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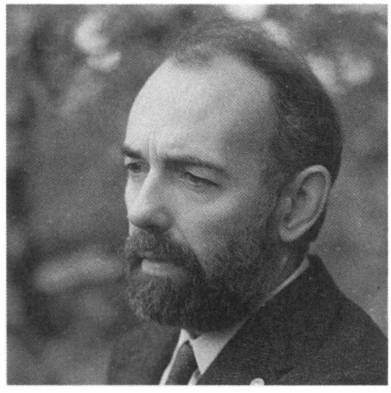

Dan Janzen's thoughts from the tropics 4

Science is forever

It is ironic that about the time (1960–1980) that tropical field biology is becoming a widespread, respectable and interesting area of research, greatly increased rates of destruction of the tropics are rendering it obsolete and impossible to conduct. However, the burgeoning conservation efforts throughout the tropics suggest that all is not lost. This 11th hour calls for exceptional and directed efforts on the part of the scientific community. Here I address the question of how the scientific literature about the tropics can be improved through changes in attitude and emphasis. My comments may seem to apply to more literature than just that about the tropics, but it is no secret that tropical scientists have much in common with their extra-tropical counterparts.

Current fashion and short-term economics have caused us to all but forget the archival function of book and journal publications. Analysis of the cause does not concern me here, though its roots obviously lie in tightening job markets, urbanization of societies, conversion of the natural world to biological factories, and the use of science for the production of material wealth. The outcome, however, is that we are producing an ever greater body of literature with less and less long term value. Equally bad, we are failing to preserve our observations of the present world for those to come, for those who will never see many of the tropical habitats and interactions that disappear even as we study them.

Lets say the U.S. National Science Foundation awards $300,000 of taxpayer money to fund a three year study of rainforest hummingbirds and the flowers they visit and pollinate. Assume that the study produces nine papers for a total of 263 pages. A realistic raw data base (what birds visited what flowers when and with what effect) might occupy 86 pages of carefully organized 8-point type. At a publication cost of $30.00 per page, this would be 0.86% of the project budget. We are left with two core questions. Why publish the raw data as printed material, as part of the papers themselves? What do we get for publishing it at all? In other words, why not do as is currently fashionable and do our best to reduce the published results to a Newsweekian summary, complete with tests of significance?

Why printed?

1) The audience for a tropical study is more than the extratropical readership looking for new cliches about the tropics. The Venezuelan, Kenyan or Malaysian field biologist needs to see exactly what you did and what you found out, to both build on your study and contrast the local situation with it. This can be done with the reprint from the journal (or the journal itself) in hand; it cannot be done if the data base resides in any other repository. Microfiche, electronic data banks, mimeo handouts and other things obtained by request are simply not reliably available, or require months of tenacious effort to locate and order. Tropical field biologists suffer 10–50% mortality on their mail, and delays of weeks to months before it does arrive. If the data is present in a reprint, it is used; if not, it is ignored.

2) Direct cross-tropical flow of information is desperately needed not only to obtain actual data, but also for inspiration by example, to promote the feeling that there is at least one other person out there in the tropical world who shares your interests, and to counter the nationalistic tendency for each tropical country to yet again re-discover the wheel. A data-rich paper has much more power in this direction than does a paper that is solely a concise summary and analysis of results.

3) The printed page is undoubtedly the only form of data recording that has any chance of surviving the growth and organizational pains of developing tropical countries. You may not think that this is a realistic worry but a journal produced in a tropical country is as interested in being fashionable as is any other journal. As the pressure grows in the developed world for electronically-banked data to accompany summary-style papers, the temptation for tropical journals to participate in disastrous experiments in data storage and retrieval increases precipitously.

4) Printed data cannot be altered. The tropics is a seething cultural mosaic in which the outcomes of scientific studies, even ones as esoteric as field biology, can on occasion have very great relevance to government, development and conservation decisions. This human

ecosystem is rich in persons who are not only personally willing to alter data to suit a goal, but contains powerful subcultures in which such data massage is a legitimate and respected social enterprise.

Largely because of this, in developing countries printed data has much greater legitimacy than does the same information in a soft form. Their trust (or lack of it) is well-placed. The researcher, and the funders of the study, maximize the legitimate use of the data on the local and international scene by publishing it in printed form.

Why published?

