The Goose

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Gothic: A Field Journal

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Ian walked me to my cabin. Ice and snow crunched beneath me and I tried to avoid getting covered in mud, although the ethereal darkness made it difficult. Secluded in the black stood Marcellina cabin, where I was to spend the summer. I really didn't know what I was getting myself into; I told my family that the cabin was named Marietta.

Affectionately known as "rumble" by the scientists there, the Rocky Mountain Biological Laboratory is a Mecca for ecological researchers across the continent. For over eighty years, the relatively unspoiled forests of Colorado's Elk Mountains have served as a natural laboratory for questions from land succession and climatic patterns to pollination and animal behavior. The town of Gothic is a former silver mining boomtown, named for the imposing mountain sentinel looming protectively over it. Its buttressed peaks and towering cliffs reminded the valley's settlers of European cathedrals. Now the valley is scientific holy ground; the area's most valuable resources are flowers and marmots rather than fuels and metals. I was not one of the field-leading scientists fulfilling government grants to explore the region's ecology. Instead, I was one of thirty students selected to participate in RMBL's undergraduate summer research program. Why they selected me I'm not entirely sure—a sentiment shared by nearly all of us.[1]

After breakfast, Ian, RMBL's executive director, guided us through the townsite of cabins and research buildings. We all focused more on the mountains surrounding us than what was at our feet, and several of us stumbled.

Ian pointed out peculiarities and anecdotes from around town: the skunk cabbage that causes birth defects in sheep, the filtered stream diversion experiment on fly reproduction, the warming meadow where data has been collected for over twice my lifetime.

The finale of the tour was a set of rectangular plots, bounded by string and anchored at the corners with wooden stakes. There were three of them in a field near the classrooms, lying unobtrusively among the dandelions.

"Now these plots," Ian said, "have been a long-term project of one of our long-time researchers, Dr. Inouye, from the University of Maryland."

[1] I would like to thank all the people and staff who made my time at the Rocky Mountain Biological Laboratory an adventure I will never forget, and for giving me the research experience that made admission into grad school easier. I am eternally grateful.

Our eyebrows rose at the seemingly unimportant twine-marked rectangles.

“Since 1971, Dr. Inouye and his students have monitored these plots and recorded the exact dates of flower blooms, and the species in the sections. It began as a simple survey, and sort of coincidentally, it has become one of the world’s longest running climate change datasets.”

As the date of snowmelt creeps forward, the plants become exposed to sunlight and warmer air temperatures earlier and earlier. The flowers bloom earlier than they did in the seventies by almost a month. In the past, Dr. Inouye could finish his semester in Maryland before the flowers would wake up, but now he must send a grad student there in advance.

Ian went on to say that the plots had the dubious distinction of making it onto several Senate Republicans’ “Pork Reports,” supposedly highlighting the most egregious wastes of tax dollars. Ecologists are often belittled by the claim that they “only study their backyards,” and that biological constants like cell structure and DNA are more deserving of study than the never-identical landscapes of the outside environment. The National Science Foundation grants go toward travel to the station and the expenses necessary to maintain the project, but in this case even the twine is strung together from recycled mailroom packaging to reduce costs as much as possible. Maybe if the lawmakers better understood what insights the backyard scientists can provide, like analysis of large-scale climatic shifts, they would want their dollars spent on them instead of a tank or border fence.

Dr. Inouye was one of many professors from across the country who mentored students in the undergraduate program. My mentor from Dartmouth College was a pollination specialist, and bees were the name of her lab’s game. Despite the abundant wildflowers, in Gothic Valley the altitude is too high for honeybees, so bumblebees are the region’s most prolific pollinators. I arrived in Gothic before my mentor, so in the meantime I went “bee bowling” with her lab’s returning veterans.

Like people, bees come in a variety of shapes and sizes. Also like people, they are prone to temptation. To study bee populations, we used bee bowls: small plastic bowls painted blue, yellow, or white. The bees, thinking they’ve found the world’s biggest dandelion, land in the bowls to get nectar, only to be stuck in a soapy solution that they eventually drown in. It’s gruesome, but essential for understanding bee populations and their trends. It is illegal to harm the bumblebees though—not that we would if we could—and the bee bowls are designed to catch the small bees masquerading as wasps or flies. For bumblebees, we broke out the butterfly nets.

