Bioregional Species Profiles for *Chelonia Mydas*, *Ocypode* spp., and *Metrosideros polymorpha*

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The experience of recording observations in the field has been filled with challenges and insights that will shape my daily perceptions of place for years to come. Perceptual acuity, filter recognition, sketching, and citizen science are just some of the skill sets and concepts that I have studied during the past six weeks. Through practice and discipline, they have provided a sturdy foundation, from which, to launch into a lifetime of meaningful inquiry and place-based learning.

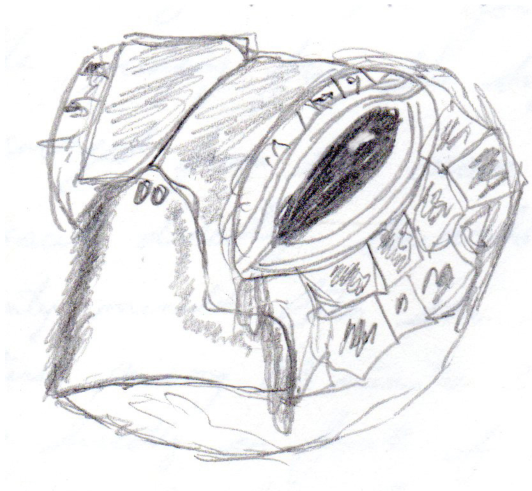
We record our perception of events as they occur before us through observation and the practice of field journaling. Examining the filters that influence what we choose to see and hear illuminates the potential bias that is inherent in our interactions with nature. Sensory awareness is but one example of a filter that can be used to expand or constrict our awareness of the natural history around us. The simple act of sitting still in a natural environment with the intention of in-depth observation has honed my listening and visual skills to the extent that even as I craft this essay, I hear the birds outside my window and can identify at least two of the calls. The fact that this new development exists demonstrates to me that the practice of journaling has propelled higher-level perceptual skills into many aspects of life, and is not restricted to only the moments spent in “deliberate gaze.”

One of the first lectures suggested that sketching in our field journals was akin more to “Pictionary” rather than art, and that its purpose was to inform. As a visual learner, I am keenly drawn towards the aesthetically pleasing. Therefore, I found it incredibly difficult to reconcile my observations with their resultant representational images, and I had to continually remind myself of the sketches intended purpose within the context of journaling. This shift in perspective provided me with the space to intently focus on the biotic and abiotic interactions in front of me rather than their representation in my journal and this practice has helped me “ease up” on my perfectionist tendencies somewhat. Even though blind contours still cause me great anxiety, I have come to appreciate that sketching is an important tool in the naturalist’s repertoire.

Our *Natural Systems Ecology* class provided exposure to important ecology concepts and the *Field Journaling* class has provided the opportunity to apply those concepts within our bioregion. It is challenging to learn the details and nomenclature of the organisms in nature and connect inhabitants to habitats and the relationships between them all. However, it is a critical practice to build a base of “field guide” knowledge in order to accurately portray observations in the journal and identify larger patterns. Journaling over time creates an important record of the changes that occur in a particular area of focus and specificity lends validity to the observations.

Field journaling over the past several weeks has led to a progressive expansion of my sensory perceptions and a deeper awareness and understanding of the organisms and habitats in my bioregion. It has also demonstrated the usefulness of creating a scientific record for citizen science. Most importantly, field journaling has proven to be an enjoyable pastime and an important forum where I can apply the concepts studied throughout this graduate program. I look forward to sharing this tradition with my students in the upcoming years.

Species: *Honu* or Pacific Green Sea Turtle (*Chelonia mydas*)
Family: Cheloniidae



Description:

The Pacific Green Sea Turtle, or *honu*, is a medium sized, long-lived marine reptile (50–80 years) whose species has been on earth for 100 million years. A blackish, gray, greenish, or brown, often yellow streaked, heart-shaped carapace, and white, yellow, or pale orange plastron characterizes the honu. The color variation is tied to the life cycle of the honu. As hatchlings, they are black on top and white on the bottom; juveniles are rich brown with gold, yellow, and tan streaks, while adult coloration turns to olive green with yellow and brown streaks or speckles and a pale orange underside (Bennett & Keuper-Bennett, 2008). Counter shading in sea turtles, (light on bottom, dark on top), is used as camouflage to blend in with their environment. When viewed from above, the dark, streaked disruptive coloration mimics light rays shimmering on the sea floor and helps conceal the honu from predators. In contrast, when viewed from below, the light colored plastron and flipper undersides help the honu blend in with the bright ocean surface.

