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## Living with the Anoles and Collembolas

I am very philosophical about sharing my house with a lot of multi-pedal and reptilian creatures of Costa Rica. My transition from being an urban Californian to a resident of the tropical cloud forest was made gradually, with much forethought and preparation. I was fully cognizant of the attitude change required to share an abode in peace (primarily mine) with my fellow creatures. It is predictable that of all the inestimable tens of thousands of species of tropical arthropods (insects, arachnids, centipedes, millipedes, etc.), a small percentage of them will infiltrate "my space". Some would brazenly come through the official entrances, others would sneak through any crack, crevice or convenient thoroughfare provided by the plumbing and electrical systems. Nevertheless. mentally ready or not, it was a giant leap from living in the semi desert to the most biodiverse and highly humid environment on the planet. Overnight, I went from having reasonable control and defense against the traffic of little feet into my Californian house to having almost none in my Tico residence.

The house sits on an exposed knoll, only 50 m from the continental divide and bathed in clouds three quarters of the year. The prevailing Atlantic super-wet trade wind can be pretty fierce blowing against the house, sometimes gusting at 30-40 mph. Thus driven, the rapidly moving thick mist licks the external walls like a giant tongue. The house and its content simply do not have a chance to dry out. Its structure is of cement block walls under a tin roof, sitting on top of a solid cement pad. Granted, the house was built by a father-son crew under my supervision over a two-year period with hand tools, local materials and US standards prevalent perhaps 30-50 years ago, but no one would disagree with me that it is a carefully built, modern house. However, slowly but surely, I have come to realize that I have constructed a modern terrarium, with me living inside.

All my previous interesting encounters with anoles and arthropods had been fleeting, mostly in the wild or outdoors. They did not involve lasting reflection, nor opportunities for longitudinal observation—the usual out of sight, out of mind syndrome. In my Costa Rican house, I have a different self-preserving motivation to learn about my housemates. Like it or not, my visitors show up at any time, day or night. They may decide to explore, leave, or stay to set up housekeeping. Many even call it quits in my pad and make me their eternal keeper.

Of the many hundreds of different (surely an underestimate) visiting species, I will mention here only two groups—the curious anoles and the suicidal collembolas. Of the former, I knew just enough to recognize one when I saw my first inside the house. Of the latter, I neither had prior knowledge nor had I ever knowingly encountered one before.

By far the more entertaining are *Anolis* and *Norops*, two genera with several hundreds of species of arboreal, small lizards (8–18 cm or 3–7 in) within the Iguanidae family. They are not particularly colorful, mostly tan to brown, but often with obvious markings and contrasting body stripes. Most have skin pigments and scale structures that can effect color changes in response to the ambient temperature and physiologic stimuli. These two genera appear very similar based on their external appearance but differ in their skeletal and scale characteristics. The experts are predictably deadlocked on how to place them into standard scientific classifications.

Anoles are diverse, plentiful, and curious animals in both meanings of the word-nosy and peculiar. During the day, when the outside temperature is above 20 C, I would see solitary, nearly immobile individuals perched on small branches about one meter off the ground on my potted plants, with their tails pointed upward, heads downward, and bodies aligned perfectly along the branch for camouflage. Not ones to forage for food actively, they would wait until a live prey (small insects or flying moths) is within pouncing reach, quickly move or leap toward it, snap the victim in flight, gulp and resume the wait. When threatened by predators (birds & mammals), they invariable hop off and land on another perch within a short distance. When pursued by another anole, they would do a small number of abrupt push-ups, tail lashings, mouth gaping, head bobbing, followed by a couple of impressive displays with their colorful dewlaps. The latter is a flat, normally inconspicuous, neck appendage that is used in territorial and courtship displays (Fig. 1). It can be puffed up to nearly ping pong size in bright and contrasting colors. On a few occasions, I saw my subject turn aggressive, chase, and bite the opponent, presumably in defense of its territory. When threatened by something larger (such as me), they would dive for cover and remain quiet, reluctant to make themselves conspicuous. However, I could often approach one quietly, and then trigger a dewlap display by wiggling my



