

FIELD NOTES

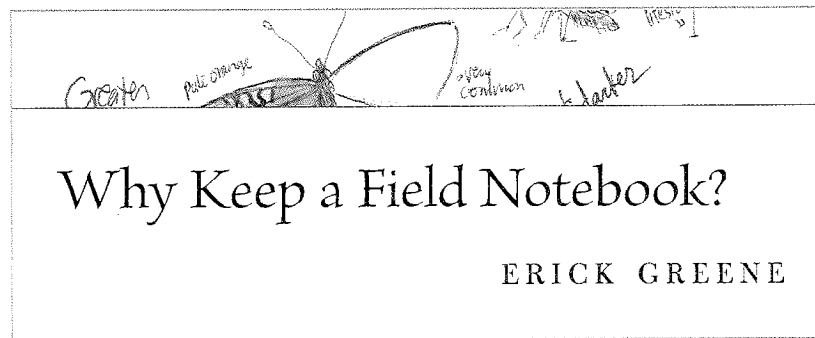
on Science & Nature

EDITED BY
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iously not every field biologist works for an institution that will per-
 nently archive his or her field notes. But that does not mean that a
 -documented personal field record is a waste of time. Notes that are
 ough yet concise are more likely to be useful for yourself, or your
 s or colleagues, and are more likely to be archived as a valuable ref-
 ce for the future. This is true whether your work consists of biotic
 eys, behavioral observations, experiments, or other field pursuits.
 world is very much in flux, perhaps now more than ever before, and
 ;-term datasets are particularly valuable and particularly scarce. Few
 . collection approaches require as little effort, equipment, or expense
 ecord and archive information as a simple pen and paper. As tech-
 gies change with an ever-increasing pace, ink on paper will remain
 ble long-term storage medium. It may be challenging to access com-
 r files that are more than a decade old—remember floppy disks?—
 a paper record can speak across generations. Write your field notes
 this goal in mind.²⁶



I STUDY ANIMAL BEHAVIOR and ecology, and I have kept field notebooks
 for as long as I can remember. My field notebooks contain data con-
 nected with a specific project I am working on as well as a hodge-podge
 of miscellaneous observations, questions that come to mind, notes to
 myself, and descriptions of interesting natural history. These field note-
 books are crucial for my research projects. I find that they are also the
 main source of ideas that takes my research in new directions. I often
 return to them for the pure enjoyment of reliving special field experi-
 ences in some amazing corners of the earth. I can crack the cover of an
 old field notebook, and these time machines instantly transport me back
 to watching squadrons of macaws and parrots flying in at dusk to roost
 in palm swamps in Peru, listening to the “wahoo” alarm calls of olive
 baboons in the Okavango Delta of Botswana as they warn each other of
 approaching lions, observing teenage male sperm whales flip their tails
 up as they begin their hour-long dives to catch giant squid in a deepwa-
 ter trench off New Zealand, or watching tens of thousands of migrat-
 ing harp seals, belugas, narwhals, bearded seals, and a mother bowhead
 whale and her baby stream under arctic cliffs to their summer feeding
 grounds in Lancaster Sound.

The keeping of field notebooks was considered an absolutely essen-
 tial activity of the naturalists and scientists of the eighteenth and nine-
 teenth centuries. Indeed, during the giddy heyday of European explora-
 tion of the far reaches of the world, the field journals of many scientists
 and naturalists returning from far-flung expeditions were published and

often became bestsellers. Even after a century or more, the field notebooks of Maria Sibylla Merian, Thomas Jefferson, Meriwether Lewis and William Clark, John James Audubon, Charles Darwin, Alfred Russel Wallace, Henry Walter Bates, and Henry David Thoreau, to name a few, offer fascinating glimpses into the science and times of these naturalists, explorers, and scientists. Many of these field notebooks are also treasure troves of information we can use to compare the current distribution and abundance of plants and animals.

Since the use of field notebooks in the natural sciences has been so important, I recently started a field notebook assignment for my upper-level Ecology class at the University of Montana. I asked my students to pick one “thing” and observe it carefully over the entire semester. The “thing” they chose could be anything from a single plant, one place, a beaver dam, their garden, a bird feeder, and so on. They had to record their observations at least once a week in a field notebook. One of the main things I wanted to get across is that one of the hardest parts of science is coming up with new questions. Where do fresh new ideas come from? Careful observations of nature are a great place to start. So in addition to their field notebooks, the students also had to suggest at least ten research questions inspired by their observations. This project was worth a considerable portion of their grade for the class, and I thought that this assignment would be received enthusiastically. I could not have been more wrong! After I described the project, the initial chilly response from the students gave way to much rolling of eyeballs and gnashing of teeth. When I asked students about their responses, I got answers such as: “I am interested in science—not creative writing.” “This is so lame—I already did my ‘expressive arts’ requirement.” “Do you want us to meditate and write about that too?” Over the course of the semester I noticed a general thawing of attitude about the project, which then grew into a real passion on the part of many students. Here is one representative response written at the end of the project by Carrie Douglas, who observed a single box elder tree in her backyard:

I have never taken a botany class before and surprisingly I don't know a lot about trees from my regular biology classes. This assignment gave me an opportunity to ask questions and find answers about trees that I have never thought about before. I have never wondered about the importance of leaves changing colors in the autumn—what actually

happens during the process, why it is important, and why leaves senesce.