Honu can grow up to 1.2 m, (measured as straight carapace length along the spine), and up to 225 kg (Zug et al., 2002). The sex of a honu can be determined by the size of its tail and front flipper claws. Both male and females have tails and claws, however, the males have noticeably larger tails, often extending past their rear flippers and their claws are longer and curved inward to help hold onto the female's shell while mating (Bennett & Keuper-Bennett).

In the past, most honu traveled to the breeding grounds in the French Frigate Shoals, located in the Northwestern Hawaiian Islands 783 km northwest from Honolulu, to mate and lay their eggs in terrestrial nests (Beletsky, 2000). However, in recent years, many honu have begun to make nests on the beaches of Maui beginning in June. Regardless of geographic location, green sea turtles return to their natal area to lay their own eggs after they reach maturity around twenty to twenty-five years of age (Bennett & Keuper-Bennett).

The hatchlings emerge from the nest in the evening hours after fifty days or so, (it varies depending upon temperature), and scurry to the waters edge as quickly as they can to avoid predation by land and air. Once in the ocean, they frantically swim out to the deep sea where they continue to develop by feeding on plankton for many years during what is called the "pelagic" stage. At ~35 cm straight carapace length and ~6 kg, the immature honu swim to their inshore territorial foraging habitats where their diet shifts to the herbivorous diet of an immature sea turtle that feeds primarily on red algae and sea grasses (Arthur & Balazs, 2008). As a primary consumer, honu impact seagrass and algae productivity in coastal marine communities.

Prior to 1974, Hawaiian honu were severely exploited by humans resulting in severely depleted stocks as eggs were removed from nests and individuals were harvested for consumption (Van Houten & Kittenger, 2014). However, the Endangered Species Act has protected them since 1978 and the Hawaiian population has recovered and is estimated to be approaching its foraging habitat carrying capacity (Balazs & Chaloupka, 2004). Although they have been legally protected for decades, there is evidence that Hawaiians occasionally rely on honu for subsistence purposes (Schaefers, 2018).

Observations and Connections:

These charismatic megafauna draw much attention from humans whether on land or in the sea, and much of the Hawaiian honu population appear to spend equal time in both. Unlike most wild animals, and other species and populations of sea turtles, Hawaiian honu have grown to trust people since commercial and artisanal hunting ended in 1978. The result is a population of sea turtles that is unafraid of our presence and tour boat operators have been taking advantage of this unusual behavior for decades. From their massive boats, they release wave after wave of bipedal terrestrial dwellers into the sea to observe these gentle reptiles on a daily basis. If getting seasick is your thing, have no fear because some of the Hawaiian populations have added a unique behavior known as “basking” to their repertoire. Although it seems to occur more frequently in some sites rather than others, the Hawaiian honu have gotten into the habit of hauling themselves up onto the beach to “sunbathe” during the day. In either habitat, they display fascinating behaviors and are a joy to observe.

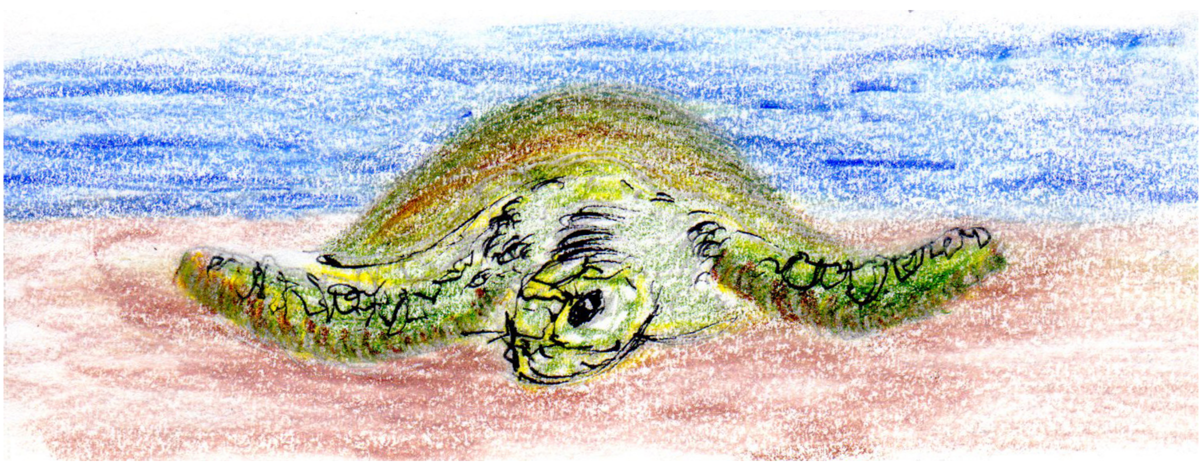
Sea turtles “fly” underwater and much of the jargon from the aeronautical industry can be applied to describe their actions; they takeoff, land, and come in for approaches. Honu propel themselves through the water with their front wing-like flippers, which create lift, and rear ones that steer, much like the elevator flaps on a plane. Although cumbersome on land, sea turtles can achieve quick bursts of speed upwards of thirty-two kph to escape predation (Bennett & Keuper-Bennett, 2008).