**Fig. 1**. *Anolis sp*, (aka Arnold) exploring the kitchen (left) and a cousin displaying his dewlap (right).

index finger horizontally and vertically across their visual field. On land, the anoles skitter in short bursts, but in water, they swim with serpentine movements. During the mating season after courtship, the male from above would grab a suitably dazzled receptive female; their tails intertwine to allow one of the two male hemipenes (the use of which alternate from one mating to another) to inseminate the mate. If unimpressed, the prospective female may decide to scamper in the opposite direction. The smallest anoles I have seen are about 2 - 3 cm long (including tails), miniaturized but very photogenic version of the adults. I learned that many lizards emerge from their eggs expeditiously by slitting the shell with a single, specialized egg tooth that is shed within hours of hatching.

My anole visitors of various species have been polite; they enter and leave via the back or front door, through a wide crack below the door. Since their distinctive markings permitted ready recognition, I started to name my string of guests alphabetically-Arnold, Benjamin, Clyde, Dennis, etc. (Had I wanted to determine their actual gender, I would have to pick them up, and search for the sex organs plus gender-specific scale differentiation). I would see Arnold exploring all through the house, hopping up and down the furniture, even on me accidentally, totally oblivious to the human occupants. I could always deduce his route around the house on warm days during my absence, from the tiny trail of distinctive scats (feces always with a spot of white crystalline urine). I know Arnie had been in my bed at least once. Months later, when Arnie stopped coming around, Ben moved in. Shy and cautious, Ben hung out mostly on my plants, hopping from plant to plant. Clyde, on the other hand, must have been in his rapid growing stage. While I was watching one day, his skin went suddenly from dark brown to milky white. After a couple of hours of total immobility, the tail suddenly started thrashing; his body twitched and jerked. For the next 2-3 hours, I was transfixed by his skinshedding dance and feast (Fig. 2). The tail skin was the appetizer, followed by the body-skin main course. The head-skin dessert took patience and skill. Clvde hopped around the plant until he found the perfect Y-shaped branching, slowly put his head between, scraped gently

until the head skin came off. He caught it in one snap between his teeth just as it started to separate and fall off, wasting not a crumb! My latest tenant is Sam, a veritable music connoisseur. Many lizards (anoles are no exception) depend on chemoreceptors on their olfactory organs and tongue for sensing food and locating mates. But I was unaware of the importance of "hearing" to lizards, not just geckos, until I finally schemed successfully to repair my digital piano. Clyde started attending my piano practice sessions. He would appear from nowhere out of the woodwork, positioned himself on the shelf next to the piano and refused to move. Since he comes out of his hiding, plays audience on the same spot of the shelf and only during my music practice, I like to believe that it was not coincidental. My literature search shows that some lizards, even those without fully developed ears, can have excellent auditory vibratory sensitivity to frequencies between 300 - 3000 Hz, overlapping those of human ears (100 - 15000 Hz). Perhaps Clyde appreciates Bach!



Fig 2. Clyde outgrowing his skin had just eaten his tail skin (top). Dennis, sleeping (bottom left). Sam, listening to Bach (bottom right).

These small lizards are good company, small, undemanding, quiet, independent, but with individual personalities. It's too bad only one is in the house at any one time, because of their territorial habit. I enjoy their company and even share common musical interest.

As mentioned above, the house floor is concrete, surfaced with ceramic tiles. Except for hairline cracks, it is solid and continuous—so I thought. The collembolas proved me wrong. That first August after moving in, after a night of heavy rain, I noticed a few dozens unfamiliar looking, brown, 2-3mm long, wingless, insect-like critters, all lifeless, smack in the middle of the floor at the center of the house, among a multitude of other dead insects. Slightly puzzled, I swept them up absentmindedly without examination. That turned out to be the beginning of a wave lasting about a month. Each subsequent invasion was always after a heavy rain, but not every heavy rain. Each invasion curiously brought a progressively larger wave of suicides into my living room. At peak density, they numbered 60-70 per 12-inch tile, covering an area of about 175 tiles, almost filling a one-pound coffee can each time. Trying to look at the bright side of things, I was very grateful that they were always found dead, always with the same distribution by daylight, starting from a clean floor. I shudder to think: what if they had functioning little legs while inside my house! The middle of the living floor was clearly the epicenter, with highest corpse density, then a decreasing gradient tapering toward the exterior walls. I was certain they must be coming through the floor, but where and how? And why are they all dead?

