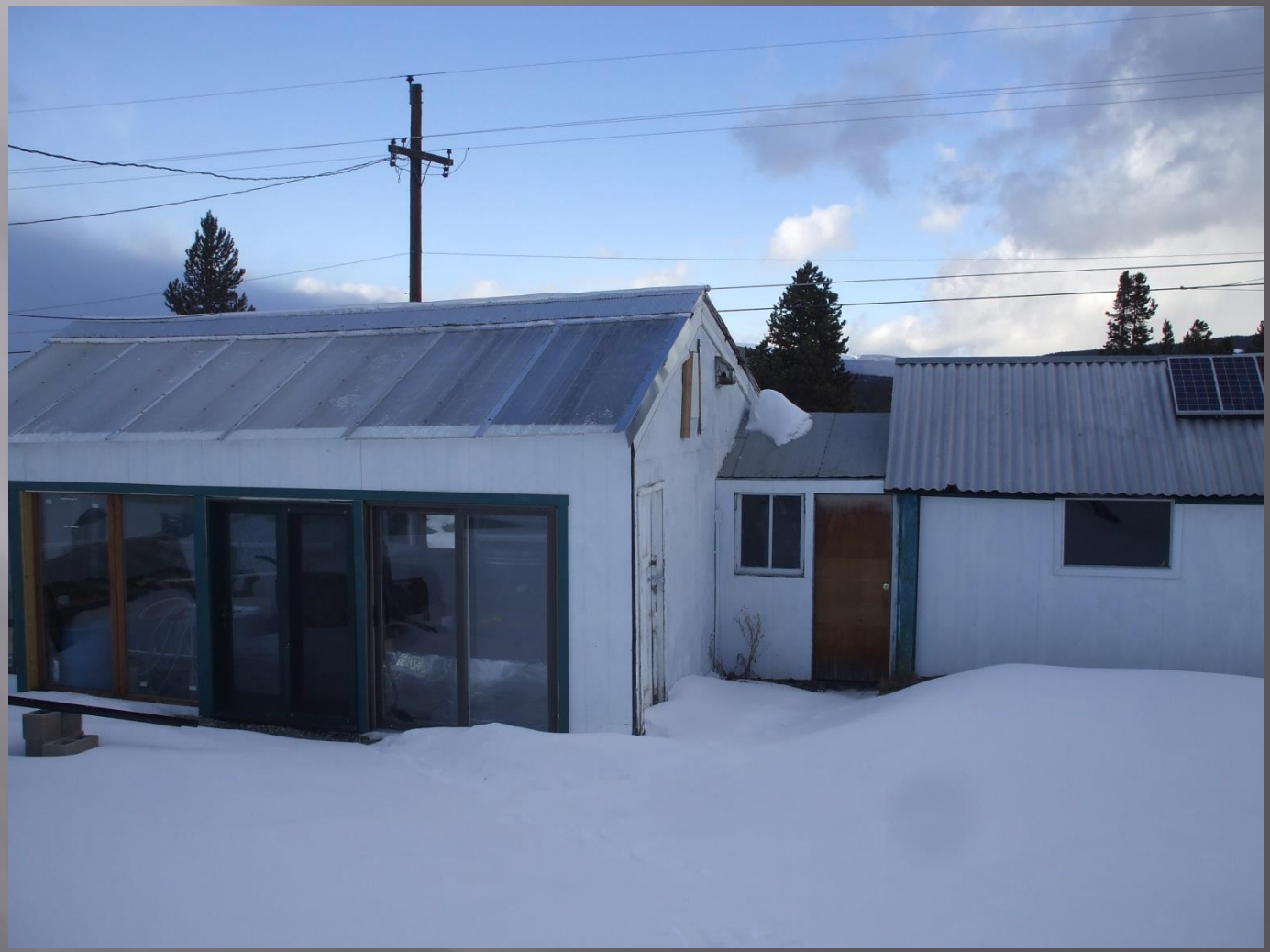
Aquaponics at 10,000ft: Trout in a Shack



Resources we started with…

- I've been building things as long as I can remember, as my parents run the Earthwood Building school, which focuses on Cordwood Masonry and Earth Sheltered Housing.
- My wife and I had previously built an off-the grid home and ran our car on used vegetable oil for two years – we're comfortable with unconventional and improvised systems.
- We were shopping for a house in Leadville anyway, and made an outbuilding with greenhouse potential one of our ideal qualities.

