3 Ground-truthing methods

RC, 2017: Bob Christensen and I evolved efficient rapid-assessment methods for documenting past and proposed logging during our timberlands ground-truthing years, 2005 to 2009. Some of our techniques are well suited to the *Last Stands* trekkers, who need to collect information on-the-fly, without lingering over time-consuming data entry, or lugging heavy field equipment.

After 2009, Bob continued to explore and apply new technologies, which these days are less about gathering dirt on bad practises and more about documenting success and failure of efforts to repair damaged streams and logged landscapes, meanwhile helping Southeast communities build job capacity that stewards environment rather than gutting it. I use similar field techniques for a wide variety of field research and educational projects, but haven't had much involvement in Tongass timber conversation for about a decade. I do carry some guilt about that, but apparently not enough to distract from the never-ending string of funner naturalist-gigs.

So I was much cheered to hear about Elsa-&-Natalie's *Last Stands* expedition this summer on Tàan, *sea lion* (Prince of Wales Island). Periodically, I update a description of the ground-truthing process, and this seems like a timely occasion to revise the last version, compiled in—lessee—2012.

Cameras On a typical field day I take 100 to 200 photos. Ground-truthing is about forest structure, stream sinuosity, and mountainside topography, all hard to capture in traditional, narrowscope photographs. For many years my solution was a Nikon DSLR with 18-200mm lens. At the low end, 18mm is as wide as you can go without fisheye effects. I would tip it into portrait position and take up to 5 overlapping photos for a pano-stitch, capturing a huge vertical and horizontal expanse of forest or landscape, free of the tell-tale out-bowed trees of fisheye lenses.

This year, I've switched to an iPhone for landscape panoramas. On many forest-assessment days, more than half of my photos are panoramas. The need for big-landscape photography will apply as well to the *Last Stands* project.[1]

Wildlife photography is great for media outreach but takes more time and patience than you can afford on a mile-eating trek, when covering ground is first priority. My iPhone doesn't deliver quite the resolution of a multi-component DSLR pano, but color balance is less finicky and often downright eye-catching. And of course iPhone or android panos require no post-field stitching in panorama programs.[2]

Also, for lightweight trekking & bushwhacking, you can't beat the convenience and weight-savings of an android or iphone, compared to slinging a big DSLR around your neck. The major limitation of smartphone photography as of 2017 is the inability to zoom. For wildlife, I currently use 2 cameras, both Lumixes.

When weight&bulk is not an issue, I carry a DMC-FZ70 with 60x zoom range. It's still only half the weight of my DSLR. When trying to go even lighter, I bring a little pocket-sized DMC-ZS40, which offers an impressive 30x zoom. It gives complete control over photo-settings, unlike most point&shoots that limit you mostly to program settings. For extended telephoto shots I use shutter mode, trying for at least 1/320 speed. Slower telephotos come out soft.

Both Lumixes take fine movies. For videography on a lightweight trek, the main challenge is figuring how to brace the camera *sans* tripod. A partial solution, if trekking poles are carried, is to add a ball-head so the pole doubles as a monopod (or dual-pole clasped 'bipod'). Related thoughts on stabilization are in *Video editing*, below.

GPS After a 2-decade succession of Garmin products—renting Trimbles only when clients demanded sub-meter accuracy—I migrated to Bad Elf GPS Pro. It's the size of a traveler's soap bar and fits in a pocket on my bill cap, where it delivers best satellite reception. Comparing Garmin, Bad Elf and Trimble tracks side-by-side, the Garmin's (or any other recreational or device-based gps) looks crude and vectorized. The Bad Elf's is almost indistinguishable from a Trimble

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1 Another asset of panoramas: they're well suited to slow pans in narrated slideshows—often refered to as

the Ken Burns effect. More below in *Video editing*.

2 I continue to stitch post-field, but on a less industrial scale. More in *Kolor Autopano Pro*

track—convincingly sinuous. Under canopy it's often better than post-processed Trimble.[3] In the open, walking a test line on the edge of grass and pavement, then downloading to high-res orthophotography, a Bad Elf track usually falls within a few feet.