This project also made me learn some important things about myself. I have always thought of myself as entirely left-brained. I love science, procedures, hard facts, etc. I hate abstract, creative or imaginative things. This caused me to be predisposed against this project at the beginning—you mean for my biology class I have to draw pictures and creatively write about a tree all semester!? Give me a break! I thought I was going to dread each journal entry. In reality, I quickly enjoyed making the time—even if it was only 15 minutes or so—to just be outside walking around and quietly observing. It would be the first time in the day that I would not be thinking about school, homework, tests, or the numerous other items on my never-ending “to do” list.

I also really enjoyed just writing informally. Just “throwing up” my thoughts on the page—no worrying about grammar, syntax, proper science writing—none of that—just writing. This is a type of writing I have never been into, but after this assignment I really think I might start keeping a field journal.

After paying attention to all the amazing biological processes unfolding right outside my back door I also realized that I have to live somewhere the seasons change. I took all the amazing seasonal changes for granted. Now I can't imagine living somewhere where the leaves don't change, the snow does not fall, or there are no spring showers. This project has truly caused me to appreciate the beautiful area we live in and I will never look at that box elder tree the same way. Now I wonder what is different for it every time I come home.

I had been puzzled with my students' initial negative reaction to being asked to keep a field notebook for an ecology class. This motivated me to look a bit more deeply to see if this is a general sentiment. To get a sense of the scope, I informally polled many of my colleagues in a broad range of biological fields at several universities. I asked undergraduate and graduate students and faculty how they use notebooks to help record their scientific activities. This much is clear from this poll: in general, lab scientists working in the areas of biochemistry, cell, and molecular biology tend to keep much better notebooks documenting their science than field biologists working in the areas of ecology, behavior, and conservation biology.

Hawthorne Thicket

below saddle of F.M.T. Jumbo
on a butterfly walk w/ Will Keeling
Aug 17, 2004
Missoula, MT.

Common Woodnymph
Cercyonis pegala

• dark brown of
two eyespots
• hopping flight
• flies higher

Clouded Sulphur
Glaucophaea phlaeas

• light bright
• head of
• back from

Woodland Skipper
Ochradia sylvanoides

• often most common
orange skipper in
midsummer → fall
• very small!

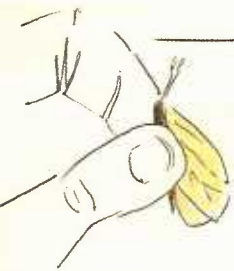
Scarlet Fritillary
Callippe spyeria

• pale orange
• host = violets
• low elev.
• foothills

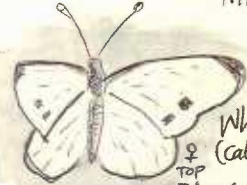
Small Wood Nymph

• note small
• red dot
• bottom

How to hold a
caught
butterfly



Nevada
Fritillary



White species
(Cabbage white?)
♀ TOP
♂ has 1 *Pieris rapae*
dot on wing

Mourning
cloak (♂)