To safely catch the bumblebees, you must get them in the net, flip the net around a few times to disorient them, close off the part of the net with the bee with your hand, manipulate the bee container through your hand, trap the bee between the net fabric and the container, get the

container out of the net, cap the container with a plunger, and carefully press the bee against the container's mesh to mark it—all without losing the bee, hurting it, or getting stung.

The bumblebees are of the genus *Bombus*, the most frequently caught ones were of species *bifarius* or *sylvicola*. I called them "biffs" and "sylvies" for short, but we all have our own nicknames for them. When caught, the bumblebees would buzz angrily for a while, then often sit in resignation to their fate while we marked them with a paint pen. Up close, you can see the fuzz of their abdomens, in a suit of orange, black, and yellow straight out of a kindergarten coloring book. They're cartoonish creatures, and despite the unnerving tremor of their buzzing, they're actually pretty cute. Even if they weren't federally protected, I wouldn't be able to stomach hurting them; their charm is overpowering. When we let them go, they never turned on us in revenge, but simply flew off to find more nectar. Maybe they were annoyed more than anything by the silly humans and their habits.

My project was on hummingbirds. Specifically, how do they react to nectar robbing of flowers? Scarlet gilia (*Ipomopsis aggregata*) is a plant adapted to hummingbird pollination; its crimson trumpet flowers are perfectly molded for hummingbird beaks. One bumblebee species, *Bombus occidentalis*, is known to bite holes at the flower's base, accessing nectar through a back door. This is referred to as nectar robbing, although I like the needlessly legalistic term "floral larceny." The robbers either drink from the hole they made (primary robbing), or use an existing hole to get nectar (secondary robbing). I was to replicate my graduate mentor's project from the year before, growing her dataset to determine whether differently robbed plants experience differences in reproductive success. My mentor previously determined that hummingbirds could differentiate between robbed and unrobbed flowers, but she didn't know if they could differentiate between robbing types, and if they could, whether they would act differently toward such flowers. For example, if hummingbirds visited fewer primary-robbed flowers than secondary-robbed ones, then the primary-robbed plants would experience less pollination and may produce fewer seeds.

On a hill roughly half a mile north of Gothic, my mentors and I picked out a study site. Before the flowers bloomed, I marked sixty plants and randomly selected whether I would artificially rob them with one of the two robbing types or leave them intact. My graduate mentor said that the gilia plants are above ground for years, but only flower once, "making a decision" to flower or not and sending up stalks covered in crimson tubes. It's easy to forget that plants are alive because they paint the landscape like montane rocks, yet they essentially decide whether to bloom or not. It almost didn't seem right for me to manipulate their chance at carrying on their lineage. The ethics of science—and the balance between protection of the individual organism and knowledge or protection of the larger ecosystem—are often unclear.

For my control plants, I slipped a cap of clear plastic straw over the tubular section of the flower to prevent bees from cutting them. On primary treatment flowers, I cut a hole at their base and

drained the nectar with a thin glass tube called a microcapillary tube and then put a cap on the flower to keep secondary robbers out. For secondary treatment flowers, I drained the nectar each day and reattached the cap. For each plant, I counted how many flowers were blooming and reset any caps that had fallen off during the night.

I began waking up prior to 6:00 a.m., when the valley was shielded from the sun and the temperature was below fifty degrees. I needed to get to my research site before 7:00 a.m. to treat my plants before the biting flies awoke and get through "Marmot Meadow" before other researchers began their observations. Passing through the meadow while they were observing the woodchuck-like rodents would potentially corrupt their data. The marmots were often emerging from their holes as I passed through, cautiously glancing at me from behind boulders. They were marked with black dye and named for the symbols painted on their backs. A large marmot and her pups hung out on a boulder near the path. She had a circle with a slash through it, so I called her Cancel, but I didn't know what her official name was.