The Bad Elf GPS pro+ saves weight by offering no map screen—instead pairing with your device via bluetooth. With a lot of awkward backdoor adjustments, Bad Elf can *sort of* talk to android devices, but full functionality is only available through iProducts. This is one of the main reasons I finally jumped the android ship and got an iPhone last year.

Bad Elf is also central to my process for assigning the most accurate locations to photographs, described below under *Robogeo*.

Fieldnotes Since the late 1970s, when I decided to become a naturalist, I've always had a pencil and scrap of paper—preferably rite-in-rain or rugged card-stock—in a pocket or belt pouch. This will probably never be fully replaced by higher-tech devices. But handwritten notes do increasingly slip into 'backup' or 'plan-B' roles in most of my outings for work or play.

A wide-ranging discussion of note-taking alternatives for scientists and naturalists is *Field notes on science and nature*. Canfield, *ed*. 2011. I reviewed this publication on *Discovery's* website.[4] Since everyone has different needs and methods, this compilation by a dozen field workers samples the scope of possibilities. Most of the contributors are senior ecologists, illustrators, etc, so they're predictably skeptical of digital alternatives to pencil and paper. But the chapter by Piotr Naskrecki on *Note-taking for penciliphobes* provides balance, showing how beautiful and powerful (and dependable, given adequate backup) a relational database with integrated sound and graphics can be.

For me, the reason for jotting notes on paper outdoors is to retrieve and embellish them later in my digital journal, discussed below. The paper is ultimately discarded. That's not the case for many field workers. Sketchbooks of

my colleague Kathy Hocker are 'finished' works of art, permanently archived. Her approach to fieldnotes and drawing is summarized in a feature article for our newsletter *Discoveries*. [5]

Ideally, before memory fades, I begin journaling in the evening after each day's outing. But on multiday expeditions, that typically proves impossible. So the challenge is to collect enough memory-joggers *in whatever form* to guarantee the key stuff survives until I finally sit down at the keyboard, usually back in Juneau. Unlike Kathy Hocker's more meditative approach to field study, I rarely stop to write more than a couple words—especially when traveling with companions, trying not to slow them down.

Increasingly, my photo-collection process circumvents the need for lots of hand-written field notes. The photo itself serves as the memory-jogger. I also almost never take waypoints, because my photos are so precisely anchored (*Robogeo*, below). It takes less time to snap a picture than take a waypoint, because the latter is useless without thumbing-in an identifying name, or maintaining a numbered list of waypoints in your notebook.

As one example, for many projects I take a photo in portrait format for every stream channel I cross, however small or ephemeral. They're named simply "*stream*" (*ACDSee*, below). At day's end, I have a spatial catalog of precisely-anchored stream points that can be classified by size or stream-order, useful for some cartographic assignments.

Audio notes Chatting with Elsa after the first leg of her *Last Stands* trek, I learned she was taking notes primarily through audio. This is an efficient solution to on-the-fly documentation. (Didn't ask if her recording app autotranscribes.) Beginning the late 1980s, I've dabbled with audio notes, first with micro-cassette tapes. Later, several of my digital cameras allowed 5 to 10 seconds of linked audio, which I deleted after transcription. For me the drawback was the many hours required to transcribe and collate those notes post-field. Today, some of that process is automated, and field-audio has the additional value of '*you-are-there'* immediacy, when added as sound track to video and slideshow presentations.

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3 One agency GPS field leader, training our wetlands team in trimble esoterica, referred to those dense, satellite-deadening forests as ":hostile terrain." *Oh! B'rer Fox! **Please** don't throw me in that d7 trimbletroubler!*

4 *https://www.discoverysoutheast.org/product/field-notes-on-science-and-nature/*

5 *https://www.discoverysoutheast.org/product/the-art-of-noticing/*

Navigation apps I'm trying here to describe products and protocols in a logical sequence from field activities to final product delivery. But in reality, high-tech ground-truthing involves constant mutual support and interplay between field and 'office-or-camp'—a chicken-&-egg relationship.