Edith's
copper



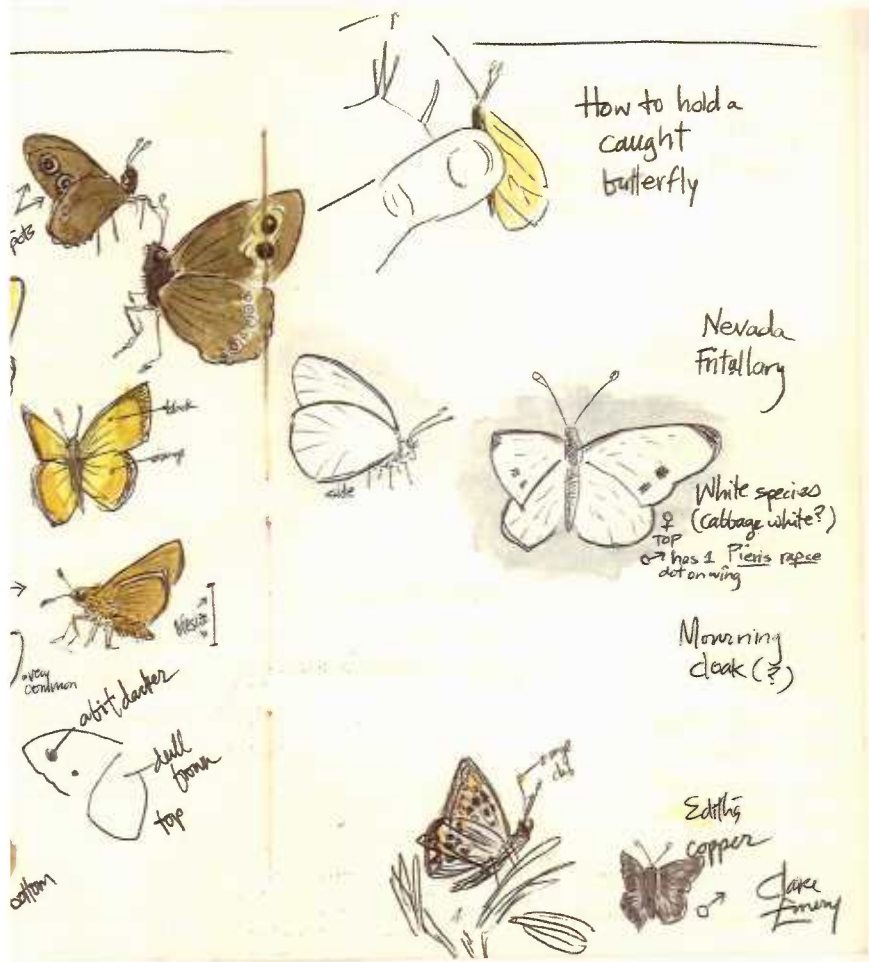
Claire Emery



Notebook pages from
artist and naturalist
Claire Emery describ-
ing her observations
of butterflies in a
hawthorne thicket.
Courtesy of Claire Emery.

Most of my colleagues who conduct laboratory research not only keep extremely thorough and complete lab notebooks, but they teach their students how and why to keep data in them. Some buy hardbound notebooks by the case and distribute them to students working in their labs. They show their students examples of good notebooks and lay out their expectations about how data need to be recorded. They often have review sessions where they look over the students' lab notebooks. Some labs even have friendly competitions in which prizes for the best-kept notebooks are awarded. Many undergraduate courses in microbiology, biochemistry, and molecular biology require students to keep lab notebooks, which can constitute

a substantial portion of the students' grades. A lines standards for notebooks in laboratory bi
In stark contrast to the vibrant culture of in molecular biology, my informal polling sug est in notebooks in field biology. When I ask graduate students in ecology and behavior ho books and where they learned to do it, I mainly These were typically followed by responses suc that." "My data are in a spreadsheet." "I writ get home." "I have a computer." The general c that field notebooks are quaint, archaic, and o
In this chapter, I make a plea for the res in field biology. I outline the different purp notebooks, describe their incredible value to b as others, and provide a list of suggested "best field notebooks.



Claire Emery's sketches of the same lilac twig made over thirty-seven days. Courtesy of Claire Emery.

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a substantial portion of the students' grades. Aysha Divan nicely outlines standards for notebooks in laboratory biology.'

In stark contrast to the vibrant culture of keeping lab notebooks in molecular biology, my informal polling suggested a lack of interest in notebooks in field biology. When I asked undergraduate and graduate students in ecology and behavior how they kept field notebooks and where they learned to do it, I mainly received blank stares. These were typically followed by responses such as: "I have a GPS for that." "My data are in a spreadsheet." "I write things down when I get home." "I have a computer." The general consensus seemed to be that field notebooks are quaint, archaic, and obsolete in field biology.

In this chapter, I make a plea for the resurrection of notebooks in field biology. I outline the different purposes and functions of notebooks, describe their incredible value to both the authors as well as others, and provide a list of suggested "best practices" for keeping field notebooks.

THE PURPOSE OF
FIELD NOTEBOOKS

People keep field notebooks for a wide variety of reasons. At one end of the spectrum, many keep personal journals that document their observations and experiences in the natural world. These field notebooks are close in format and spirit to the notebooks of the naturalists of the eighteenth and nineteenth centuries. This type of nature-journaling is mainly pursued by the amateur naturalists—meant in the best sense—who love to study and experience nature without being paid. These notebooks tend to capture the beauty and wonder of the natural world and help to hone the observational skills of the authors. They typically combine field sketching and painting with keen observation. This form of nature-journaling is thriving;

many museums, natural history societies, and summer camps offer clinics on how to keep nature journals. For example, the nature artist and biologist John Muir Laws teaches clinics on field journaling, and his book and website contain valuable advice and pointers.² Other excellent books, such as those by Hannah Hinchman and Claire Walker Leslie,



Oct. 21, 2007
@ ditch off Rattlesnake
Creek just N. of
Rattlesnake Community
Farm
~58°F, still, cloudy

Here near the Rattlesnake Farm,
a ditchside tree bears the scars of
many years of bear marking —
I wish I could see them here,
rounded bodies scraping + clinging,
arms swatting, backs stretching



October 26, 2004
~11:30 am
clear sky, hazy blue
~45°F, crisp air
N. Hills walk-off
Dickinson St.

quinty chortle squeak!
This flock of wide-winged,
short-tailed birds surprised us &
popped up out of the grasses on the
E side of the N. Hills.

Their bodies were mostly dark,
with lighter areas in the primaries on the wing.
After seeing them once, we flushed them
again by walking towards them.
With the same
chortle-grunt-squeak, they flew up the
hill out of sight.



Questions remain:

- Later: it seems we saw a flock of Grey Partridge. They are common on the N. Hills @ Mt. Junco. Introduced from Europe - no info on eggs yet -
- What kind of birds?
- Habitat needs?
- Coloration?
- Nesting behavior?
- Egg coloration?

Meanwhile, magpies chatter in the trees below, wheels spin & turn by, flocks of black birds turn white in the light as they turn. At last to sit in silence, to be without motion, and hear the world offer up its stones...