After that first invasion, I scrambled for the nearest reference entomology book. The first order of business was to know what I was dealing with. The C-shaped exoskeleton, segmented body and short antennae all spelled arthropod (Fig. 3), but to get past it I needed to know the number of legs. With my magnifying loupe, I counted three pairs of fairly normal looking legs, one pair per body segment, that put me in the *insect* group — but wait, there appeared to be one more appendage that might be a leg attached to the last segment. Within minutes, looking the section under orders of wingless Insects, I spotted the order Collembola, commonly known as springtails. The description fit my mystery critters to a T. With a little reading, I learned that some 6000 springtails (and relatives) species exist worldwide, very abundant in damp environments, subsisting on smaller organisms in soil, humus and aquatic habitats. While very abundant and common, they are inconspicuous and seldom noticed until they become pests from their sheer number, as in green houses and mushroom farms. I can now add tropical human habitat to that list.

A hallmark physical feature of collembolas is an abdominal appendage known as the *furculum* (the 7<sup>th</sup> appendage I alluded to), which has the form of a "latch" held under tension between the third and fourth body segment. When released, this spring mechanism allows the insects to push themselves against the substrate and propel in the air. To crosscheck my preliminary identification, I needed to get my hands on a live specimen to confirm the purported jumping locomotion. As luck would have it, the hard rains stopped suddenly and so did the nocturnal suicidal invasions. A year went by with no springtails; I was beginning to wonder if I would ever see them again. One enduring lesson I learned living in the midst of high biodiversity is, to paraphrase

Ken Miyata in *Tropical Nature* "Rare phenomena are common, common phenomena are rare". That is to say, every daily encounter may likely be a rarely observed event (statistically speaking). For example, a beautiful iridescent long-horned beetle videotaped by chance in our first year at Nectandra turned out to be quite rare. We (ten pairs of eyes, almost full time) did not get to see another until this year, ten years later. In the meantime, we learned that it might be an undescribed cerambycid, according to an expert.

Getting back to the collembolas-after almost two years of waiting, I actually was hoping for the springtail invasions and felt lucky when a few dead ones appeared after a heavy rain. I set out to wait for them during a rainstorm. None arrived by bedtime, which was consistent from past pattern. I set my alarm clock for midnight but saw no collembolas hopping around. Two hours later, nothing; four a.m., still negative. The next morning, there were just the usual few dead ones, too few for me to catch them in the act of sneaking in. Two more intense rainstorms and two nights of scheduled wake ups, still no luck. Disappointed, I gave up for lack of ideas and to meet a writing deadline. During one of several evenings while I was at my computer, my luck turned. It was raining cats and dogs. I was completely absorbed with my work, parked in front of the computer until past midnight. The overhead light was off. In the general darkness of my surroundings, I suddenly had the visual sensation that the floor was moving under my feet and around me. Stifling an urge to scream, I stood up and reached for the room light switch. As my stomach was reacting to the scrunching sensation under my shoes. I saw them when the light came on. The collembolas were arriving in the thousands! They were coming as a wave of tiny reddishbrown, whiskered hunchbacks, all hopping around in tiny (about one cm) jumps, propelling toward where I was sitting. Since that heart-stopping first meeting, I had opportunities and more time to compare notes in the literature with my observations to piece together the missing information.

Collembolas are detritivores, hence their association with soil, and organic debris. They mature through multiple moltings, hence the need to remain concealed in a moist environment. Their extreme sensitivity to desiccation would explain why I only find dead collembolas. They died of thirst once they are inside the house. But what drove them to entering in the first place? Sex, I presumed.

