tetracycline, and requires VFD.



What is a VFD?

- Veterinary Feed Directive.
 - Applies only to antibiotics also used in humans.
 - Intent is to manage resistance, prevent “superbugs.”
 - Tetracycline, tylosin, lincomycin, derivatives, others as determined by FDA.
 - NOT Fumagillin.
- Must be issued by DVM and within the “DVM-client-patient” relationship.

Nosema

- Microsporidia – related to fungi.
 - “Bee dysentery.” Bees defecate in and on the hive.
 - Worse in the winter, when bees are confined.
 - Seriously interferes with protein metabolism.
- *Nosema apis* and *Nosema ceranae*.
 - *N. apis* used to be the only species in North America.
 - Mostly a winter problem.
 - Rarely lethal.
 - Responded to Fumagillin.
 - *N. ceranae* has pretty much replaced it.
 - Much more virulent.
 - Fumagillin is not nearly as effective.



Nosema

- Treatment.
 - Fumagillin-B and Fumadil-B.
 - Essential oils. (Many brands and types.)
- Cultural control.
 - Resistant stock.
 - Ventilation.
 - Clean and recycle equipment.
 - Strong colonies.



Viruses

- There are about a dozen affecting bees.
 - MSU (Michelle Flenniken's lab) is a hotbed of bee virus research.
 - Most are very similar single-stranded RNA viruses. (Same taxonomy as flu, rabies, coronavirus, ebola...)
 - Many are “paralysis viruses.” (Israeli, Lake Sinai, chronic, slow, acute, deformed wing, Kashmir...)
- At lower levels of infection, the paralysis viruses have subtle behavioral effects.
 - Navigation.
 - Foraging.
 - Social behavior.
 - Sound familiar...?

Deformed Wing Virus

- Most common, or at least most easily observed.
- Vectored by *Varroa* mites.
- *Varroa* is probably a true vector – virus replicates in the mite.
- Affects behavior and immune function.
- Late-stage “terminal” bees often crawl around the yard.

Deformed Wing Virus



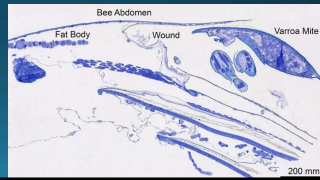
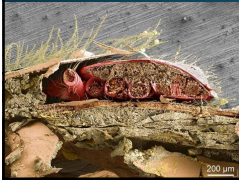
Varroa destructor



- It ain't called that for nothing...
- *Varroa* mites are far and away the #1 cause of bee mortality in the US.
- Direct effects are bad enough – damage integument, ~~suck blood~~, weaken larvae and adults.
- Indirect effects are probably worse.
- Maintain viruses in circulation inside the hive.
- ~~Mechanical and biological~~ transmission.
- Uninfected mites can acquire viruses by sharing a brood cell with infected mites.

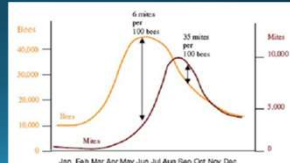
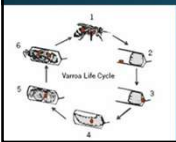
Varroa destructor

- Not actually a “vampire.”
- Feeds on fat bodies, not haemolymph.
- Fat bodies are a bee's liver and immune system.



Varroa destructor

- Growth is exponential.
- Collapse occurs in fall, when drones are not produced and mites shift to workers.



Varroa destructor

- Develops in capped cells, life cycle is 10 days.
- Lives on bees. Spread by robbing, drift, and lurking on flowers.
- Prefers, and produces more offspring in drone cells than in workers, but infests both.



Varroa destructor

- The current recommendation is to maintain mite levels below 2%. (That's essentially "zero.")
- Usually about half of NHBS samples have levels of *Varroa* over 4%.



Varroa Sampling

- Lots of options, but **DO SOMETHING!**
 - Sticky boards, sugar rolls, washes.
- All are of about equal relative accuracy. "Very low" is the target. "Medium" and "high" both equal "dead."



