Electronic Field Guide to the Plants of Popular Recreation Sites in Arizona's Sonoran Desert

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Abstract
Field guides occupy the intersection of plants and people. Improving the user's understanding of nature, plant field guides have the potential of increasing the satisfaction of their outdoor experience. A more satisfied field guide user is more likely to take action to preserve places where native plants grow.

Unfortunately, print field guides are either too technical or incomplete, resulting in frustration rather than satisfaction. Most offer no systematic method where a user may identify an unknown plant based on observable characteristics, relying instead on randomly browsing through a series of illustrations in the hope that a static photo or drawing will resemble the plant in question. Picture-book taxonomy is unreliable when the geographic area under consideration is large and the vegetation diverse. Arizona, especially its Sonoran Desert is such an environment, where sporadic precipitation fosters the unreliable occurrence of annuals and species with unusual growth forms, which may not be included in field guides to the Southwest, West, or North America. Print field guides, which include all known plants to small, isolated geographic areas such as popular parks is simply not cost effective.

Electronic field guides are not constrained by these economic limitations and they offer a superior method of identifying plants. With an eye to the future where dynamic, interactive features become the norm for high tech users packing portable electronic devices over hill and dale, this article introduces a novel field guide to plants using standard spreadsheet software. Based on floras produced by graduate students and others for 12 popular recreation sites near large population centers, this E-guide offers a fast, reliable, non-technical tool for large numbers of outdoor enthusiasts to identify plants in areas they already visit and enjoy.

Print Field Guide Survey

Identification Methods

A survey of selected non-technical plant field guides is quite revealing (Table 1). Not all such guides are created equal, but most suffer from the same shortcomings. Surprisingly, few offer any systematic or rational tool, whereby a non-specialist could pick it up and identify an unknown plant by following a logical sequence of steps. Instead, most present a series of static illustrations that the user is supposed to match to the plant in question. The problems with such an approach are immediately apparent. What if the plant in question is not at the same stage of development as the one illustrated? The illustrations usually rely heavily on colorful flowers for herbaceous plants and leaves for woody species. However, anytime you focus on an illustration, rather than a description you run the risk of being mislead by superficial resemblances. Illustrations should validate the identification not determine it. Dichotomous keys are often used in an attempt to solve this problem.

Technicalities

Plant keys, long considered a tried and true method of identifying plants, suffer from their own set of shortcomings. The vast majority are far too technical for the average outdoor enthusiast who lacks specialized training in plant morphology and its associated jargon. Additionally, plant characteristics used in the key may be quite difficult to determine, even when the characteristic is relatively well understood. For example, the choice between evergreen and deciduous is often presented. Unfortunately, at the height of the growing season, when most people find themselves confronted with such a choice, they will not be able to make the distinction. Keys work for botanists with experience and specialized training in what to look for on an herbarium sheet as well as in the field. Randomly browsing illustrations or pouring over detailed and technical couplets in a dichotomous key lie at opposite ends of the spectrum of tools offered in plant field guides. Both extremes suffer from a deeper issue or shortcoming, that of which plants are included in the specific guide in the first place.

Scope

Plant field guides offered in print cover large geographic areas: states, regions, or continents. Individuals using these guides will encounter a wide variety of plants. Accurate field guides must introduce significant technical aspects or make cuts in the plants they might include. Economic considerations favor the latter strategy. Consequently, many field guides include only trees, cacti, or wildflowers. Others focus on certain elevational boundaries or habitats such as deserts. In any case, subjective choices are made as to

what plants to include. Plants considered common, conspicuous, desirable, or obnoxious, like vegetative celebrities are most often featured on the pages of plant field guides. Even those field guides which focus on one class of organism like trees, are always incomplete in their coverage. Users of such guides must make distinctions between the plants growing where they are and those growing far away. Economic considerations prohibit the profitability of publishing a print guide to the plants of the Superstition Wilderness for example. However, if a hiker encountered a tree there, it would be much easier to sort out its identity from other trees in the Superstitions rather than trees in the next State. E-Guides do not suffer from such economic or geographic limitations.

While print field guides fail to include species that fall within their scope, the extent of their failure to include certain species varies widely. Using trees as a convenient medium of comparison between the proposed E-Guide at the end of the Table 1 and selected print guides, we find that the percentages of species excluded varies from 95% (Fandex) to 15% (Peterson's). The percentage of species not included in each relevant print guide is listed under the name of the guide in Table 1. The tendency of field guides to limit their scope to specific organisms such as trees also contributes to a sense of intellectual isolation. Not only do print field guides exclude species that lie within their scope, they also fail to encompass broad practical elements that might make them more useful such as a trail guide to where the plants occur in their native surroundings.

Generalists interested in everything they encounter from plants to animals to rocks must purchase and carry many guides. The burden of the expense and bulk are obviously prohibitive. Consumers also make choices and which guides to exclude from their collections is one choice. The individual trying to identify a plant that is not even included in their guide is faced with certain frustration.