Once I got this far, the nature of the cue for mass movement toward my living room was not hard to guess -light. Although not proven, light is highly suspected as being the signal to "congregate with hot dates" for many insects.

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Let's imagine the following: at a certain time of the year, there is a huge bloom of mature springtails of this particular species (as yet undetermined) underneath the house in the soil, all primed by their pheromones



Fig 3. Collembola (10X)

to find mates. A rain comes; the saturating humidity will buy time to find and spend with their dates. In nature, the signal is Mother Nature's moon. Biologists have learned to trap insects by tricking the insects with manmade lights at new moon when it is at its smallest. In my case, it must have been my computer monitor beckoning through a crack on the floor! The march of the springtails starts. Throngs of hopping bodies squeeze through, forging toward the squarish moon. On those nights with the massive suicides, I must have left the monitor on (one of my bad habits).

The exact site of entry remains a mystery. My best guess is a break in the floor hidden under the central partition walls, where they would have to "spring" up and through a 20 cm concrete crack. Not knowing where to seal their entrance, I have come up with a more effective solution—I shut down my disco at eight *every* night during the rainy season. The collembolas will have to find their thrill somewhere else. --The editor

## Beauty and the Elf

One of the most enjoyable aspects of our Ecoloan Fund lending work at Nectandra Institute is the chance to interact with our borrowers. Unlike standard banks where the loan officers and bank clients are happy enough to see each



others back, NI staff visit with communities, to look in on the progress of the eco-interest paying activities, be it tree planting, watershed maintenance, water sampling, workshops, etc. Then there are the rewards of

being invited to various community celebrations. One such celebration was on March 7 at the Zarcero County Fair. The organizer of the event, AFAMAAR, dedicated the most popular event, the Beauty Pageant, to Nectandra Institute at the Beauty Crowning Ceremony to celebrate their successful Eco-Loan. AFAMAAR is a watershed land acquisition association of several communities. This annual event is one of several ways AFAMAAR raises funds for future watershed land purchases. (See June Newsletter 2010 at www.Nectandra.org for more details).

## Other News Highlights

Aug 2010 Representatives from eleven water management boards of the Balsa River watershed communities attended a workshop on the legal rights and responsibilities of community-based entities involved with the administration of local water service. Nectandra Institute was the organizer. The presenters were environmental law experts from CEDARENA, a Costa Rican non-governmental organization.

**Aug 2010** Residents of Angeles Norte and Nectandra Institute staff jointly identified around 30 different bird species on the 27-acre property purchased in 2007 by the community's water management board with the very first eco-loan. Nectandra Institute and partner communities plan to monitor birds on the various restoration properties to track potential changes.

**Sept 2010** Almost 300 people from various towns of the Balsa River watershed inaugurated the third annual *New Culture of Water* Month celebration in Tapezco. Each September, Nectandra Institute and representatives from our partner communities organize a series of events to build support and awareness for watershed protection and restoration. This year's events included the announcement of the winners of the *Clean Communities* and *Healthy Rivers* competitions, an outdoor ecological mass, a recycling drive, an exhibition of handicrafts made with reusable/recyclable materials, and several others.

**Oct 2010** Alvaro Ugalde, our president, received the *Environmentalist of the Year* award by Latin Trade Magazine during its annual BRAVO Business Awards gala, for his 40-year commitment to conservation and protection of biodiversity. Alvaro took the opportunity to address several hundred Latin American business leaders and political figures, about the urgent need to fully comprehend the role of the planet's natural capital within "the most ultimate of supply chains" so that we may be able to strike "a better balance between material development and the protection of the natural resources that make that kind of development even possible."

**Nov 2010** Women from several upper Balsa River watershed communities, jointly with Nectandra Institute, resampled local creeks and rivers to continue their water quality analysis work. They are part of a five-year water-quality monitoring project initiated in 2009 to sample specific locations every six months. The objectives are to document potential changes, as the large dairy distributors are instituting stricter sanitation and effluent treatment policies.

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