Varroa Control

- Conventional pesticides (amitraz, coumaphos, fluvalinate).
 - Organic acids (formic, oxalic, lactic, beta hop acids).
 - Essential oils (Thymol).
 - Resistant stock.
- Pesticide resistance is inevitable.
- Integrated Pest Management.
 - Manage resistance by using a variety of methods.
 - There are no silver bullets.



"Varrox" for Varroa Control

About 1-1.25 grams per deep. You will have to time your vaporizer. It will slow down as the battery discharges.

"Varrox" 12V vaporizer. You will need a battery and a respirator. The Varrox can be shock-cooled.

This is not a registered pesticide. I am not a regulatory official.

If You Don't Treat for Varroa, Your Bees Will Die.

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.

Smoker fuel is where you find it. Be able to put your smoker out.

Always have more than one hive tool. Don't be afraid to modify your equipment.

If you're going to light the smoker, light the smoker!

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Feeders bulge, get stuck, and drown bees. Fix them.



Recycle your old frames. Make candles!



There are many ways to feed bees.

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Check for mites.



Yay! Free bees!



Replace your queens. Control your genetics. That doesn't necessarily mean "buy them." Befriend the UPS guy...

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Warming box for crystallized honey.



Building stuff is cheap fun.



Robbing screen.



Mark 1 bee feeder.



Mark 2 bee feeder and bee-stuff carrier.

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



What success looks like in the early spring. "Mountain Camp" feeding method.



Mountain camp feeder frame with 10 pounds of sugar. Note the bumpers for ventilation. Sugar will also absorb excess moisture.

Untouched all winter, devoured in the spring.

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Don't set your bees on the ground. It's hard on your back.



Glue and nail your frames. You're building for years.



Wash your gloves. Often.



Always have tape. Wear a hat, too.

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Be organized. Make a list of what you need to bring to the bee yard.

Drinking water. Wash water. Extra tools. Tape. Nails and screws. Tools. Fire and smoke. Fire extinguisher. Sting kit.

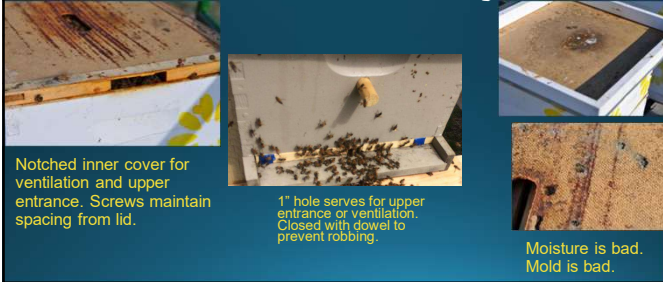


Paint pens to take notes, stylus to take pictures (with gloves on.)

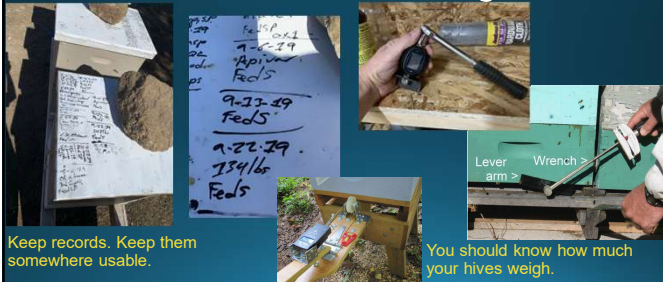


Don't bring the dog...

Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



Tips, Tricks, & Things to Watch Out For: How Cam Does Things.



So What's a Beekeeper to Do?

- Bees are livestock. Treat them that way.
- Start with healthy stock and good genetics. Keep them that way.
- Shelter them. Feed them when they are hungry, and treat them when they are sick. Leave adequate winter stores.
- Control Varroa.
- Inspect your hives.
- Replace your queens regularly.
- Follow the literature so that you know what you're looking for. (That doesn't mean internet blogs that support your favorite narrative...)
- Minimize stress, maximize health.