Perdix perdix
The Grey Partridge

Emery

Claire Emery's observations of bear-marking on a tree (left), and observations and questions about the grey partridge (*Perdix perdix*) (above). Courtesy of Claire Emery.

also focus on integrating observation and art in nature journals.³

At the other end of the spectrum, some keep notebooks that follow a much more structured format, such as the Grinnell system. These represent a formal mode of recording when and where specimens were

collected. Although they contain scientific data collected in a very formalized way, they lack the personal observations, musings, hypotheses, and sketching typical of nature journals.

To my mind, the most useful and interesting notebooks of field biologists are hybrids; as well as recording details and data of field research, they record the observations, thoughts, musings, and peregrinations of the author. In general, scientists take a range of different approaches in recording their fieldwork because it is a rich and varied undertaking.

WHAT A FIELD NOTEBOOK MEANS TO YOU

A field notebook serves as the basic documentation of your science. The central function of a field notebook is to record and organize your data, and this is the best place to have a complete and accurate record of your experiments and observations. You will find that when you get around to writing up your research, a well-kept field notebook will make that task immeasurably easier. This is because a well-organized field notebook serves as a "central command center" that allows you to collect many other related materials. For example, you may generate lots of information that is not stored in your notebook, such as photographs, recordings, samples collected in the field, and computer files of various types. You can very efficiently organize all of your data in your field notebook. Before embarking on a field project, it is useful to consider what kind of records will be important to you once you complete the work.

Another value of field notebooks is their ability to serve as an incredibly fertile incubator for your ideas and observations. By jotting down interesting observations, questions, and miscellaneous ideas, your field notebook can serve as a powerful catalyst for new experiments and projects. Excellent examples of these sorts of field notebooks can be seen in the work of Bernd Heinrich, Jonathan Kingdon, and many others.⁴

Finally, a well-kept field notebook will give you great pleasure. How quickly we forget! You will find that rereading your field notebooks will give you a chance to revisit corners of nature and remind you of the sorts of natural events that are meaningful to you.

WHAT A FIELD NOTEBOOK MEANS TO OTHERS

Well-kept field notebooks can be extremely valuable sources of information to other people. For example, Henry David Thoreau is best known for *Walden*, which resulted from the field notebook he kept while he lived for two years in his cabin on Walden Pond near Concord, Massachusetts. Until recently, the thoughts and information Thoreau recorded in his notebooks were influential mainly for their social commentary and observations of American society at the beginning of the Industrial Revolution. Thoreau was an excellent naturalist and a keen observer of nature, and between 1851 and 1858 he kept detailed records of the flowering times of about 500 species of plants. His meticulous observations are now extremely valuable, since they were made just before massive amounts of greenhouse gases would be pumped into the atmosphere. Ecologists Charles Willis, Brad Ruhfel, Richard Primack, Abraham Miller-Rushing, and Charles Davis have teamed up to compare Thoreau's observations with the plants that are currently found in the Concord area. In addition to Thoreau's notebooks, they have also been able to locate a number of excellent ones kept by other people in the same area.⁵ Between 2004 and 2006 they conducted similar surveys and were able to compare their results with Thoreau's: during the intervening 160 years about 30 percent of the species recorded earlier are gone, and about another 40 percent are so rare they will probably not survive much longer.⁶

Another illustration of the scientific value of well-kept field notebooks comes from the Catalina Mountains near Tucson, Arizona. The Finger Rock Canyon Trail is a strenuous hike, gaining more than 4,000 feet in elevation. The trail spans many different plant zones, and about 40 percent of all species of plants in the Catalina Mountains occur in this one canyon. During the past twenty years, Dave Bertelsen has hiked more than 12,000 miles on this trail and has kept meticulous notes on the flowering dates of almost 600 species of plants.⁷ Mike and Theresa Crimmins teamed up with Dave Bertelsen to analyze his incredibly rich data set. These notes allowed them to document profound changes in the plant communities over the twenty years Bertelsen kept his field notebooks: about 15 percent of the species have moved up the mountain and are blooming up to 1,000 feet higher than twenty years ago; some species, such as saguaro cacti and ponderosa pines, seem to be suffering high mortality rates after sustained droughts.⁸

