Resolution and Trespass in Field Diagnosis

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Introduction

Clients routinely hire us as American Society of Consulting Arborist members because of our real or perceived expertise in field diagnoses. In our zeal to meet their expectations, we may inadvertently impose or extend beyond the real boundaries of what we actually know or can realistically defend under diagnostic conditions in the field.

Further, one of the basic elements of field diagnosis, and within many legal issues involving tree risk, is the question of what can or could have been known from a set of circumstances in the field (Photo 1). In some cases, the field diagnosis or assessment was made by an individual that may not have particular expertise in entomology or pathology beyond informal training received in the green industry.

Many factors affect any individual's ability to "know" what they believe they know. However, in the end there is a finite amount of information that can be "known" or reliably ascertained in any field diagnostic situation. I will call this "resolution," or the ability to discern, and also use it as a reference to maximum visual acuity as the two are related. For the later, a human eye with excellent acuity, the maximum theoretical resolution is a 0.35 mm line pair at 1 m. (http://en.wikipedia.org/wiki/Eye#Relationship_to_life_requirements).

Photo 1. Sap rot fungus fruiting structures on a scaffold branch of a Norway maple. There is a definitive amount of information that can be observed using visual field diagnostic techniques because we all have basically the same ability to see. Beyond observation, inference and interpretation are used to complete most field diagnoses.

Although the limits of field diagnostic resolution might seem like an obvious or easy to determine issue, what can be known in field diagnoses often is the center of debate amongst "experts" in legal issues. Resolution is also frequently ignored in field diagnostic reports and consultations, where diagnoses are made that far exceed actual field resolution ability. I believe it is important that we consider our actual abilities before we begin to exceed what we can actually know in the field, and are truly able to identify. Exceeding field resolution indicates that a broad set of assumptions have been made that may or may not be true, or the individual is unaware of the error committed in their diagnosis.

Steps in Field Diagnosis

No matter what your level of expertise in field diagnosis, there is a more or less accepted "protocol" most of us use to reach ultimate resolution in the field. One commonly used systematic method is Visual Tree Assessment or VTA. The initial triage steps in VTA employ observation, recognition and interpretation, while recognizing more advanced techniques and analysis can also part of VTA and may be required for eventual conclusion (Lonsdale 1999).

Observation

Observation is usually systematic and visually focuses on each major tree part (roots, buttress roots, trunk, scaffolds, etc.) for deviations from normal growth patterns (symptoms). The importance of using a systematic approach and documenting one's observations cannot be overemphasized despite the fact that it is probably the most tedious step in field diagnosis. We all know that the failure to observe and not recognize, or otherwise "overlook" a critical piece of evidence in field diagnoses is reason for professional ignominy, if not just a red face followed by some level of excuse making. In legal issues, failure to observe can be very difficult to defend, particularly if it can be shown it was someone's responsibility to make such observations.

Theoretically, when using standard diagnostic tools (hand lens, pocket knife, binoculars, soil probe, sounding mallet, probe, and basic hand tool excavation equipment) we should all be on equal ground when it comes to making any observation about a tree, the site, and circumstances particular to any diagnostic scenario. This is because we all have basically the same visual acuity or ability to see, and have the same ability to ask questions and observe. In essence, at a certain level, nothing is hidden from view if one looks where one needs to.

Good observation skills are clearly learned. Not knowing where to look, or that one should look in a particular manner, is another matter that is typically an educational deficit. For example, knowing to look using a hand lens at needles of spruces for fruiting structures of certain needlecast fungi that appear in stomata is a learned skill. Observation can also be obscured, as discussed below, by a lack of recognition. Therefore, failure to observe is a possible error in field diagnoses that can be related to training and expertise, but not in most cases attributable to physical limitations. Hopefully, this type of error is the least common made in the field.

Recognition

The next step in VTA, recognition, clearly raises the bar in field diagnoses. Recognition may influence observation and diagnosis because it presupposes knowing what one is looking at by having identified it previously (direct knowledge). In reality, we may also recognize through inference (i.e., it looks similar to something one identified previously; therefore, it is likely of similar origin or cause) or revelation. Of these, revelation is obviously the least useful. However, most of us at one time or another would have enjoyed some divine revelation to help us out of a difficult diagnostic situation.

Inference is valuable in field diagnoses. In fact, most field diagnoses are based on inference. Because of the small size of most pests and in particular pathogens, we do not have adequate field resolution to see at the level needed to identity by direct knowledge many fungi, some insects, bacteria, viruses, or abiotic agents. We use inference based on known symptom patterns, timing of symptoms expression, host susceptibility, and previous experience to form reasonable deductions about causation even though we cannot see or resolve the detail we actually require. Use of signs, or evidence of the causal agent, can strengthen field diagnosis, but is still only an intermediate step in final resolution.