After treating the plants, I observed the hummingbirds and timed their visitations to my test plants. The broad-tailed hummingbird (*Selasphorus platycercus*) and the rufous hummingbird (*Selasphorus rufus*) were the two species that floated among the flowers. Male broad-tailed hummingbirds whizzed around like iridescent green bullets, a specialized feather in their tails making a distinctive whistle as they flew. Female broad-taileds and both sexes of rufous hummingbirds didn't make as much noise and glided through the valley like fairies. Perched up the hill from my test plants, I sat as still as possible, trying to ignore the biting flies crawling up my limbs and squinting through shimmering clouds of gnats to watch the fairies that daintily drank from the glasses nature carved for them.

The hummingbirds were nearly as frustrating as they were beautiful. One female rufous hummingbird would sit in the aspen sapling above my head and chase away other birds that came into her adopted territory. Of course, she only drank from my test plants every few days. Maybe if she knew what I was doing she would have helped.

On Independence Day weekend, the annual 1/3 marathon down the mountain from Gothic into Crested Butte took place. By 7:00 in the morning, our town was filled with runners ready to sprint back toward civilization, fleeing nature after a brief visitation. I left before the race officially began so I could walk the eight miles into town. As the runners began to pass me, Styrofoam cups accumulated on the roadside, where thick grass tried to hold them back from the nearby pristine mountain streams that eventually connect to the Pacific.

Crested Butte's population mushrooms for the holiday weekend and, as tradition dictates, the students and faculty from RMBL participate in the post-race parade. Some of us sweaty from the trip down the mountain, and many of us bearded, we looked like rejected extras from *Lost*. In the center of our group rode one of RMBL's cooks on a golden bicycle, dragging a rickshaw. Sitting in the cart like a foreign dignitary was a papier-mâché marmot that hid a keg of cheap

beer and looked more like a withered yellow gummy bear. As we walked the parade route we yelled our responses to Dr. Scott Wessinger's questions:

"Who are we?"
"WE ARE ROCKY MOUNTAIN BIOLOGICAL LABORATORY FOUNDED IN 1928!"
"And what do you do?"
"SCIENCE!"
"Where do you do it?"
We pointed up the valley, "OVER THERE!"

We all cheered and began to chant, "R-M-B-L! R-M-B-L! . . ."

We continued the ritual all along the parade route as part our yearly public outreach effort, meant to give an amusing and engaging face to the often-clinical field of science. The deep crowd of onlookers laughed, pointed, and snapped pictures, taking great delight in the absurdity of our unconventional appearance and performance. We made a sharp contrast to the manicured storefronts and quaint charm of Crested Butte. I wondered how many of the people whose photos I may have appeared in looked us up, or simply wrote us off as eccentric hippies.

One of the cabins frequently hosted campfires at their pit. Alcohol, pot, and musical instruments were passed around as the fire crackled and wood and drug smoke mixed.

One of us spoke up after our joints were exhausted, "Does anyone know any scary stories?"

An ex-military student I'll call Tigger said, "You know what's really scary? We're over 350 with no sign of slowing down."

Three-fifty referred to parts per million of atmospheric CO_2, a benchmark popularized by environmental activist Bill McKibben. The 350 threshold marks the estimated boundary between recoverable and permanent environmental harm from carbon pollution. We're now over 400.

The crowd around the campfire sighed in defeat and shook their heads.

"I work at the warming meadow, where the microclimate is about two degrees warmer than most of the valley. It's all sagebrush, and that might happen to the rest of the valley if it keeps warming," one of the students said.

I looked up at the aspens above our heads, taking root where they could among the pines and boulders. There was a breeze, and it seemed like the trees were trembling.

"It'll look just like California," he continued. "And that's terrifying."

"Maybe that's what they want," someone said. "The U.S. won't stop until the whole world is California."

The sagebrush and oak hills of the Central Valley are brown, uniform, and beautiful in their own way, but very different from the unkempt verdant mountainsides that surrounded us.

Easier to develop.

"Tigger, why'd you bum us out?" another student said, somewhat frustrated.

"Hey, you guys asked for scary stories. Don't shoot the messenger."

I grabbed another log and put it on the fire, sending up a flurry of embers. The logs in the pile were aspen and pine. When the valley warms and they die, they'll burn just as brightly, standing upright as wildfire consumes them.

The rectangular twine plots near the research center are shaped like graves.