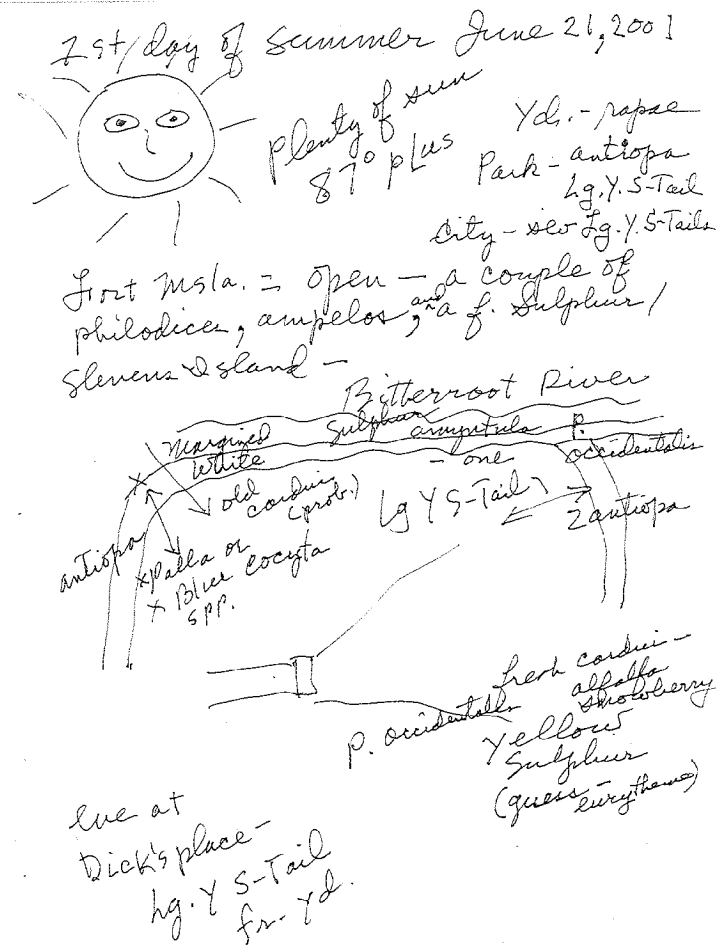
A final example of the persuasive power of field notebooks comes from western Montana. Will Kerling kept detailed field notebooks of his observations of butterflies, plants, birds, and mammals over a quarter-century in Missoula, Montana. He documented the emergence dates, flight times, and locations for ninety-six species of Lepidoptera around the city. The city of Missoula was considering buying private land on Mount Jumbo, a hill overlooking the city, to incorporate into a network of open spaces. There were debates about whether public funds should be used to buy private land for the park system. Will's field notebooks were used as evidence of the special biological diversity and richness of Mount Jumbo,⁹ and the city bond measure easily passed. Mount Jumbo is now a cherished crown jewel of the open spaces system for Missoula.

There is clearly tremendous value in keeping good field notebooks, but what do these look like in practice? Are there some common features to consider?

BEST PRACTICES

As I have thought about my own notes and talked with a range of scientists and naturalists, I have assembled a list of topics that I ask my own students to think about before starting fieldwork. These are things that I have found work well for me as well as ideas gleaned from other inveterate keepers of field notebooks. Through the process of assembling this list, two main guiding principles have emerged: First, you will forget things far faster than you expect—most people think they will remember details of their observations and studies for longer and better than they actually do; and second, you will not know at the beginning of a study all the things that might be important or interesting—for this reason, it is a great idea to record more information than you think you might need. These two principles should be kept in mind through all of the following suggestions.

Use a hardbound notebook. Loose paper is the devil's work! There are a wide variety of good notebooks available, and your choice will depend on your purpose and personal preference. I generally use a notebook that has always been readily available in university bookstores, which are sturdy, inexpensive, and come with lined and numbered pages.

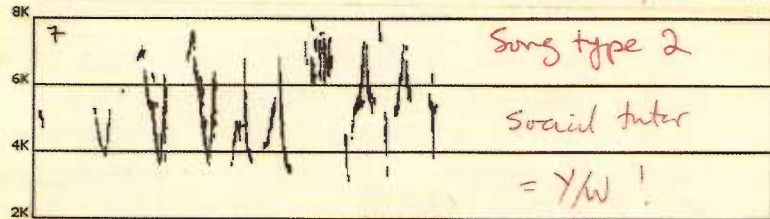
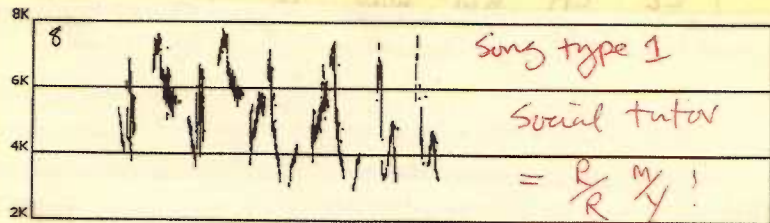


A page from Will Kerling's notebook from June 21, 2001, that documents butterfly observations near the Bitterroot River in Missoula, Montana. Courtesy of Will Kerling.

These are the size of letter paper, which some people find too large. Smaller, hardcover field notebooks with waterproof paper are also popular. Some people use a very small notebook that can fit in a shirt pocket in the field, and then transcribe this information into another notebook at home. I find that this adds another step in the process, and so unless you have a really compelling reason, I suggest using just one field notebook. If you plan to include lots of field sketches, you will want to consider unlined, bound notebooks with paper specially made for art and sketching.

Sonograms 23 May 93

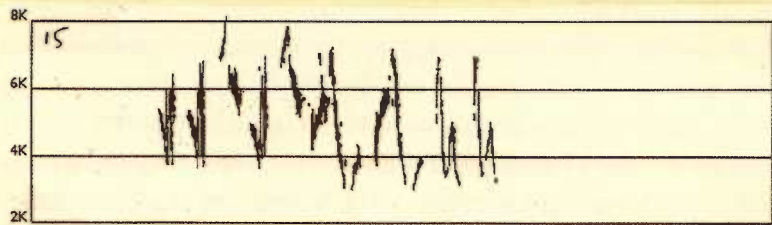
Dull bird above Prescott house seems to have 2 song types - at least on 23 May,



Out of 26 songs recorded, there does not appear to be one type given preferentially ($\#1/26 = 0.5$)

Sequence: 111122111212122122212222

There is variation within each song type.