Static

Most print field guides are designed as "one size fits all." They are static. Each time the user picks one up, they will start at the beginning and go through the same steps. Each time a yellow flowered plant is to be identified, they will turn to the section for yellow and start flipping through the illustrations to find a match. Each time a tree with simple leaves is found, they will start keying from that point. Unfortunately, depending on the person, the plant, and the place, it may be appropriate to start with flowers today but leaves tomorrow. Print guides do not offer this sort of dynamic flexibility.

An E-Guide Story of Development

Surprisingly, an electronic field guide using standard spreadsheet software, resolves all of the shortcomings associated with print field guides listed here. Additionally, a number of other advantages have surfaced, not the least of which is compatibility with the broader trend within society toward the use of electronic approaches to tasks previously associated with paper-based products and processes. However, electronic field guides are not without their own set of challenges, making their full acceptance a gradual process as the human - machine interface is held in lower esteem than the human - print interface.

Having created an electronic version of a dichotomous key using a standard Web browser, I sought an alternative approach to developing an electronic tool for identifying plants, one that could be easily updated as new species were added, names changed, or other modifications became necessary. After consulting with a trainer of various desktop applications, relational databases such as Access were ruled out. Spreadsheet software was suggested by this trainer who worked with both novice and experienced computer users. Excel was selected due to its availability and widespread use among PC users. The auto-filter function (see the instructions in Appendix 1) allows the user to sort on any combinations of characters quickly and in a dynamic fashion, different each time an identification is attempted.

Methods

Popular recreation areas were matched with available plant checklists produced from floristic studies at Arizona State University (2006). Twelve pre-defined checklists were selected from SEINET (The Southwest Environmental Information Network), including the Maricopa County Parks, Superstitions, Seven Springs, Organ Pipe Cactus National Monument, Castle Dome Mountains, and South Mountain. Plants readily identifiable and continually available were selected using the growth habit information on the Plants National Database (US Department of Agriculture 2006). This includes sub-shrubs, shrubs, trees, cacti, vines, woody grasses, epiphytes, and yucca-like plants. Herbaceous plants have not yet been included due to the spotty nature of their appearance depending on a variety of irregular and unpredictable environmental factors. Their appearance is quite seasonal and typically quite brief. Successful field identification of plants begins with a complete list of plants and plants that will be encountered throughout the year, regardless of local environmental conditions.

A master list of plants was created, identifying the species found in each area. Common plants are defined as those which occur in more than half of the areas

listed (seven areas). They are indicated by red text. Each group (cacti, epiphytes, woody grasses, yucca-like plants, and vines) were shaded differently on the master list and in the section marked by a tab for each group. Woody plants (sub-shrubs, shrubs, and trees) constituted the largest group and they were left unshaded. A glossary defines plant families, plant characteristics, and the geographic areas included.

Tabs were created for each group and a series of non-technical characteristics set at the head of each column. The characteristics used varies with each group. For example, spine characteristics are used for cacti, leaf characteristics for the woody plants, flower color for all groups, and specific distinctives applicable for each species conclude the series of characteristics used. Columns for the area where the plant was found, family, and common names were also created. A variety of sources were consulted for this information including Shreve and Wiggins (1964), Kearney and Peebles (1960), and the Jepson Online Manual (University of California Berkeley 2006).

This E-Guide offers a number of advantages over traditional print guides in addition to those already stated. This electronic file is free, easy to share, easy to update, and expandable to include a variety of natural elements of interest to particular users such as rocks or animals. It can also be distributed with trail guides to the areas included, making it more of a comprehensive approach to enjoying and learning about the natural environment.

Contrary to convention in the print realm, illustrations in the E-Guide are used to validate the identification, not determine it. The goal is to have the user look at the plant, critically and carefully. There is no substitute for a careful examination of a specimen. Casually matching plant with illustration is more often associated with carelessness and inaccurate identifications. This E-Guide includes nearly 1,000 images linked to various Internet sites, primarily from SEINET (Arizona State University 2006), Plants National Database (US Department of Agriculture 2006), and CalPhotos (University of California Berkeley 2006).

Limits

No electronic product is without its bugs. While not a bug, the future acceptability of such a novel field guide has yet to be determined. One of the challenges to its use is the version of Excel used to operate the guide versus the version used to create it. Incompatibilities are possible. The manner in which the file is used will also affect its performance. If the Excel file is used within a Web browser, it performs differently than if it is used only in Excel. Use within Excel only rather than within a Web browser is recommended. Finally, to view the illustrations, a link to the Internet is required.

A library card catalog offers a reliable example of a transition from print to electronic formats. It has taken a generation of users to fully accept the electronic format of library catalogs. Electronic field guides may require a similar time frame to find general acceptance. Who would expect or desire to go back to the card catalog in a library? One day the same will be said of print field guides.