Prefield prep, for me, mostly involves sweeping together all available carto-graphic resources. I'm rarely satisfied with off-the-shelf basemaps or imagery for realtime navigation (Delorme's for example). They may keep you from getting lost, but are mute about changing bedrock type, canopy gappiness, Tlingit place names, or channel-type.

The more detailed and customized our field maps, the more efficiently we traverse and target the key destinations on our study sites—especially impor-tant for off-trail travel. It really helps to see your track and position on a high-res air photo (raster—large file size) or USFS roads (vector—small file size). In an ideal world, our navigational devices would have the same power, on-the-fly layer-swapping and ease-of-use as our desktop mapping programs.

But I've been frustrated with the clunkiness of GIS-paired field apps like *ArcPad* and *Collector*. While waiting for them to get friendlier, here's a simpler solution for anyone with access to *ArcMap* or similar GIS program.

My current favorite navigational app is **Avenza**—not least because it's dual-platform—nice for teams using an assortment of devices. *Avenza* is a simple, free, geopdf reader. From *ArcMap* we export custom geopdf base maps—for example a high-res LiDAR-based bare earth (raster) showing marine escarp-ments and glacial moraines so subtle they're sometimes overlooked on the ground, with overlays of wetland type or predicted stream lines (vectors). *Avenza* shows our position and track over this pdf. If our device is paired with Bad Elf, the realtime track is also high-resolution, [6]

Phones versus tablets Each has obvious pros and cons for field use. Even tablets (minis at least) are light enough that you don't have to choose which to include on a bushwack. Lately, I've been carrying both. My iPhone 6s+ is mostly for communication and landscape photography, as explained above. For offline navigation I prefer the larger 7-inch Nexus tablet (no phone, adequate onboard gps) Not only a roomier screen for display of *Avenza* geopdfs, but also the assurance that I'm not sucking down my rather stingy cellphone data-plan. [7]

An unexplored advantage of tablets for field use (except by me, as far as I can tell from web-searching) is stereoviewing. Previous pages of this scoping document have 3-D stereopairs that are beautifully displayed on a high-res tablet. Simply bring along a lightweight pocket stereoscope and you can view as many landscapes as you have time to load pre-trip. More on tablet stereo is on the *Discovery* website. (*http://www.juneaunature.org/tools/stereo-photography/*)

Raven's-eye photography Drones have become a central part of my ground-truthing tool kit since November 2014. Merging tree-skimming flyovers with bushwacking video is an effective combination for slideshow summaries.

Here, for example is a story of post-glacial succession from drone elevation: *https://vimeo.com/217728202*

ACDSee In this image-management program I give a descriptive name to each photo, add my name and location to the EXIF data, and then, after culling duds and no-longer-needed panorama components, re-number shots sequentially (*143_ closedcanopy*) to keep them in chronological order. *ACDSee* includes a google map window displaying locations of geo-tagged images during the photo-editing process—helpful in assigning geographically-meaningful names.

Most smartphones and many cameras can stamp lat-longs to the EXIF data. Resulting photopoints are tolerably accurate. But none of these devices have GPS resolution as good as a dedicated recreation-grade Garmin, and certainly not as good as a billcap-mounted Bad Elf. Also, it may take awhile for a smartphone or camera-gps to 'wake-up,' particularly under canopy. For fast-moving trekkers in dense forest, some of the daily photos from smartphones or

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6 High field precision could be considered overkill for simple navigational decisions. The real value of precision comes after downloading, as explained below under *Robogeo*.

7 This is probably stupid on my part, and not something I recommend, but I don't protect either phone or tablet in fully waterproof containers, which double device bulkiness. I pack ziplocks in the event that light drizzle graduates to serious rain. On really rainy days (1-inch+), I simply don't bring them. *Weather Underground* forecasts have probably saved me from drowned devices on more than one occasion.

gps-enabled cameras will always download with empty lat-long fields.