(22)

20 May 93

L R

DD?

2010-77669

~~BB~~ ~~MM~~ G_M R/BK

CL	CD	GW	WING	TS	TL	WT	FAT
10.38	5.87	4.80	71	17.68	55	32.0	0
						- 17.0	
						15.0	

Hump Bird

G B M Y

2010-77668

CL	CD	GW	WING	TS	TL	WT	FAT
10.00	5.70	4.86	71	17.05	56	15	0

Overcast and calm in AM. Started raining at 1300 h, with thunderstorm activity in evening.

I looked up barn side, but very few of the birds were responsive for netting.

We caught a hump bird - DD? and then another hump bird on the hump (= NSF song 92??) June got recorded 5.

Interesting differences in behaviors. Many males are mate-guarding - sticking very close to ♀ and not really responsive to songs.

up Dull birds seem new fence line gully, singing but skittish - flies away from play fields. One for an UB SY ♂ behind Dick Hutto's house.

Keep your contact information in a prominent location. The front of your field notebook is best. In case you lose your notebook, make it obvious how someone can contact you (phone, address, email) and return it to you. I usually offer a small bribe (a small amount of money, ice cream, beer of choice) and lots of good karma.

Write for yourself and for posterity. If nothing else, this encourages me to pay a bit more attention to my lousy penmanship, and increases the chances that even I can read it. Indeed, one of the biggest challenges in using Thoreau's field notebooks has been to decipher his difficult script. This mindset will also encourage you to write very clear descriptions, and minimize obscure references to things that only you will understand. If you keep a good enough field notebook, it will be valuable to others now and in the future.

Write pertinent field information with every new entry. You should enter the date, time, and location at the top of every page. It is a good idea to underline these to highlight them. The "Grinnell system" and other systems have very strict and formulaic ways of recording field information. You may or may not choose to follow these, but at a minimum you should also record elevation, information on habitat type, routes you are traveling, and weather. If your study depends critically on some environmental variable, you will obviously need to record more detailed information on that. For example, if you are studying the songs of tree crickets (whose call rate is extremely sensitive to temperature), you will want to have a very accurate field thermometer with you.

Add information on your location. You should record enough information about where you are working so that another person could return to your exact site. You can do this by including detailed maps, GPS coordinates, sketch maps, and so on. If you are visiting different sites, carefully record information on your routes. If you are conducting intensive studies in just one or a few locations, you can describe those once and then refer back to them. For example, Byron Weber, an avid naturalist in western Montana, kept detailed field notebooks for almost twenty years of his daily observations from one small area along the Bitterroot River. He included a sketch map in his field notebooks and then after that he could refer to specific observations. On December 12, 1983: "4 AM -40°C . . . R'-5 magpies, 2 ravens . . . only a sliver of open water near the shore."



A map from Byron Weber's observations of the fauna and flora of the Bitterroot River in Missoula, Montana. Courtesy of Byron Weber.

Record your methods. When writing about your science in publications, it is important that you include enough methodological details so that someone else could replicate your study. The logical place to record many of these details for field studies is your field notebook. You will forget many of these details faster than you think, and you will search for details when writing your “methods” sections of your papers. It helps to think of using the pages in your field notes as a rough draft of your methods section. If you are collecting information with specific types of equipment or machines, make sure that you record what you are using in your field notebook. For example, if you are recording sounds of insects, the characteristics of those recordings will vary depending upon what type of recorder you are using (tape recorder, digital recorder), recorder settings (for a digital recorder, sampling rate, bit depth, and so on), what type of microphone you are using (shotgun, omni, cardioid, parabola, size of parabola, and so on), filter setting of the microphone, temperature, distance between you and the insect, and what is between you and the insect (lots of vegetation, no vegetation). The interpretation of your data will depend on such details, and so it is critical that you record them accurately while in the field.

Make backup copies. Hearing even one horror story about someone who did not make copies of field notebooks and lost irreplaceable data is enough to make any field scientist shudder. During the middle of a busy field season, it is well worth spending fifteen minutes at least once a week making photocopies of your new entries. If you are generating lots of irreplaceable data, you may want to make copies more frequently. This is the equivalent of backing up your computer files. You should get in the habit of scheduling this—write it on your calendar and do it. Store your backup copies in a different place from where you keep your field notebooks.

If you use abbreviations, make sure there is a key in your field notebook. Some people are in the habit of using abbreviations to record locations, species, people, and so on in their notebooks. Even you may forget what your abbreviations mean, and certainly it will be confusing or impossible to others trying to interpret your field notebooks. Byron Weber includes a key of the abbreviations he used in his field notebook right next to his field map.

Don't leave home without it. You should make sure you are comfortable with the size and style of your notebook. It is also important that you have something comfortable to carry it in so that there is no temptation to leave it behind. You should feel naked in the field without your field notebook.

Form a writing habit. Writing in your notebook should become second nature to you. Thomas Jefferson was such an inveterate chronicler of daily events in his notebooks that he even took the time to record the weather four times on the day he helped write the Declaration of Independence. So unless you have something far more pressing than writing the Declaration of Independence, you have no excuse for avoiding your field notebook!