Resources we started with…

- Have built/helped with a few greenhouses before – learned some things to avoid in harsh climates. (hoop-house with poly covering, glazing north side, expensive heating/cooling systems, inadequate thermal mass.)
- Didn't have much money for this project – needed to use indigenous or repurposed materials as much as possible.

Why an aquaponics greenhouse at 10,000ft?

- Poor local soil – Leadville was a mining town and much of the soil is contaminated, and it is also low in organic material.
- Short growing season (about June 20th – August 20th) – a greenhouse is required to grow many standard garden crops.
- Also dry and windy – aquaponics is much more water efficient.
- Thermal mass – circulating water is a great way to store solar heat for cold nights.
- Plus other AP advantages – reduced watering, weeding, and fertilizing. Source of protein.

What has worked well…

- Planter beds made of repurposed wood from demolition lined with pond liner material – inexpensive and no leaks after 3 years.
- Planters filled mostly with granite gravel. We covered the top two inches with Hydroton as a compromise with what others were using, but now I would stick with gravel: less expensive and easier to get out of root balls. (but heavier).

What has worked well…

- Automatic feeders – allow freedom, reduces maintenance time. But regular monitoring and hand feeding supplements.
- IBC tote fish and sump tanks – inexpensive, flexible, durable.
- Clear bubble wrap under glazing
- Raising trout…

Fish

Raising Rainbow Trout!

- Locally available
- 8 months from fingerling to harvest size
- No fish lost to unknown causes/disease
- Very tasty! Easy to clean.
- Tolerant of water temps from freezing – 70 degrees F in our experience. (typical summer temp – 63 deg. F.)

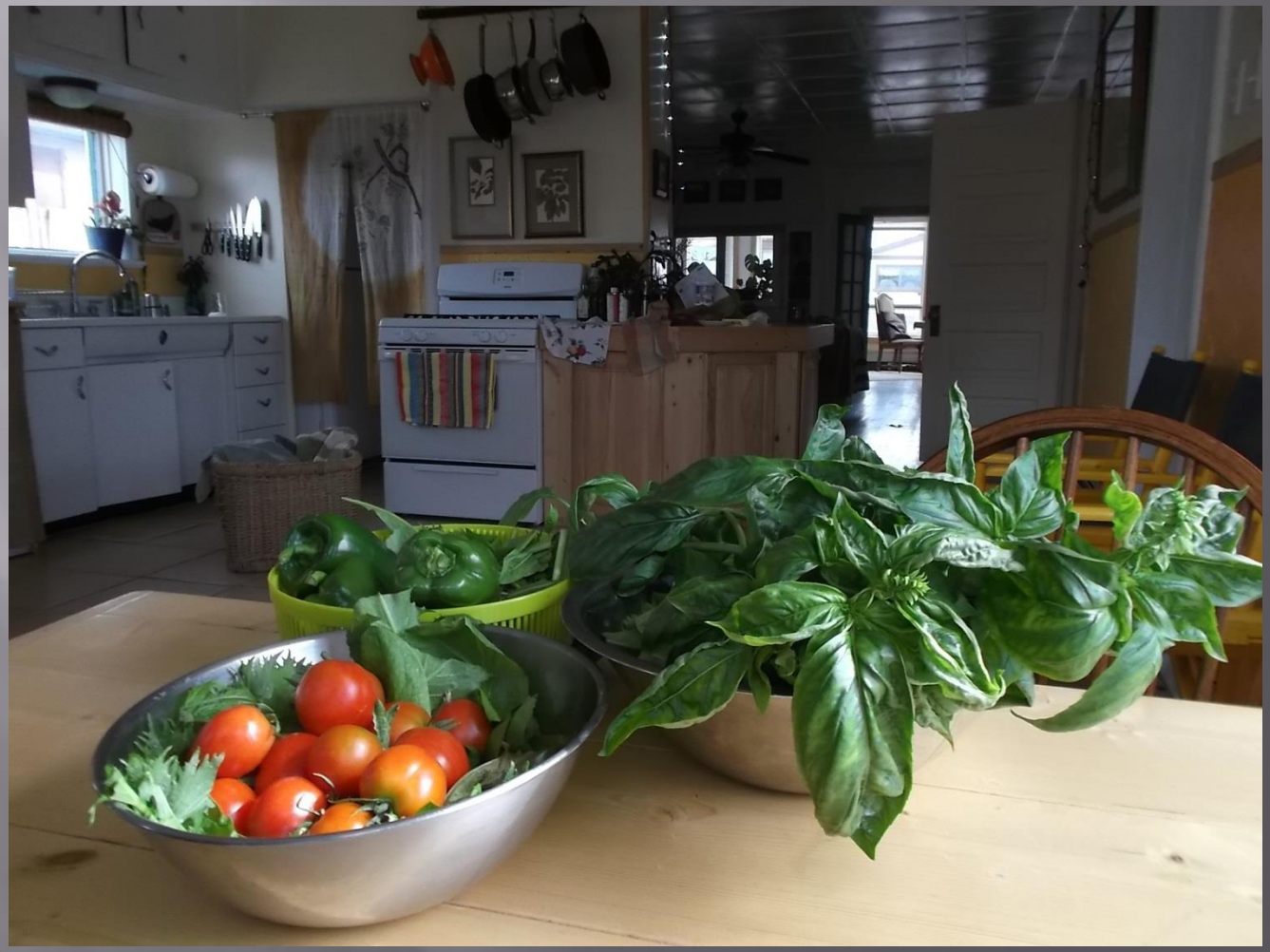
Raising Rainbow Trout!