The solution is to bypass the camera's GPS, and reassign lat-longs by linking to the strongest possible GPS track.

Robogeo This program compares the time on camera and GPS, automatically dropping photopoint icons onto the downloaded GPS track as kmls/kmzs for *Google Earth*, or shapefiles for *ArcMap*. That's a huge time-saver if you take over a hundred photos per day. When exporting, be sure to write the photo's *title* to the attribute table so it can be labeled on the map.

If your camera time is not perfectly synched to the GPS time, *Robogeo* can account retroactively for the offset. But it's easier if you adjust camera time beforehand. When shooting from a plane, ask your pilot to place your Bad Elf or other GPS in the window for best reception, and synch your camera to the nearest second. At flight speed, a couple seconds' offset is a significant error.

On route-maps prepared for the daily journal, I show the GPS track, and all *Robogeo* photopoints. That way, readers interested in a specific location can see whether there's images in that vicinity. But to avoid information-overload, I number only the photos excerpted to the journal.

I rarely take waypoints, because my named & numbered photopoints *are* my waypoints. Images usually hold far more memory-stimulating information than a paragraph of handwritten or even audio-recorded fieldnotes—as long as I get to the journalling before the experience evaporates.

Kolor Autopano Pro This is one of many panorama-stitchers, some free. As mentioned under *Cameras*, above, I now mostly rely on iPhone for panos.[8] But there remain a few cases where I continue to rely on *Autopano*.

Let's say you want a high-res panorama of the mountainrange 2 miles across the channel. Because smartphones can't zoom, those mountains would be a disappointing, narrow band in the middle of the pano. With a zoomable camera, frame a mountain at the left edge of the range, sandwiched by just a bit of

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8 Unless you sweep your iPhone panos perfectly horizontal, they'll require edge adjustments in *Photoshop*. Rather than losing information to cropping, I enter warp mode in *Photoshop* and drag blank portions to the margins. Warp mode is also good for straightening those outward-leaning trees.

ocean and sky. Staying at that zoom setting, click your way across the range, overlapping photos by ~20%. Drop those into a pano program.

ArcMap is the favored cartographic tool for 21st-Century researchers and naturalists. Since Bob Christensen introduced me to this program in 2001, about a quarter of my total computing time has been spent *ArcMap*. Almost all maps and orthophotos in this scoping document are exported from *ArcMap*, with final touches and labelling in *Photoshop*. Describing *Arcmap* is beyond the scope of this *Methods* section. I'll only note that it's probably the most important tool for anyone aspiring to become a master 21st-Century ground-truther.

Journaling For me, it's during the reflective postfield 'data-sweeping' process that the real synthesis emerges. In the heat of bushwacking, my attention is usually diverted by not getting poked in the eye. Once all the track and photo processing is done, I open *InDesign*—a page-layout program—dropping in the daily maps and best photos. Retracing the day's bushwack, comparing ground scenes to canopy texture on air imagery, I 'write my way around the images.' Journaling is my way of savoring the country, and of taking the reader as graphically as possible into the field experience.

In the early years of the Ground-truthing program, Bob and I were disappointed at how few colleagues in conservation took the time to fully read our lengthy, lovingly-illustrated reports from the field, distributed as pdfs. In part, that's because few (me included) are willing to sit passively for more than a few minutes in front of a computer monitor. The digital age has sapped our attention span. Today's computer-jockeys are hummingbirds, demanding soundbite communications, compelling graphics, bottomline conclusions. Ground-truthers must become multimedia storytellers, sharing the woods experience in ways that grab attention.

The term 'executive summary' reveals the pressure-cooker intensity of today's agency and NGO heirarchies. Multitasking commanders are buffered from the tedium and danger of front-line engagement, fed pre-chewed bites of 'science,' to quote in their 'campaigns.'