While underwater, honu spend much of their time at rest, eating *limu* (seaweed), or being groomed by little fish in “cleaning stations.” The honu I observed at rest tended to prefer the protection of underwater rocky ledges and caves that were formed by lava as it entered the sea. When those weren’t available, they were seen tucked into “coral beds” where their disruptive coloration allowed them to blend in with their surroundings.

The coral beds also serve as food sources for sea turtles that scrape algae off shallow-water corals with their strong, serrated jaws. Because of the frequent visits to many of these coral beds, “cleaner fish” are seen living in dedicated spots called “cleaning stations.” Honu are often seen in a queue, lined up one behind the other, waiting their turn for a cleaning. Some of the fish, such as the goldring surgeonfish (*Ctenochaetus strigosus*) are herbivores and eat the algae off the turtle's carapace, while others, like the Hawaiian cleaner wrasse (*Labroides phthirophagus*) pick parasites from their soft tissues.

In my observations of two populations of *C. mydas*, the North Shore group at Tavares participated in "basking" behavior while the South Shore group at Makena Landing did not. This is not to suggest that the Southern population does not go ashore, but rather, they are not seen as abundantly as they are at Tavares where I have personally observed upwards of thirty individuals. Among terrestrial fresh-water species of turtles, basking on land is a fairly common behavior. However, among sea turtles, it is "comparatively rare" (Whittow & Balazs, 1982). Theories as to the reasoning behind this behavior include synthesis of vitamin D, control of algae growth on the carapace, fat mobilization for metabolic purposes, and avoidance of predators (Whittow & Balazs).

What is noticeable in the Tavares population is that their movements appear to be more closely linked to sunrise and sunset. Honu were observed sporadically basking during daylight hours in small groups with a maximum of five individuals. However, as sunset approached, there was a mass influx of *C. mydas* exiting the ocean and crawling up the beach just beyond the waterline. At one point, just after sunset, there were upwards of ten individuals hauling their 225 kg bodies through the sand. When I returned before sunrise the next morning, there were thirty plus individuals sleeping in the sand and as the light in the east began to glow, they started their return to the sea. Just after sunrise, there were but six remaining. Were these movements related to the tide? The moon phase? Or were they simply modifying their behavior to avoid the nocturnal predation of sharks? Why do they exhibit this behavior more frequently on the North Shore and what makes them choose the same spot each time?



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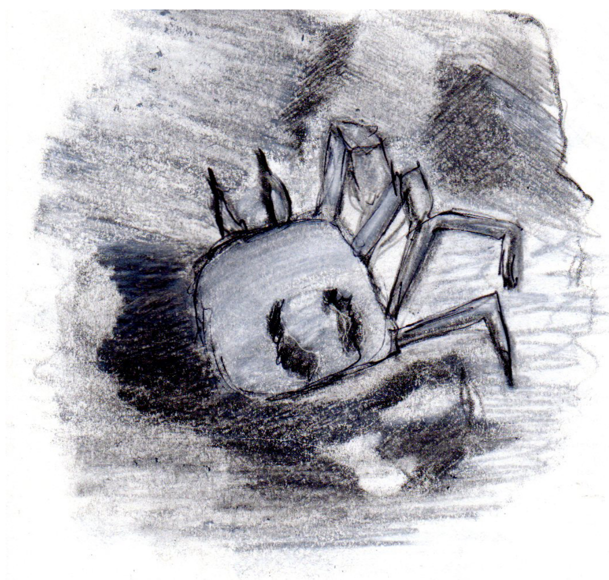
Species: Horn-Eyed Ghost Crab (*Ocypode ceratophthalma*)
Pallid Ghost Crab (*Ocypode pallidula*)
Family: Ocypodidae