- Fed with commercial pellets (nice with automatic feeders), with worms from vermicomposting supplements.
- Want to try Black Soldier Fly larvae for feed next.

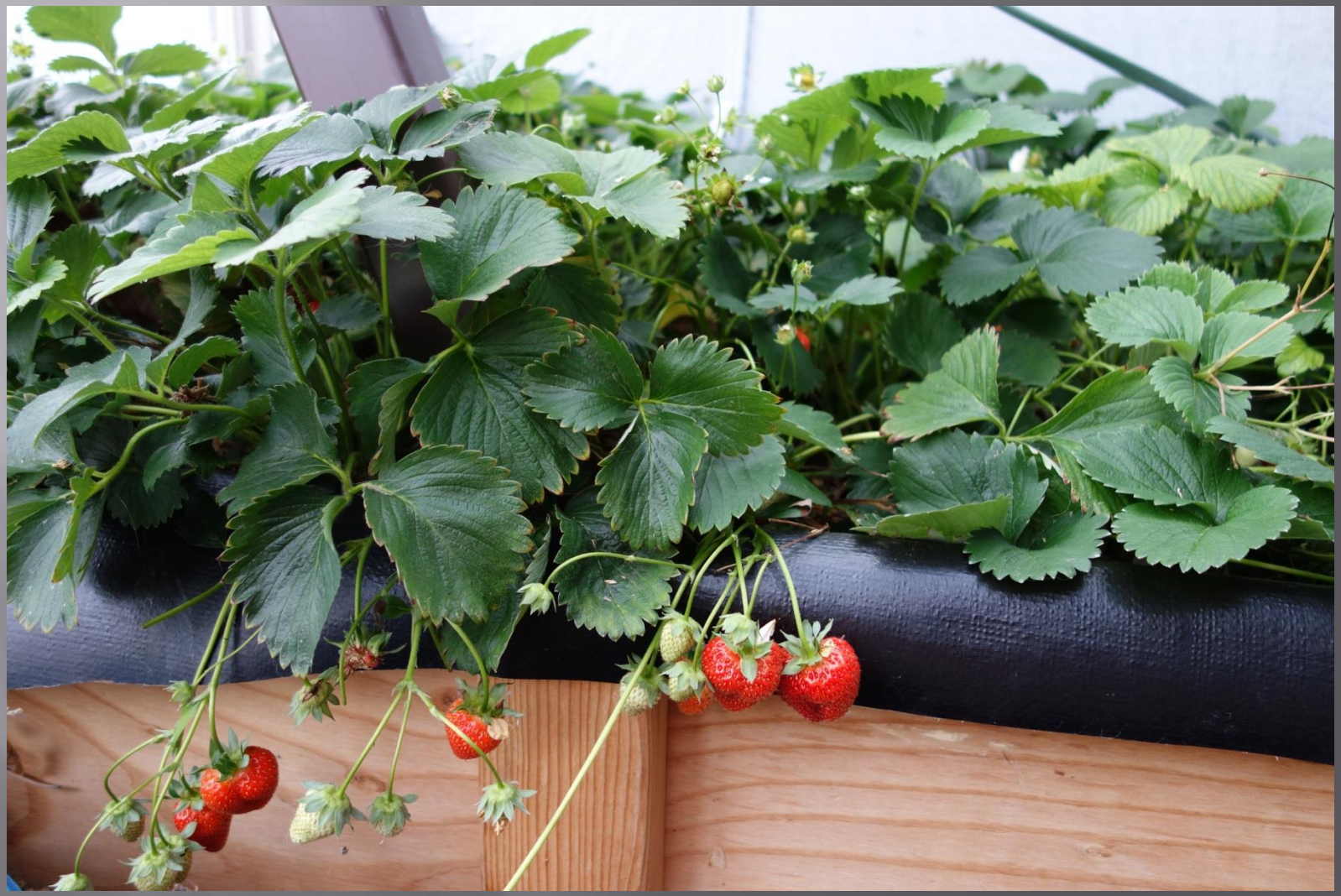
The great Tilapia disaster…

- Tried Tilapia in one tank in 2013.
- Spent a lot of time/money heating water to Tilapia temps (70 deg +) in our climate
- Tilapia were extremely slow growing – most failed to reach harvestable size in 8 months.
- High mortality rate – possibly diseased population?
- Spiny – punctured hands through rubber gloves when cleaning.
- Less appetizing flavor, less nutritious (in my opinion)
- Verdict: too cold in Leadville for Tilapia!

Plants



Strawberries!