I had a spectacular view from my research site, and watching the morning arrive was so entrancing I almost wished I didn't have to focus on the sprite-like hummingbirds gliding across the valley. There was a placid mirror of a pond adjacent to the East River beneath me, caused by the skilled engineering of a lone beaver. I saw the beaver twice, nothing but ripples and a swimming stick betraying its presence. Before I arrived in Gothic, part of the road across the river had washed away from a torrent of snowmelt, but the beaver dams survived.

The dirt road up the valley continued across the river from my research site, and as secluded as the valley is, a regular trickle of vehicles would pass by. The dry sand of the road kicked up under their tires, and I was sometimes mesmerized by the dust plumes rising and dissolving into the air. That may be why people are skeptical of climate change: they see the dark smoke emanating from a manufacturing plant, but within seconds it's seemingly gone. Out of sight, out of mind.

The butterflies and hummingbirds had different ways of accomplishing the same basic end. The butterflies were out to catch your attention, drawing erratic and looping paths across your line of sight to guarantee that you noticed their efforts to keep the plant population breeding. When they did pick a flower to drink from, the butterflies were ponderous, savoring the nectar and reveling in the good that they were doing for the ecological community. In contrast, the hummingbirds reminded me of machines, silently operating behind the scenes. They didn't draw attention to themselves with meandering strolls through the flowers before choosing a meal. They were linear, spending one to two seconds per flower, mechanically working their way through the meadow. They didn't wish to be recognized for their efforts, but sought only the fuel to keep their energetic hearts running for another day. The butterflies were nature's philosophers, the hummingbirds her scientists.

My summer of work did not yield significant results by itself (statistical significance is measured by a less than five percent chance that any non-zero results came from random chance). My graduate mentor said she would analyze my data in combination with hers from the year before, and if there was significance, she would try to publish it. My name would be attached in that case, and graduate school would hopefully open its doors a little wider for me. At the time of this writing, I am in the dark as to the exact future of my data.

One day, I heard Cancel the marmot making an alarm call in Marmot Meadow. Seeing a student with a radio tracker looking for some of the collared and monitored ground squirrels, I initially disregarded it. She sometimes reacted the same way when I walked through the meadow in the morning. A tremendous rustling in the bushes surrounding the stream to my left soon followed, and a black bear appeared from the thicket, moving at a semi-gallop up the hillside toward me. I could barely see its head above the clumps of osha and larkspur, a seemingly harmless dog-like face lifting its head for air above a floral sea. I had never seen a black bear before and was momentarily frozen in happiness, but as it grew closer I realized I was being risky. When it was about fifty feet away, I stood up and shouted. The bear stopped and hurried back into the undergrowth around the stream. Seconds later, her cub stood up to see what was the matter. It was barely taller than the plants, and when it turned to run, it was invisible. The mother bear waited on two legs across the stream for her cub, and when I estimated how tall she was, I found that we could have stood eye to eye.

I went to warn the student in Marmot Meadow, because getting between a mother and her cub is a death wish. She had neither seen nor heard the bears because of her focus on the radio tracker. She couldn't have been more than 150 yards from the pair.

While watching for hummingbirds the next day, I noticed a rare yellow variant of my test plant. I had glanced at it for weeks and never actually saw it. Despite our immersion, we could never observe everything around us.

At the end of the summer, there was a reception in the dining hall celebrating our work and the community donors who helped make it possible. While some of us were skeptical about the donors' motives, we also consciously or unconsciously used the mountains as an avenue for advancement. I was in Gothic to pad my grad school résumé and learn whether field ecology was right for me; others were there to work on thesis projects, to make money for college, or to gain experience for future employment. We would have readily criticized the Crested Butte developers, yet none of us thought twice about the construction of the new dining hall next door.

Like my first night in Gothic when I trudged through icy slush, I have but a vague notion of what awaits me in my academic and career futures. Whatever may come my way, I am better for learning about the intricacies and challenges of my field, navigating the perils of research design, and experiencing the crucial but complicated relationship between environmental biology and society at large. I will always consider myself privileged to have lived among RMBL's beautiful souls and landscapes, and my time with the bumblebees, hummingbirds, and marmots will never leave me.

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