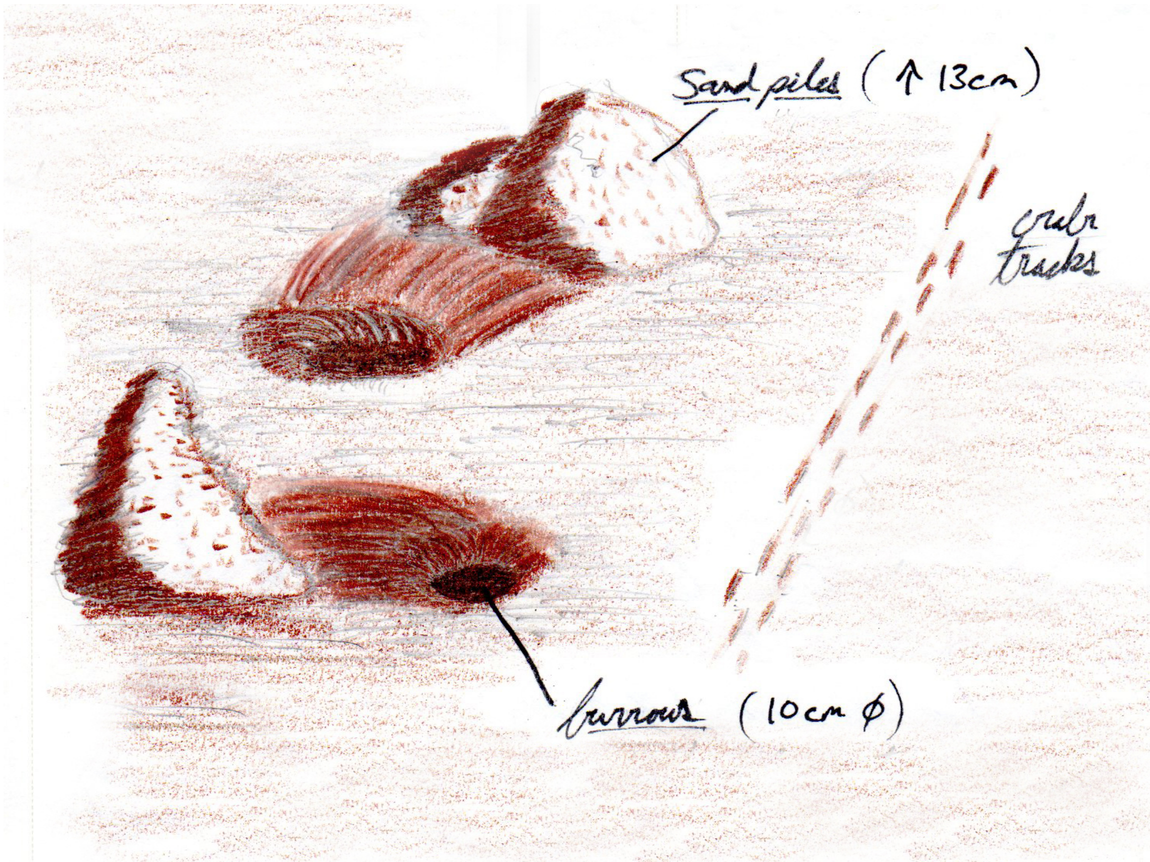


Description:
Two species of *'ōhiki*, or ghost crabs, are present in Hawai'i, the larger, (6-8 cm carapace), mostly nocturnal Horn-Eyed Ghost Crab (*Ocypode ceratophthalma*) and the smaller, (less than 2.5 cm carapace) diurnal Pallid Ghost Crab (*Ocypode pallidula*). Both species have ten jointed legs and two chelae. However, *O. ceratophthalma* is pale with a greenish tinge and two dark chromataphores on the rear of its carapace and *O. pallidula* has a pale, translucent coloration. Apart from differing circadian rhythms and a considerable contrast in size and coloration, the two species share much in common such as habitat, trophic ecology, and behavior.