1) The traditions of publication in field biology have been developed in nations where a large body of information about the widespread native species is widely known, and a specific study is often added to this. The statement that acorns are dispersed by deer is unlikely to be believed by the editor, reviewers or readers. However, the readers of papers about the species-rich and patchy tropics, be they from anywhere, are often unfamiliar with the organisms discussed. This makes them both gullible, and unappreciative of the importance of details. If the details, the raw data, are published with the study, the reader can both become self-educated and see directly how the data apply to the case at hand. Parenthetically, I should note also that good photographs of the organisms concerned are documentary, educational and archival in this context.

2) The tropics are rich in field biologists with, shall we say, either unconventional or downright warped philosophies of data analyses. Raw data accompanying seemingly (or unseemingly) outlandish or very "old-fashioned" papers allow the reader to decide directly how appropriate are the conclusions. Again, this function becomes ever more important the more distant the background of the reader and the author, and the less in common between the subculture of each. If love is the universal language of the street, then data is the universal language of tropical field biology.

3) In the tropics, more than perhaps anywhere, we are doing salvage biology. Many of the things we see and record will not be available to up-coming generations. The failure to document these systems as the opportunity presents is more than just a failure to provide reference points in contemporary analyses and a basis for later comparisons. As most of the natural world becomes used to grow humans as draught animals, the vacuum of information on the real world will be filled by hypothetical constructs of how nature "ought" to be; every documented system we leave behind places one more boulder in the path of the distressingly large number of scientists that enjoy arguing over what they think nature is rather than actually observing it in place. We have only a few years before "the tropics" is represented by a smattering of serendipitously placed preserves; data-rich field studies at other sites are the only barrier that will keep these preserves from becoming viewed as the full range and realm of tropical possibilities.

4) For the same cause, tropical field studies desperately need elaborate and thorough descriptions of study sites and methods. In many cases, the next generation of biologists will not be able to visit the site to understand the idiosyncratic circumstances under which a study was conducted. This places a particularly heavy responsibility on a specialist to place the study in the context of organisms and ecological processes that are normally considered beyond the scope of the study. A study of tree demography in a "pristine" African forest cannot ignore that fact that all the large mammals may have been recently hunted out. A study of succession in a Mexican cornfield must include an examination of the proximity of seed sources in other vegetation types, if the study is to have general applicability. If there is any one universal truism about tropical ecological processes, it is that they are circumstance-dependent.

5) Acquisition of field data in the tropics is often extremely labor intensive, a labor not only of youthful vigor but the enthusiasm of first discovery. This acquisition can often also be very costly in hard cash. It is absurd to use that data to "test" some hypothesis, draw a conclusion, publish that conclusion, and discard the raw data. Yes, scientists' jobs, fame and promotions are currently (and absurdly) based on such "tests", but some day we will grow up.

It is preposterous to think that we can bleed any particular data set for either its direct or comparative potential with the tools and ideas currently at hand. The existence of a data set that was hard to obtain may inspire its use in many unimagined ways, but once discarded, the data is unlikely to be sought and obtained again owing to the lack of the right combination of driving forces or the lack of the actual field situation in which to conduct the study. A detailed study of pollinators of a roadside goldenrod (*Solidago*) patch in Michigan may be neither a unique system nor extraordinarily costly to repeat. On the other hand, a structurally similar study in a Ugandan rainforest may not only be risky and costly, but unrepeatable and unique for all of biology now and in the future. I do not have strong feelings about the Michigan study, but feel that the Ugandan one should be published in excruciating detail.

6) It may be argued, and often is, that raw data publication should occur only if funds and journal format permit. Wrong. Journal format can be changed (see below) and the raw data, while perhaps the least readable and currently least used part of an article, may well be the most valuable part of the study. Publish the *other* parts "if funds permit". Part of the current fad for papers that are poor in data (and rich in hypothesis testing) is self-generating. The fewer data-rich papers there are, the less likely is someone with the interest and skill to use someone else's data to good advantage, and thereby show that such use can and will occur. To rein-

force an earlier point, the recording of data explicitly for others to use (as opposed to the insecurity of "documentation") renders the site and study description of paramount importance, and exposes the fact that this is an area long ignored in research papers.

7) Research papers contain, already, one important section that is essentially unreadable as prose (and it is not designed to be readable as prose) – the Materials and Methods section. There is absolutely no reason why research papers should not also contain a second non-prose section – Archival Function – as an appendix, as a table (they are identical) or simply as another section. Set in small type, the cost will be minimal and the gain maximal. For editors concerned that their journals be readable in the sense of weekly news magazines, it is certain that any cursory reader will recognize an Archival Section for what it is, and simply skip over it.

D. H. Janzen, Dept of Biology, Univ. of Pennsylvania, Philadelphia, PA 19104, USA