Birds Exploring Defect as a Proven Foraging Strategy

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As commonly used, the concept "normal" describes some thing or situation that is "good" or at least understood. "Back to normal" sounds comforting. I am sure folks living in Normal, Illinois, are proud of their hometown. When part of my job was helping diagnose tree pest issues for forest landowners, a concept that proved helpful at workshops was telling attendees to "learn what normal is." It followed that if plant inspectors examined their valuable trees and shrubs in all seasons, stages, and ages, and thus thoroughly knew what normal or healthy looked like, they would better be able to detect the early onset of potential problems. As our doctors tell us, the earlier an issue is detected, the better the chances of curing it. Nip it in the bud.

Birds clearly use this notion, or its opposite, "defect," in detecting animal prey. Where something is absent, out of order, abnormal, or does not look right, the cause or maker of said variance from normal might be present nearby. Where there's a broken window, there might be a burglar. Where you see crumbs, the Cookie Monster lurks. Origami is found in the artist's shop. Dead leaves are red flags that just might lead under bark upstream to larvae with jaws or sucking mouthparts. If we birders learn to look at the world the way birds do, we will hopefully see more birds. At worst we will see interesting behaviors.

The types of defect birds explore in their pursuit of prey are many. This article describes but a few of the common visual patterns I have observed Colorado birds keying in on while attempting to perform an activity that takes up about a third of their waking hours every single day of their lives—feeding themselves and their dependent offspring.

Missing Foliage or Holes in Foliage

Leaves are centers of action in plants with chlorophyll, which is most of them. When combined with sunlight, water, and carbon dioxide, chlorophyll enables the almost miraculous and Planet Earth–sustaining phenomenon of photosynthesis whereby plants manufacture their own food. The resultant sugar production by plants attracts consumption by many animals, foremost being invertebrates. Of course, insects form the bulk of backboneless animals that eat plants. The most straightforward insectivorous herbivory, simple chewing of holes in leaves, is carried out by forms with chewing mouthparts.

Included are larval and adult beetles, larval moths and butterflies, orthopterans (grasshoppers and their kin), mantids (praying mantids and walking sticks), and certain hymenopterans (bees, wasps, and ants).

It seems easy to understand that birds would have learned by trial and error investigation of their world that, where leaves exhibit evidence of recent chewing by insects, the actual perpetrators of the damage might be present (Fig. 1). In a natural world ruled by survival, repetitively successful trials morph into method. We have all seen tree-crown foragers like warblers, vireos, orioles, and chickadees tracking down larvae by first noticing holes.

Leaf Discoloration

An entire leaf can be discolored (pale green, yellow, or ultimately brown) if it is nutrient deficient, dying, or dead. This is usually the result of an issue farther down the line in the branch to which it is attached, the trunk its branch grows from, the roots feeding the upper part of the plant, or even the soil. Whole leaves showing uniform discoloration are usually not caused by something directly feeding on them, and thus would not be all that productive for foraging birds looking for causal organisms.

One key word in this description is "whole." If, on the other hand, the discoloration is limited to *parts* of the leaf such that they form an irregular oval (called a blotch mine) or snakelike track (called a serpentine mine), then interest by birds is revived. Leafminers are highly evolved defoliators that have mastered the technique of feeding on leaves by getting between the upper and lower leaf surfaces and chewing in this unique, narrow space. The bodies of leafmining moths, flies, beetles, and wasps are quite dorso-ventrally compressed to fit their life style. Being a fairly big human, I remember times in crawl spaces when such a body would have been handy.

I have seen birds consume blotch mining larvae in two ways. In the first they delicately peel off either the roof or floor of the tunneling larva's comfort zone and extract it. In the second, especially used by big-billed birds like grosbeaks, they simply glom onto the entire discolored mine and enjoy a protein-spiked bit of salad. With serpentine miners, the method of removal is usually delicate extraction at the end of the path that is being elongated. Since the larva digging the tunnel is growing bigger as it feeds, the most prudent end of the track for a bird to open is the widest end. The action end of the tunnel is also somewhat darker due to its greater accumulation of excrement pellets.

Another exception to dead leaves usually not being all that productive as a site of exploration are dead leaf *clusters*. Little groups of

dead leaves might have been killed by lepidopteran larvae that tied them together with silk in the form of a shelter (see next section), or they might have been tied together after they died by a spider. Certain warblers like Worm-eating and Golden-winged are noted for their fondness for morsels found within dead leaf clusters (Fig. 2).