Hawaiian ghost crabs are found in the intertidal zone, which forms the semi-terrestrial ecotone between marine and sandy beach environments. Within this realm, 'ōhiki "excavate deep, voluminous, and complex burrows" and are considered the "great bioturbators of beaches" (Lucrezi & Schlacher, 2014, p. 201). The burrows excavated by male *O. ceratophthalma* display prominent pyramidal sand piles outside the funnel-shaped entrances to attract mates, while *O. pallidula* burrows can be identified by a distinct "fan-shaped" spray pattern of sand outside the smaller entrance (Hoover, 1998, p. 288). The excavation and repair of the burrows takes place mostly at night for *O. ceratophthalma,* and during the day for *O. pallidula.* Despite the differences between the two dwellings, burrow functions are the same. Lucrezi & Schlacher stated

> Burrows have multiple functions […] the provision of refuges from predators and shelter from weather extremes, […] to provide crabs with a moist environment that enables them to take up oxygen and to avoid desiccation during hot conditions, […] moulting, sex-specific signaling […], and egg development. (p. 221)

'Ōhiki are consummate omnivores in the littoral food web and obtain food from diverse sources and by a variety of strategies such as deposit-feeding, active predation, and scavenging (Lucrezi & Schlacher, 2014). Deposit feeding occurs when the ghost crab ingests small amounts of sand and filters out diatoms, copepods, seagrass, algae, and bird feces and expels the remaining sand. Scavenging off the carcasses of stranded or dead organisms supplies nutrients, as well as active predation of sea turtle eggs, and hatchlings. The diverse trophic plasticity of the 'ōhiki sets it apart as “the apex invertebrate consumers on beaches while being predated by a diversity of reptiles, birds, and mammals that forage at the land-sea interface” (Lucrezi & Schlacher, p. 201).



Observations and Connections

The ghost crabs found on Tavares Beach in Maui displayed distinctive types of foraging, agnostic, and fossorial surface behaviors that are characteristic of the Ocypodidae family. To observe both species, I arrived at the observation location on the west side of the cove prior to sunrise in the hopes of catching a “changing of the guard.” I had noted from previous observations of sand piles that *O. ceratophthalma* was distributed solely on the far west side of the site. I presume they chose this location due to its proximity to the tide pool foraging grounds and to avoid the green sea turtles on the east side, which disturb the sand as they haul their 225 kg bodies up the beach to bask. I carefully walked the beach so as to avoid disturbing the burrows and settled myself in a beach chair front and center stage, with multiple burrows surrounding me.

‘Ōhiki have incredible sense of vision with a 360º field of view and can detect large objects at least 45 m away (Lucrezi & Schlacher, 2014). They are also the fastest crustaceans on land and reach speeds up to 4 m/s (Burrows & Hoyle, 1973). The combined sensory and locomotive prowess of the ghost crabs explain why I didn't see a single ʻōhiki until I sat motionless in my beach chair for several minutes.

As the faint glow from the rising sun began spreading from the east, I observed multiple specimens, of varying sizes, commuting to their burrows from the tidal pools farther west. They casually progressed along the swash zone, frequently stopping to ingest a mouthful of sand, filter out the nutrients, and return the remainder to the sea. Apparently, many had gotten their fill in the tide pools and proceeded to search for their burrows located above the high tide water line.

As the platoon of crabs casually marched towards me, some would fall off in one direction or another and "try on" a burrow for size. Sometimes they fit in the funnel-shaped hole, and sometimes they didn't. Although *O. ceratophthalma* are reported as being capable of returning to their burrows from 100 – 200 m away, others believe that 30 m is a more accurate distance (Lucrezi & Schlacher, 2014). In any event, some cases in which they were unable to "shoehorn" themselves in, resulted in the ʻōhiki wandering off aimlessly in search of one that was "just right." In other situations, where a crustacean was able to get himself partway down, he would find himself forcibly evicted from the lair by its rightful occupant in an agnostic display of outstretched chelae. And yet in other cases, premeditated theft was the agenda.

A resident would slowly emerge from its burrow in hopes of gaining one last snack before bed. The crab paused to ensure the coast was clear before heading to the swash zone "buffet," unawares that a squatter was hiding behind the sand pyramid. His patience paid off. As the resident sauntered towards the waterline, the squatter scurried around the corner of the pile and just as he was going to make a dive into the hole, the resident caught sight of the action and dashed to intercept. The two crabs locked chelae and pushed and pulled each other across the sand until finally the resident emerged victorious and reclaimed his burrow.

O. ceratophthalma became less active and less visible as the sun rose higher in the sky. As the larger crab turned in for the day, *O. pallidula* became more and more visible as they excavated their burrows after the night's high tide. Why did the larger crab adapt to a nocturnal cycle? Is it because there are fewer predators at night? Perhaps the diurnal crab is smaller because there is more threat of predation during the day. It is fascinating that they share so many behavioral, sensorial, and ecological traits. Yet distinguished by their circadian rhythms, their physiology has adapted to suit the needs of light vs. dark.