We all have to rely on inference to conduct field diagnoses and to proceed with our field investigations reasonably. Inference allows us to continue without needing to confirm everything by direct observation and/or direct knowledge. This allows us to progress diagnostically with a degree of certainty and return to more definitive diagnostic approaches if needed at a later time. Or, decide to continue and not return if the inference is not critical to the issue or case at hand. For example, when investigating an apparent nutritional problem, one observes a few necrotic spots from an unknown foliar disease and does not investigate it further because it is unlikely to be causing the chlorosis on the entire tree. However, it is important not to extend our inference beyond a reasonable point, or to use it at all if the information is critical to important conclusions in the diagnostic.

Interpretation

The final step in initial VTA is interpretation. Interpretation is based on observation and then sufficient resolution in the VTA recognition process. Interpretation is an intellectual exercise based primarily on inference. In many field diagnoses, interpretation together with its companion prognosis is the grand finale of the diagnostic process. Interpretations based on errors in observation or recognition are usually relatively easy to address because their formulation is known to be based on erroneous assumptions.

In the legal world, experts may come to vastly different interpretations of what could or could not be known given the same set of observations, and possibly even agreement over what could be resolved from these observations. Further, even if the experts agree on the interpretation, significant disagreement may exist over whether any particular type of observer could have been expected to arrive at such an interpretation. This issue will continue as long as human observation, recognition and interpretation are involved in field diagnosis, and is a topic that is likely worth an article by itself.

Trespass in Field Diagnostics

Recognition in field diagnoses also has a clear and finite limit due to resolution or only being able to visualize at a certain level of acuity. This may be the most common place where we trespass beyond what we actually can know within field diagnoses. We all do it because inference allows us a certain, albeit undefined (professionally or otherwise), latitude in field diagnoses. We all identify common pests or their symptoms in the field, sometimes reporting pest names to genus and species levels. Depending on the situation and end use of the information, this clear use of inference instead of direct knowledge is likely acceptable.

However, in some cases diagnostic trespass occurs where inference is used to report information as if it were resolved from direct knowledge (for example, field identification of a disease caused by a micro-fungus based on symptom expression or observations of fruiting structures). By definition, the diagnosis was made by inference and should be stated as such. The "so what" is this can result in diagnoses and interpretations that are misleading at best and at worst are just plain wrong.

Photo 2. A *Laetiporus* species on a red oak identified based on field observation. This decay fungus, commonly known as the sulfur shelf or chicken of the woods, is known to consist of a number of different but somewhat similar appearing species.

Field diagnoses are just that, identifications made under field conditions. By nature, they are not laboratory, microscopic, or other specific analysis. Therefore, field identification of many insects, macrofungi (e.g., conks of wood decay fungi), or microfungi (those that may partially be viewed with field magnification) are obviously tentative at best. I believe it is easy to become complacent and to make definitive statements about pest species identification in field diagnostics based on inference. For many pests, this seems to have become acceptable even though one did not actually observe the characteristics that allow the diagnosis to be based on direct knowledge or the use of a laboratory for confirmation. No direct observation using microscopic examination or testing for definitive taxonomic or genetic characteristics of a particular pathogen or insect were ever used, but genus and species are discussed or listed as a representation of fact.

In some cases this is a clear, albeit accepted, misrepresentation. For example, the common, "easy" to identify sulfur shelf *Laetiporus sulphureus* (Photo 2) is known to consist of a group of closely related species with similar but sometimes overlapping host, ecological, morphological and genetic differences, and based on genetic differentiation, several unidentified species appear to exist (Lindner and Banik, 2008; Burdsall and Banik, 2001). Similarly, it is difficult to identify individual *Armillaria* species in the field without full consideration of the host range, ecology, geographic distribution, microscopic, biochemical and cultural characteristics of any particular collection (Watling et al., 1991).

Resolution and Trespass in Field Diagnosis *continued*

Field identification to genus is even tentative. For example, many stromatic canker forming fungi commonly identified in the field as *Hypoxylon* have often been reassigned to other genera or can be confused with other similar appearing stromatic forming fungi that may or may not be pathogens, or are clearly saprobes. For example, the ubiquitous fungus *Biscogniauxia* (*Hypoxylon*) *atropunctata* has several similar appearing species that are saprobes but appear in similar circumstances to *B. atropunctata*. Similarly, the well known Hypoxylon canker of aspen caused by *Entoleuca* (*Hypoxylon*) *mammata* could be easily confused with the similar appearing but lesser known Cryptosphaeria canker (*Cryptosphaeria lignyota)*.

In the above cases, the details may be academic or not, but the implication for ASCA consultants is that it is important to periodically check nomenclature, updated pest information, and field assumptions before we commit diagnostic trespass. I think it is preferable to characterize an identification exactly how it was made nonetheless, so if questions arise there is clarity in how far the diagnostic process was taken.