Inhabitants of plant structures, like webbed-together leaves or galls, *not* involved in actively forming the structure, are called "inquilines." These "squatters," if you will, take advantage of a left-behind home and use it for their own purposes. Earwigs, aphids, spiders, lacewings and many other arthropods commonly live as inquilines. They benefit from the labor of other creatures but suffer at the beaks of their predators which care not who the building contractor was.

As mentioned, whole brown leaves, while usually not all that populated with prey themselves, can indicate issues upstream. Woodpeckers know well how to exploit the larvae of bark and wood-boring beetles that divert water from distal parts of a tree, causing its leaves to discolor. It is rare, indeed, to see a Hairy or American Three-toed woodpecker in a tree that does not have a crown red with a preponderance of dead needles. A mountain picid scans a conifer-

*Fig. 1. Brownheaded Ash Sawfly (*Tomostethus multicinctus*) larvae and chewing damage to Green Ash (*Fraxinus pennsylvanica*), Colorado Springs, CO.* Photo by Dave Leatherman

Fig. 2. Warbling Vireo inspecting cluster of dead Russian-olive leaves, probably for an "inquiline" species like an earwig or spider. Lamar Community College Woods, Lamar, Prowers County, Colorado on 12 September 2013. Photo by Dave Leatherman

Figs. 3, 4, 5. Pine showing dead top (left), evidence of woodpecker predation on bark beetles in trunk of a pine with a dead top (middle) and bark flakes on ground under a bark beetle-infested pine with a dead crown after visitation by woodpeckers extracting beetle larvae (right). Photos by Dave Leatherman

ous hillside and goes to the pine, fir, or spruce with a discoloring or dead top (Fig. 3). A birder, likewise, looking for a year-list three-toed should key in on the red trees, too, and once found, search the branches and trunks to which those discolored needles are connected. In winter, think like a bird. Look for abnormal. While walking a trail or snowshoeing, notice the oddball trunk surrounded by snow littered with flakes of bark pulled off by woodpeckers digging down to phloem-feeding beetle larvae (Figs. 4 and 5), which they found from afar by noticing foliage that was not the normal green of surrounding conifers.

Origami

Many leaf-feeding insects modify leaves by rolling, folding, or tying them into rather fancy, consistently patterned structures that potentially protect the makers from weather and detection by predators. Most of these are either lepidopteran larvae or spiders, and both utilize silk produced from mandibular glands or spinnerettes, respectively, to hold their creations in the desired position. The idea is to fashion a protective structure and then engage a path to adulthood by eating out of the structure. With the right search image, leaf rolls, folded leaves, and leaves tied together

Fig. 6. Three styles of leaf modification (aspen in this case) or "orgami": from l to r, rolling, folding, and tying, each the work of a different species. Photo by Dave Leatherman

Figs. 7 & 8. Plains Cottonwood leaves at the LCC Woods in Lamar, CO tied together and somewhat discolored by subsequent feeding by a moth caterpillar within this structure (left). At right is an unidentified moth larva from tied aspen leaves (overtopping leaf has been removed) near Telluride, CO that is closely related to the unidentified larva found in the tied cottonwood leaves at left. The pale green areas in this photo show evidence of leaf grazing by the caterpillar and are the kind of abnormal discoloration birds key in on. Photos by Dave Leatherman

(Fig. 6), when arrayed against a background matrix of normal leaves, stand out. Once a bird finds one of these artsy meal packages, they handle it in ways similar to the ways they handle detected leafminers: probe for and pull out the inhabitant (Figs. 7 and 8), or if the structure is small, eat the whole thing. By far the most common method I have observed is beak probing followed by rather precise exorcism. Warblers and chickadees have mastered this.

Retained Bud Caps

Tree buds are sheathed in a cap. In spring or early summer, as the new foliage of an impending growing season swells and elongates, the cap is loosened. Under the sheer force of meristematic cell division, it is shed. Free of this cap, the new blades or needles are free to unfurl and expand to full size. The caps of an individual tree, particularly those within one aspect of one tree, tend to pop off in synchrony. That is, the uniformity of light and temperature on one side of a crown tends to result in fairly uniform growth. The caps from neighboring branch ends tend to freefall within a day or two of one another. The timing or "phenology" of seasonal events like budbreak and autumn leaf drop can be quite exact in one tree, one clone (as in the case of color in aspen), or even one whole hillside. But if you examine enough trees at the time the bud caps are being shed to make

Fig. 9. Red Crossbill removing a retained bud cap prior to eating the larva feeding on foliage underneath. Photo by Dave Leatherman

room for the next set of photosynthetic greenery, you will eventually see a cap here and there that did not get the memo. Often this is the result of insect mischief and is the sort of thing birds notice.