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Species: ‘Ōhi‘a Lehua (*Metrosideros polymorpha* Gaud.) vars. ‘*polymorpha*’ and ‘*glaberrima*’
Family: Myrtaceae

Description:
The endemic ‘Ōhi‘a lehua (*Metrosideros polymorpha* Gaud.) is the dominant tree species of the six main Hawaiian Islands. It accounts for 50% of the basal area within almost every habitat and moisture zone and is found from near sea level to the tree line at 2,800 m (as cited in Mortenson et al., 2016). The colonization of this multi-formed, slow-growing, and long-lived, generalist species began approximately 3.9 million years ago on Kaua‘i (Percy et al., 2008) and led to its present-day 350,000 ha establishment across the archipelago (Gon et al., 2006). The widespread distribution of this canopy tree across its ecological range provides critical habitat for Hawai‘i’s wildlife and protection for its invaluable watersheds (Loope & Uchida, 2012).

Polymorpha, meaning “many forms” is an appropriate name for the ‘Ōhi‘a; its growth habit can be tall and erect or shrubby and prostrate depending on the habitat it occupies. They are an evergreen species characterized as having multi-branched or compact crowns and mature trees can reach up to 20 – 25 m tall and diameters up to 90 cm (Gustafson et al., 2014). They are slow growing with an annual growth rate of 0.3 - 0.6 m in height and 1 – 3 mm in diameter (Friday & Herbert, 2006). “Larger, rounded trees with smooth oval-shaped leaves are found in wetter forests, whereas drier environments have produced smaller trees or shrubs with small, whitish hairy leaves to counteract the bright sun and dry conditions” (Lilleeng-Rosenberger, 2016, p. 268).

The leaves are dorsiventral and vary from thick dark green with dense abaxial pubescence to thin, bright green, and glaborous. They are opposite, clustered, and range in shape from obovate to orbicular, elliptic or ovate, 1 – 8 cm long and 1 – 5.5 cm wide. Margins are flat to revolute, apex rounded or sometimes obtuse to acute, and the base cuneate to cordate. The petioles are 1 – 16 mm long by 1 – 3 mm wide (Wagner et al., 1999).

Flowers red, in inflorescences of 2-5 pairs of cymules, glaborous or appressed or pubescent, peduncles 7-18 mm long, 1-3 mm wide, pedicels 2-8 mm long, 1-2 mm wide, bracts broadly ovate to suborbicular, 5-10 mm long, 3-5 mm wide; hypanthium 3-7 mm high, 3-8 mm wide; sepals rounded to triangular, 1.5-4 mm long; stamens 10 – 30 mm long; style 13 – 30 mm long.

Persistant flowers pollinated by birds and insects. Fruiting hypanthium 3-8 mm long and wide, pubescent or glaborous, capsules slightly included to exserted (Wagner et al., 1999). The ‘Ōhi‘a forests "provide habitat for most of the 35 native forest bird species in Hawai‘i, 21 of which are threatened or endangered, most of the over 900 species of endemic vascular plants, and many of the 5000 endemic species of insects" (Mortenson et al. 2016, p. 84). Culturally, the ‘Ōhi‘a tree is “considered one of the *kinolau*, a physical manifestation of Kū, one of the four Hawaiian deities. Kū stands for strength and anchor [...] and can be translated into the ecological concept of keystone species” (Mueller-Dombois, et al. 2013, p. xiii).

Observations and Connections

On Maui’s windward side, I observed three distinct populations, (of two varieties), of *Metrosideros polymorpha* Gaud. on four different occasions during June 11-July 11, 2018. *M. polymorpha* Gaud. var. ‘*polymorpha*’ was found in the dry forest zone (el. 450 m), while *M. polymorpha* Gaud. var. ‘*glaberrima*’ was found in the mesic forest (1,066 m) and montane wet forest zones (el. 1,344 m). These three distinctly different vegetation zones are delineated based on their annual precipitation, elevation, and resultant plant and animal communities.