Set up a structure for your field notebook. Although many people just start at the beginning of a field notebook and keep a running log, it can be extremely useful to set up sections to keep track of very specific information. You can make tabs that stick out that help you easily find your different sections. For example, at the back of my field notebooks I have found it very useful to include dedicated sections for the following:

Driving log: I keep track of each research-related trip, date, gas and mileage, times left and returned, and destinations. This makes it very easy at the end of the season to summarize all my travel, especially if I have a grant for travel expenses.

Expense log: I record all expenses related to my research. I tape a small envelope right on the page in which to keep the receipts.

Permits: If you need permits or special permission for any of your research, such as banding birds, getting onto wildlife refuges or private property, or collecting rare plants, you should have copies of these with you in the field at all times. It is easy to keep an envelope taped in the back of your notebook with all of your permits.

Photo log: I keep track of all of the photos I take in this log. I record locations and dates, and any notes related to the pictures I will find useful later. You can keep logs for any sort of ancillary information you are generating, such as sound recording logs, sample collection logs, or data logs with the names of computer files you generate.

Contact log: In some of my research I need to get onto private ranches or refuges. I have a list of contact information for ranchers, private landowners, and refuge managers with whom I need to keep in touch during fieldwork.

You can easily set up your own discrete personalized sections for any sorts of information that will be useful to have collected in one place. Be liberal in the amount of space you leave for each of your sections.

Create an index. An index to your field notebook serves a similar function to the logs described above—they are both very efficient ways for you to organize and find information. They differ in that you can set up a log at the very start, whereas you create an index after (or during) a field season. In an index, you can indicate where in your field notebook you can find information on specific experiments (you may be running several experiments in parallel, and information on them may be interleaved in your notebook), specific species of interest, and specific habitats or locations. A good index takes some time to compile, but it quickly repays itself by making it very easy for you to locate specific information later. Byron Weber's 1983 notebook shows one page of the index that lists the pages where he made observations for each species. The asterisks indicate pages that contain information on that species more than once on the same page. Byron's indexes contain similarly detailed lists for mammals, reptiles, amphibians, fish, arthropods, plants, the condition of the Bitterroot River (ice, water levels, river traffic), weather, people, astronomical observations, and a miscellaneous section (formation of Bitterroot Audubon chapter, Lee Metcalf National Wildlife Refuge, state legislative actions on wilderness bills and nongame wildlife bill, Bob Marshall Wilderness area, and earthquakes). These are especially detailed indexes, but you can see how they make it easy to retrieve information.

Treat your field notebook like a scrapbook. You should view your field notebook as a central clearinghouse for miscellaneous information that is relevant to your research project. If there are related bits of information that you will find useful later on, sketch them, write them down, photocopy them and staple or tape them in your notebook. My field notebooks

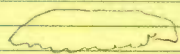
- BIRDS 1/83
74. Northern Rough-winged Swallow 67, 74, 75, 85
75. Barn Swallow: 72, 78, 83, 85, 88, 89, 92, 94, 97, 104
76. Cliff Swallow: 88
77. Tree Swallow: 45, 49, 50, 54, 64, 65, 70, 75, 85*
78. Black-billed Magpie: 18*, 21, 22, 23*, 24, 30, 32, 35, 36, 37, 38*, 41, 43, 45, 48, 49, 65, 70*, 73, 74, 75, 76, 77*, 79*, 80, 81, 85*, 86, 87, 89*, 90*, 92, 94, 96*, 99, 100, 102, 105*, 110*, 111, 112, 114*, 115, 120, 121*, 123, 124, 126*, 127, 131*, 133*, 135, 139, 145, 150, 151, 153, 156, 157, 158, 159, 163*, 167, 169, 170, 172, 174*, 176, 177
79. Common Raven: 18, 19, 22*, 23*, 24*, 29, 31*, 32, 34, 38, 39*, 57, 63, 75, 77, 79, 95, 105, 111, 121, 123, 131, 134, 150, 154, 169, 170, 171
80. American Crow: 122, 125
81. Clark's Nutcracker: 38, 60, 120
82. Black-capped Chickadee: 17, 18*, 19*, 21*, 23, 27, 29*, 30, 31*, 34, 35*, 36, 37, 38*, 41*, 50, 60, 75, 84, 86, 90, 92, 94*, 96, 97, 99, 101, 103, 104, 107, 110*, 111, 112*, 113, 114, 116, 124*, 125, 126, 128, 129*, 131, 132, 133, 134, 137, 140, 141, 148, 150, 151, 156*, 157, 159, 160, 161, 162, 163*, 167, 169, 172, 174, 176, 177
83. Mountain Chickadee: 51, 69, 93
84. White-breasted Nuthatch: 19, 21, 29, 36*, 39, 51, 74, 75, 92, 94, 102, 115, 126, 128, 134, 140*, 141*, 142, 148, 150, 151*, 170, 174, 177
85. Red-breasted Nuthatch: 19*, 30, 39, 41, 93, 96, 102, 104, 107, 121, 123, 129, 152
86. Brown Creeper 129
87. American Dipper 175
88. House Wren: 65, 66, 67, 70, 73, 75, 76, 84, 85, 86, 87, 89*, 94, 98
89. Winter Wren: 106, 111, 120
90. Marsh Wren: 95
91. Gray Catbird: 75, 94, 95
92. American Robin: 29, 30, 34, 37*, 38*, 40, 46, 50, 59, 61, 65, 69, 70*, 74, 75, 83, 85, 86, 88, 89*, 90, 92*, 94, 95*, 96, 97, 98*, 99, 100, 102, 104, 106, 107, 111, 112, 114, 148
93. Varied Thrush 98
94. Unidentified Robin 67