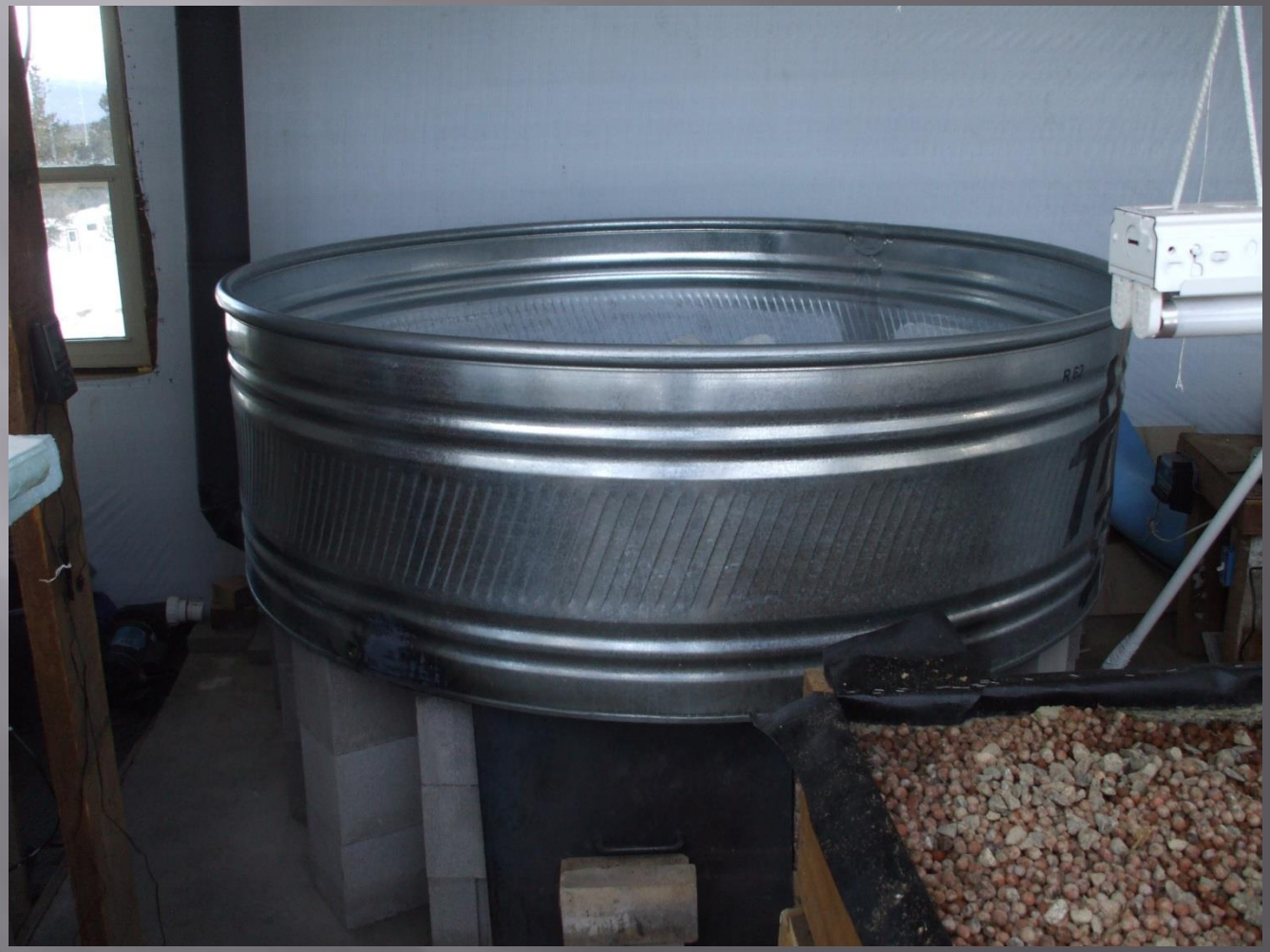
PLANTS

- Great success with strawberries – consistent fruiting, insect resistant, perennial, self-spreading.
- Consistent success with most greens (but not spinach?)
- Good tomato harvests, but still looking for best varieties.
- Peas, cabbage, carrots all successful
- Variable success with cucumbers, basil, peppers. Mostly due to insect issues, but also water/air temperatures.

Bugs

- Aphids! Were devastating the second spring, but completely controlled with Aphidius Colemani
- Spider mites – still a problem, particularly herbs and cucurbits. Tried predatory mites, but no success (humidity?)
- Root aphids – possibly damaging some crops. Seeking best control method.

Wood-fired hot tub



Wood Fired Hot Tub

- Efficient way to heat the greenhouse, and fun place to relax in.
- Total cost: about $400, took 2 days to build.
- Mostly used in late winter/early spring to get a kick start to the season.
- Acts as additional thermal mass through rest of year – so much mass now that the exhaust fan is now irrelevant: temp will not rise above 90 deg F.

Other features…

- Rainwater collection from south roof direct to AP system.
- Solar power backup system – nice to have, but have never needed!
- Two separate AP systems, each with one 250 gallon IBC tote and two 4’x 8’ planters. Nice for redundancy (less chance of loosing all fish), and fit space nicely, but twice as much fiddling with flow rates, water levels, water testing…

What I'd do differently…

- Shape, structure, insulation, etc. of the existing "shack" really weren't ideal for a greenhouse. Moisture problems, cold drafts, rodent control, and shading are less than ideal.
- Could certainly have built a better greenhouse from scratch – but liked re-purposing building and saved money.
- One large fish tank instead of two systems?
- Better job insulating before AP system startup, I was too excited! Now hard to reach some walls.

What I'd do differently…

- Wouldn't bother with lights – not worth cost for our system.
- Exhaust fan with thermostat hasn't been needed since adding hot tub and barrels for thermal mass and bubble wrap for additional insulation under glazing – could have saved money here
- Not used Hydroton, just stuck with gravel

Kind of year round…

- As long as the water is circulating, the system doesn't freeze up in winter (even without added heat)
- Greens established in fall are good all winter
- Not much winter plant growth
- Harvest all fish in Nov/Dec
- Worth keeping water running for perennials and worm population
- Plant growth resumes in April

Rough accounting:

- $5000 for greenhouse and AP system materials
- About $15/month for electric for pumps.
- Spend 1-2 hours per week for general maintenance, gardening, feeding, etc.