Printing out a ~70-page, all-color groundtruthing report is ridiculously

expensive. But growing popularity of tablets, large-screen phones and e-readers, along with easier access to highspeed internet with cloudbased documents and video, gives me hope for a wider audience.[9] As paper books slip toward extinction, our communications will increasingly intermingle print, stills, audio, video and probably media we can't conceive of yet. Many of my pdfs already have embedded video; the only challenge is file-size. Any journal with more than a couple 2-minute videos soon exceeds a gigabyte.

In 2008 Bob and I posted a 29-page pdf review of TLMP and the conservation coalition response, along with email notifications to a long list of collaborators. We received almost no feedback. A week later, I distilled our commentary into a narrated slideshow. It was my first effort in this format, over-long (~40 minutes), excrutiatingly detailed, and a bit rambling. Even so, I quickly heard back from about 20 colleagues who endured the entire presentation. Not a viral response, granted, but an eye-opener about the importance of format.

Online slide shows and video editing I'm a newbie to film and video-editing, and don't presume to offer advice on advanced, technical aspects. I'll stick to a few observations on sharing natural history through moving pictures.

In my presentations, video is used sparingly—partly for file-size issues and partly because video tends to lead the viewer by the hand. Nice as a spice but not the main course. Still images give the audience more time and freedom for self-directed exploration.

That said, some subjects (shrew frenetics, riparian drone passes, bushwacking difficulty) are way cooler in video than stills. In my narrated slideshows posted to Vimeo, I intermingle still images—usually panned or zoomed—with videoclips that rarely run more than a minute.

I create most of my narrated slideshows in *Proshow*, which outputs to .exe format. Executables unfortunately don't play on mac, but direct transmission to other computers/devices through flashplug is a relatively minor component

of my outreach. *Proshow* also outputs directly to Vimeo. For about 2 years I've been archiving material ranging from 20-second clips of foraging ravens to 45-minute presentations. (*https://vimeo.com/user44517242*)

One advantage of *Proshow* is the efficient use of still images, panning, zooming and dissolving smoothly without creating giga-file-sizes, as in *i-Movies*. For comparison, I panned for 10 seconds through a nice landscape .jpg in *Proshow*, outputting to .exe at highest quality. File size: 7.4 megs, image resolution very crisp. Next, in Cyberlink's video-editting program *PowerDirector*, I 'keystoned' that same jpg, outputting to an equivalent 10-second .mp4 at 1920x1080. File size: 19.5 megs, image resolution okay but detectably softer.

Conclusion: if most of a presentation is composed of stills, use *Proshow*. If most or all of the compilation is movies, use a dedicated video editor like *PowerDirector*. My vimeo-postings longer than 10 minutes use both: *PD* for the video elements, and *Proshow* to package them with stills and audio narration.

Only when I plan to film wildlife (*eg. https://vimeo.com/228331206*) do I bring a tripod. For opportunistic wildlife filming, unbraced camera-wobble is the challenge. Shakey clips can be stabilized afterward to some degree in programs like *PowerProducer*, usually at the expense of cropping and softening. But stills-dominated slideshows are much enlivened by even 5 seconds of a critter in motion. I often extract just the most stable segment of an otherwise unusable video, and slow it to half or one-third speed, which makes wobble less irritating.

For more examples of Juneau-area nature archived on Vimeo, check out Doug Jones (*https://vimeo.com/user32335610*) and Bob Armstrong (*https://vimeo.com/user31149746*)

It's ironic that our pleas for attention to nature are disseminated through media more dedicated to selfies. But good communication in any medium shares 2 things with good natural history: persistence and love of detail.

A less technical and more philosophical description of the ground-truthing process, with emphasis on journaling, is in my fall 2011 article for *Discoveries*, titled R*ecording nature: Field journaling as Raven goes global*. Visit *www.discoverysoutheast.org*, and search under *Publications*.

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9 I also hope that tablets, in particular, will return us to the mental relaxation of book-reading. For me, reclining with good literature on a tablet is not fundamentally different than page-flipping a book or magazine. Photos are more luminous, and for map-rich, high-res documents, digital is *better*, because you can zoom in to check out zones of interest.