Clearly, a more important pitfall exists. Once we stop our scientific inquiry, complacency can obscure new discoveries right under our own noses. For example, the well known field diagnosis (observation of black pycnidia sticking out of stomata of green spruce needles) of the common Rhizosphaera needlecast caused by *Rhizosphaera kalkoffii* (Photo 3) was shown to be potentially unreliable because another fungus, *Stigmina lautii,* also appears in a similar manner (Hodges, 2002). The importance of this discovery is unknown; however, it was likely there in front for of us for sometime, obscured by our inference and lack of resolution. Failure to periodically check diagnosis made by inference in the field will miss these diagnostic discoveries.

Photo 3. Pycnidia, or the fruiting of *Rhizosphaera kalkoffi* coming out of stomata of spruce needles, were previously a strong field diagnostic sign of Rhizosphaera needlecast disease. However, recent finding is that the fungus *Stigmina lautii* produces a similar appearing sign in the field suggests higher magnification of fruiting is needed to discern between the two different fungi.

Photo 4. Bands on a needle of *Pinus radiata* caused by *Phytophthora pinifolia* in Brazil. This unusual discovery for a *Phytophthora* infection of pine needles could not be made using field symptoms (Photo by and permission to use from Dr. Rodrigo Ahumada)

We drift even further when we infer species identification from symptoms. It is common place in field diagnoses to use symptoms to identify familiar diseases, insect or abiotic pest problems. We all "know" the identification of the common pests and accept those as sound field diagnoses. However, the existence of Asian longhorned beetle in Wooster, MA, after its presence there for possibly over 10 years before its discovery, shows the potential for diagnostic complacency to have a high price. Apparently everyone failed to maintain an appropriate scientific attitude and look closer.

Further, a needlecast disease outbreak in radiata pine plantations in Brazil was shown to be caused by a *Phytophthora* species, a pathogen not associated with such symptoms on pine (Photo 4) (Durán et al., 2008). Field diagnoses based on symptomatic assumptions as to cause could never have resolved this unusual discovery. Is there a similar *Phytophthora* caused disease in the United States?

Laboratory verification of field diagnostics is obviously discretionary depending on the final use of the information. But there are clear implications of not investigating further what we believe to be true based on past experience or information.

Application in Consulting

This is how I see the resolution effecting field diagnostics and reporting for ASCA members.

1. Never stop observing. Keep looking. All recognition, resolution, and inference is first based on sound observation. Where possible, shift your perspective to gain a different view of what you are currently observing. Failure to make an important observation is a critical and a hard to explain error in field diagnoses. Be sure to state how your observations were made and any limitations of your observations if they are known.

2. Recognize when you are using inference versus direct knowledge. Question all conclusions based on inference. Look for them in reports or other documents. They are a significant weak link in any diagnosis where they have been substituted for direct knowledge, particularly if they are reported as such.

3. Use field recognition and resolution appropriately. For example, check to make sure you are not using resolution, such as genus and species names, where appropriate resolution was not used to gain such information. Or, cite what methods were used to make such a resolution, or what characteristics support the diagnosis if further analysis was not possible, or indicate the tentative nature of your identification.

4. Periodically check your field inference using diagnostic labs or other more advanced diagnostic techniques. Clearly, every field diagnosis does not require microscopic or other advanced assessment. But, check your diagnostic assumptions, and where warranted, confirm it with direct knowledge methods. If symptoms do not seem typical of the common field diagnosis, keep observing or check to see if other causes are possible.

5. Keep checking the literature and Extension pest management newsletters and as new pests are identified and changes in nomenclature are common, but are usually reported at the research level in scientific journals before they filter down and become "common knowledge" to practioners.

Literature

Burdsall, Harold H., Jr., and Mark T. Banik. 2001. The genus *Laetiporus* in North America. Harvard Papers in Botany 6:43-55.

Durán, A., M. Gryzenhout, B. Slippers, R. Ahumada, A. Rotella, F. Flores, B. D. Wingfield and M. J. Wingfield. 2008. *Phytophthora pinifolia sp. nov.* associated with a serious needle disease of *Pinus radiata* in Chile. Plant Pathology. 57(4): 715–727.

Hodges, C. S. 2002. First report of *Stigmina lautii* in the United States. Plant Disease 86:699.

Lindner, Daniel L., and Mark T. Banik. 2008. Molecular phylogeny of *Laetiporus* and other brown rot polypore genera in North America. Mycologia 100:417-430

Lonsdale, D. 1999. Principles of tree hazard assessment and management. The Stationary Office. London. 388 p.

Watling, Roy, Glen A. Kile, and Harold H. Burdsall. 1991. Nomenclature, taxonomy, and identification. In Armillaria Root Disease. C.G. Shaw and G. Kile, eds. Agriculture Handbook No. 691. USDA Forest Service. pp. 1-9.

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