3 Feb 2007 Saturday

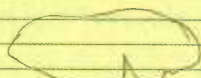
left at 8 AM and arrived in Kilauea ~ 11:30
 had sleep along the way completely hunched - bare
 fields, steep, interceded plots.
 Stopped at fur seal haul out.

Sperm whales ~ 18-20 m

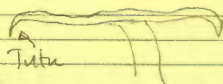
Presentations by
 Lisa Bond - Skippers
 with Whale Watch



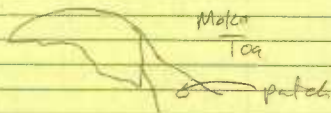
Kaupapa



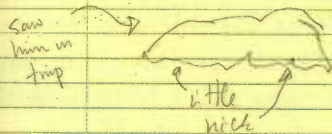
Tiaxi - quinidim
 took on killer whale



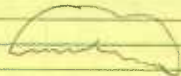
Tutu



Maka
 Taa
 patch



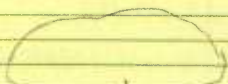
Little
 nick



Mamu = bird



mudle
 missing bit



saddle back - scars on
 back

1989 - ~4000 visitors
 last year ~ 1,000,000 visitors
 2100,000 wharf whale watching

Notes during my recent research trip to New Zealand documenting the tails of individually recognizable sperm whales in words and sketches.

tend to be repositories for a hodgepodge of what seems like only peripherally relevant material—business cards, newspaper articles, miscellaneous sketches, notes from lectures or articles I have read, ideas to follow up on, and so forth. I am constantly amazed at how often I return to and use the “scrapbook” function of my notebooks.

Rained 0.3" last night
 Intermittent overcast

26 May 93

2010-77679

B Y
 M B

CL	CD	GW	WING	TS	WT	Fat	TL
10.00	5.86	5.06	7.3	17.28	15.5	0	58

at fence + bench above A-frame

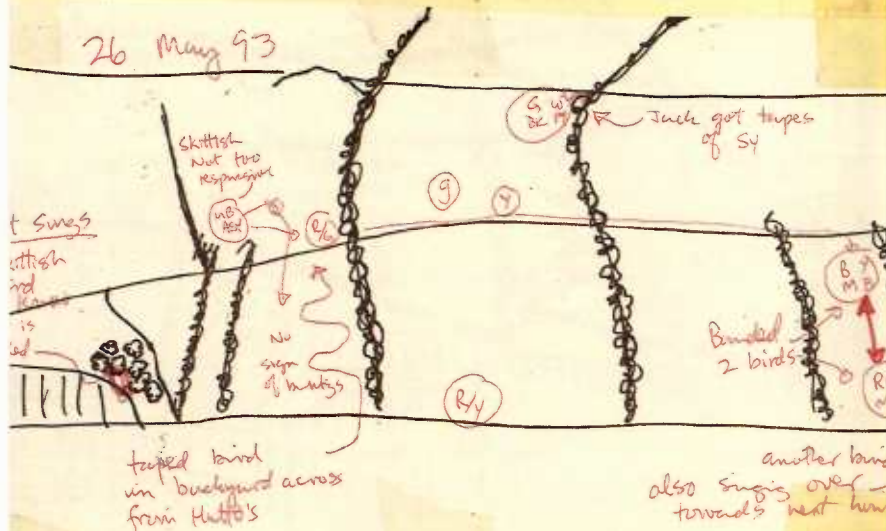
(L) (R)

2010-77680

R W
 M R

CL	CD	GW	WING	TS	TL	WT	Fat
8.84	5.81	4.58	74	18.26	57	15.5	0

26 May 93



Many Cowbirds on hill. ♂ with groups of ♀♀.

Two pages from field notebooks I kept while conducting research on lazuli buntings in Montana in May and July 1993. They contain field maps of my study (affixed with tape) along with notes on locations and behaviors of birds seen those mornings, banding information, spectrograms of the songs of individual male buntings, and observations on the behavior of brown-headed cowbirds.

It is ironic that in spite of the rich history of field notebooks in the natural sciences, this tradition appears to be weakening, especially in the very field that spawned the tradition—field biology. I have made the case that field notebooks are still useful—if not essential—in field biology. This list of suggestions offers a place to start. Decide what your purpose is for keeping a field notebook, and design it in such a way that it works for you. You will find that a well-kept field notebook is a rich form of documentation. It will aid immensely in writing up your research projects, it will be an incredibly fertile place for generating new ideas, it will be a source of pleasure to you as you read it over, and it may prove to be very important to scientists in the future.¹⁰

ACKNO

C