During the Colorado Field Ornithologists' Convention in Salida in May 2015, I was lucky enough to witness a great example of birds keying in on defect right in the parking lot of the motel next door. There, in a sea of asphalt and defying all that we are taught in botany class about the requirements for proper tree growth, was a rather magnificent Colorado blue spruce towering perhaps 60 feet over the cars. And in it were birds, many birds. Mostly they were Red Crossbills and Pine Siskins. We know these birds to favor conifer seeds pulled from cones, but not on this day. Opportunistically, they were gorging on larvae of the western spruce budworm.

Why the name "budworm"? Because after spending the winter as very tiny larvae within loose silken tents ("hibernacula") attached to a small twigs, they come out of hiding in spring and tunnel into swelling buds. There they feed on nubile needles. Perhaps half the content of a bud, sometimes even more, is consumed before the needles therein even have a chance to practice their genetically programmed deal with the sun. Without a full complement of needles pushing outward, infested buds tend to blow their tops late, or not at all.

What I quickly noticed with those voracious crossbills and siskins was a very certain orientation to a particular subset of new shoots. They were not at all interested in most pristine lime green puffs of soft new needles at branch ends. They were homing in on the ones with retained caps. A quick flick of the beak dislodged the papery cap (Fig. 9), revealing the fat, carmel brown budworm larva within. She/He Scooooooorrrrres!!! (Figs. 10 and 11). And a "hat trick" only took two minutes.

Figs. 10 & 11. Red Crossbill (top) and Pine Siskin (bottom) feeding on Western Spruce Budworm larvae found under reddish-brown retained bud caps such as the three immediately under the crossbill. Pristine new growth, such as appears in the far right of the crossbill photo was uninfested by budworms and went unsearched by the birds. Photos by Dave Leatherman

Frass

This word is a polite way of saying "poop." Insect excrement is a natural outcome of their feeding, and like holes, discoloration, origami, and many other versions of "defect," can be used to detect the frasser (Figs. 12 and 13).

A Case of a Caterpillar Hiding Defect It Caused

Remember those old TV Westerns where the stagecoach robbers would try

Fig. 12. A frass pellet at the rear of a tomato hornworm caterpillar. Photo by David Shetlar, Ohio State University

Fig. 13. Tomato hornworm frass pellets on the ground under an infested tomato plant. Photo by David Shetlar, OSU

to hide their horses' hoof prints from the posse by sweeping the trail clean with a tree branch? The American dagger moth (*Acronicta americana*) knew the trick centuries before the drama of the Wild West. The fuzzy yellow caterpillars with a few black tufts scallop big holes in maple leaves (Fig. 14). To hide this evidence that might be used by birds to find them, they clip the petioles of fed-upon leaves, which then drop earthward (Fig. 15). Perhaps at some stage in the escalation of this predator–prey arms race, birds will spy partially chewed leaves with very short petioles littering the ground under infested maples and look up.

Fig. 14. American Dagger Moth caterpillar on ground looking for pupation site. Photo by Dave Leatherman

Fig. 15. Silver maple leaves partially chewed and petiole clipped by American Dagger Moth caterpillar at left, intact leaf at right. Photo by Dave Leatherman

Essentially, birds noticing defect in an effort to find what made the defect is a lot like what the human birders do who find all those wonderful species on the Rare Bird Alert. They know what normal looks like and try to find Waldo hiding in the mix. Many more examples exist besides what was covered above: specks on the glass of a still water surface; something that moves/falls in the "wrong" direction compared to the mostly ordered flow of leaves in a light breeze; a limp or weak flutter amid the herd/flock; movement under the still grass; vibration beneath otherwise silent bark; the inattentive back of a clueless finch bellied up with a flock of paranoid cohorts at a feeder; and so on.

Bird like a hungry bird and my strong suspicion is you will sate your soul.

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