Prior to human contact around 1,500 years ago, the native vegetation in this area was classified as the dry forest zone, which existed in the rain shadow of Haleakala at an elevational range of 200 m - 1,000 m. This particular site is directly leeward of the NW rift zone, a geological feature that has a strong influence on the weather in this bioregion. Annual rainfall east of the rift zone at this elevation averages approximately 2,000 - >10,000 mm, while rainfall west of the rift zone averages <2,000 mm annually (Juvik et al., 1998). This unique location places the Montessori School of Maui campus in a transitional zone where squalls can be seen approaching from the NE, hit the ridge, and turn northerly to release the bulk of their precipitation merely a kilometer or two away and send misting rains, blown by the prevailing trade winds, over the campus. Meanwhile, across the street to the west, the skies are clear with no precipitation.

The study area on the campus is a vegetated buffer zone 140 m long and 5 m wide along the NW property boundary, which is marked by a stonewall with a drainage swale between it and the native plantings. A reinforced gravel driveway abuts the native buffer to the southeast and the site is highly disturbed with a long history of pineapple crop production, cattle grazing, and is characterized by compacted mollisols.

The native buffer was planted in 2008 and has suffered some mortality. However, the plants that remain are in good health and represent a variety of species that would partially represent the original specimens in this vegetation zone. Koai’a (*Acacia koai’a*), a’ali’i (*Dodonaea viscosa*), ‘ohi’a (*Metrosideros polymorpha* Gaud. var. ‘*polymorpha*’), loulu (*Pritchardia* spp.), koki’o ke’oke’o (*Hibiscus waimeae*), koki’o ‘ula (*Hibiscus kokio*), pili grass (*Heteropogon contortus*), kului (*Nototrichium sandwicense*), alahe’e (*Psydrax odorata*), and ala’a (*Pouteria sandwicensis*) represent the indigenous species. Polynesian-introduced species were also planted, such as hala (*Pandanus tectorius*), ti (*Cordyline fruticosa*), and ko (*Saccharum officinarum*). Two alien silk oak trees (*Grevillea robusta*) remain in the buffer due to their mature size of 91 cm dbh, and the maintenance crew is constantly battling against the highly invasive canegrass (*Arundo donax*), and glycine (*Neonotonia wightii*). Alien bird populations, *Cardinalis cardinalis*, *Carpodacus mexicanus*, *Passer domesticus*, and *Bubulcus ibis*, were observed flitting between the large canopy trees and bees were seen retrieving nectar from the ʻŌhiʻa blossoms.

Without the benefit of continuous field journaling it is difficult to explain the mortality rates, since I was not present when the original buffer went in, and have only anecdotal information and a few photos from the installation. It would take some research, but it would be good to find out the exact number and species of plantings that went in in 2008 and compare them to now.

There is an old drip irrigation line present that was installed with the buffer plantings and no longer works. Though presumably, it did at one time and it could be that they were over or under watered. The soil that the campus sits on was at one-time pineapple field and was heavily treated with pesticides that have been residually found in the area's soils. That may have been to ill-effect of certain tender plantings. I can say that in my time at the school, the plants definitely suffered from alien species competition; the glycine was so thick that it nearly choked out the silky oaks at one point and the cane grass overran much of the remaining space. To that point, they suffered as much from lack of maintenance as anything else. Which brings up an important issue. All too often the aliens outcompete the slower growth habits of native plantings. These projects, while well-intentioned, demand continued maintenance to ensure their success. Even then, at what point do we say it is too much. In a situation such as this, the argument could be made that money is spent on landscape maintenance regardless of the plantings so why not plant natives? But if alien species are going to continue to out-compete them, does the maintenance cost of the native buffer exceed that of an ornamental buffer that is not necessarily aggressive but can keep up with the real pest species? Overall, projects of this sort should be approached with a clearer understanding of the soil conditions so that necessary mitigation and soil building practices can be implemented. Appropriate water regimes must be in place for each species, and a commitment to long-term maintenance must be made. It's a tall order for many landowners, but for some, the benefits of landscape restoration far outweigh the costs.

The mesic forest zone on the windward side of Maui is a band of vegetation found on weathered andisol-ultisol soils between 750 - 1,250 m, just below the montane wet forest community. It is characterized by few droughts and receives an annual rainfall of about 100 - 250 cm (Ziegler, 2002). Historically, this zone held the predominant vegetation on the larger islands, but by the late 18th century, it was primarily a cultivated zone and no longer supported natural forest vegetation (Cuddihy & Stone, 1990). As ranching in the area increased, the remaining vegetation was all but eradicated along this elevational gradient, which directly contributed to the declining health of the watershed. In order to remedy the situation, a state forest reserve was established to begin growing commercially beneficial timber species in these forest plantations. For some reason, this one particular grove was spared from reforestation efforts.

The koa (*Acacia koa*) and a few ʻŌhiʻa lehua (*M. polymorpha* Gaud. var. ʻ*glaberrima*ʼ) dominate this open-canopy community for 0.8 km along a ridge <300 m wide. The understory is comprised of non-native weeds like the Kāhili ginger (*Hedychium gardnerianum*), guinea grass (*Panicum maximum*), strawberry guava (*Psidium cattleyanum*), and eucalyptus (*Eucalyptus robusta*) saplings. Other alien species in the grove were the australian tree fern (*Sphaeropteris cooperi*), downy wood fern (*Christella parasitica*), palm grass (*Setaria palmifolia*), and one black wattle (*Acacia mearnsii*). The three native understory species I could positively identify were the uluhe (*Dicranopteris linearis*), a dense mat-forming sprawling fern that was able to hold back the alien species in one large area, the ʻakala or Hawaiian raspberry (*Rubus hawaiensis*), and maile (*Alyxia oliviformis*).

The ridge itself was flanked to the east and west by steep gulches, several hundred meters deep, and filled with native Acacia koa, Metrosideros polymorpha, the endemic liana ʻie'ie (*Freycinetia arborea*). Also visible in the gulch were the Polynesian introduced kukui (*Aleurites moluccana*) and the invasive *Hedychium gardnerianum* was observed creeping down into the gulch like a slow-moving tsunami. I sat on the edge of the ridge looking down into the gulch and occasionally caught a flicker of red and heard the unmistakable call of the ʻi'wi bird (*Vestiaria coccinea*) as it searched for ʻohia blossoms, which it has coevolved with over the millennia. The ridge itself was home to a large population of alien house finch (*Carpodacus mexicanus*) that seemed partial to this more open habitat. Also of interest was that the east side of the trail consistently contained more *H. gardnerianum* than the west and there was increased *A. koa* and *M. polymorpha* Gaud. var. ʻ*glaberrima*' basal area on the west side. Perhaps the invasive scourge is approaching from the east and has not yet overtaken the west side of the ridge.

Lāʻau ʻohi wai, or the forest that gathers water, covers 11,796-hectares between ~1,000–2,000 m in elevation along the windward slopes of Hāleakalā on the Hawaiian island of Maui. The montane wet forest community is located below the orographic cloud zone and receives annual precipitation in excess of 300 cm (Culliney, 2006). This "cloud forest" is considered a zone of great intrinsic value with "islands of biodiversity [that support] a high proportion of endemic species" (Giambelluca et al. 2009, p. 230).

M. polymorpha Gaud. var. ‘*glaberrima*’ dominates the montane wet forest zone’s closed-canopy community and its companion understory is comprised of dozens of native plant species such as the ‘ōlapa (*Cheirodendron spp*.), the hāpu‘u (*Cibotium spp*.), and the ‘ōhā kēpau (*Clermontia* spp.) along with small pockets of non-native weeds like the Kāhili ginger (*Hedychium gardnerianum*), and strawberry guava (*Psidium cattleianum*). Birds such as the ‘i‘iwi (*Drepanis coccinea*), and the kiwikiu (*Pseudonestor xanthophrys*), and the only native terrestrial mammal, the Hawaiian hoary bat (*Lasiurus cinereus semotus*), hold court with a multitude of invertebrates and snails that all add to the diverse, interconnected community.
Many specimens of *M. polymorpha* in the wet forest community developed “arched” trunk bases as a result of germinating and growing on fallen “nurse logs.” The tiny seeds germinated in the cracks of the log and grew adventitious roots over the log to connect the tree to the soil below. As the ‘Ohi’a grew, the log decomposed until it became part of the soil, leaving the prop roots of the ‘Ohi’a behind.

Typically, adventitious roots, which develop from plant nodes in many plant species, are used to lend additional support to a tree on wet soils. As it reaches towards the light in closed-canopy situations, it requires an increase in base diameter to keep the tree from “up-ending.” However, I noticed adventitious roots on both the ‘*polymorpha*’ and ‘*glaberrima*’ varieties, which were on very different soils in completely different plant communities. The other ‘*polymorpha*’ specimens found in the dry forest zone were in full sun and showed no signs of developing roots at the nodes. The one constant between the two varieties in the different zones were the trees’ location in deep shade. Perhaps the catalyst for the development of adventitious roots is not just wet soils and nurse logs, but is also triggered by shade. This would be a good study on plant adaptations.

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