Testing

Demonstrations of this guide have been made in a variety of settings, such as public library programs and adult education classes at Mesa Community College. In each setting, the Excel file has been freely distributed to interested parties. It has also been given to high school biology students with favorable feedback. Testing is ongoing. Free copies of the file are available from the author at hislightaz@yahoo.com, or PO Box 30731, Mesa, AZ 85275.

Conclusions

Based on initial feedback, the E-Guide described herein has the potential of radically changing how we identify plants in the field. Its simple design, use of standard software, low production cost, and ease of use make it a strong competitor with print guides. Based on the user's ability to successfully identify a specimen with each guide in the shortest time, this guide outperforms print guides currently available.

Future developments will focus on the creation of a similar guide to Arizona's mountain recreation sites such as Chiricahua National Monument, the Sierra Anchas, Pinal Mountains, the Grand Canyon, and San Francisco Peaks. This guide will include herbaceous annuals and perennials. A third file is also being created for cultivated plants in the Valley of the Sun (Phoenix). Ethnobotanical information is currently available with the desert file. Landscape information could be added to the file on cultivated plants.

Electronic field guides have yet to assume their final form. Several versions are available and others are under development. Regardless of the form they take, now is the time to explore the options, test the limits, and discover the best means to identify specimens in the field accurately, quickly, and easily for novice and expert alike.

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Tips for First-time Users: Electronic Field Guide to the Plant's of Popular Recreation Sites in Arizona's Sonoran Desert

Step by Step Guide & Principles

Step One

Start by opening Excel then the "desflora" file in the top directory on this CD. AS with most computer programs, there is more than one way to accomplish this task. You could go through "My Computer" or the Windows Explorer program to open this file. It doesn't really matter how you open the file, but it is important for you to open it so it runs in Excel not and Internet browser so the images open properly.

Step Two

Determine which group the plant belongs in: Trees/Shrubs, Cacti, Vines, etc. as listed at the bottom of the spread sheet (Figure 1). Take note of the plant's attributes as appropriate for the group: leaves/flowers for trees and shrubs, spines for cacti, etc. If you are unsure what these terms mean, check the glossary (another tab at the bottom of the sheet). Currently, herbaceous plants are not included (wildflowers, ferns, weeds).

Click on "Data" in the menu bar and select "Filter" then "Autofilter". Notice the drop down arrows at the top of each column. By clicking on these drop down arrows, you will be able to select from a specific range of attributes, eliminating others from consideration.

Step Three

This guide is location (Place) driven. Use it in association with hiking, biking, and other recreation activities in the popular sites included (Figure 2). Note the text in red indicates a "common" plant, one which occurs in over half of the areas included.

I recommend that you start with the location column. If you know the plant family, you could use that next, but more than likely, you will use available attributes for the plant in question. You are not restricted to any specific attribute like most print guides, based solely on flower color. Here, you can proceed with only leaves and in the arid Soutwest, that is important.

For illustration purposes, let's start with South Mountain trees and shrubs.

Step Four

Now select a plant attribute, such as leaves simple/divided or alternate/opposite/whorled. Plant form should only be used if you have a clear example of the form such as tree. Otherwise, use this attribute to validate your identification base on other characteristics. For illustration purposes, we will select "divided" leaves. We now have the woody plants on South Mountain with divided leaves. If "opposite"is now chosen (Figure 3), you are left with only two plants.

Step Five

Continue to select attributes until the list is sufficiently narrow, so that it is reasonable to check the images to validate your identification. In our example, yellow flowers are present. This choice leaves you with the single plant – creosote. Congratulations! (Figure 4).

The column "Distinctives" may narrow the list considerably at any point in the process, but do not start with this column since the attributes included are too specific.

Note, this guide does not start with pictures, it ends with them. It is necessary to first take a closer look at the plant rather than a static photograph or drawing. This practice will help you develop an eye for detail and improve your skill when it comes to identifying the flora of Arizona.

Principles

Most of the hikers, bikers, and equestrians enjoying desert treks in southern Arizona are not trained botanists and most of the plant guides for the area do a poor job of assisting them with plant identification that is comprehensive, accurate, and easy to use. Therefore, our first principle, is that we have a need.

Secondly, by using the floras completed as master's degree projects at local universities for the popular recreation sites in the Sonoran Desert, we achieve a comprehensive list of plants which a large number of people will encounter as they seek to enjoy and better understand the wild desert resource we find in our "back yard". Therefore, we have a sound basis to meet the need in principle number one. We need a better tool to put this information into the hands of interested people.

Since print plant guides are expensive, bulky and incomplete, it is time to explore an electronic alternative. The "autofilter" function in Excel allows you to list a few key, non-technical attributes and select from that list quite easily to match the plant in hand with its proper identification. This functionality is not yet available in palm pilot devices but it is not far away. In the meantime, a CD can be used in any PC running Excel. No unique plug-ins or software is needed. In an age of technology, the time has come to apply this tool to enhance our outdoor enjoyment. Better understanding fosters appreciation which leads to better care and a healthier environment.

A link to this site should be available at the Desert Plants website shortly after the publication date.
http://cals.arizona.edu/desertplants

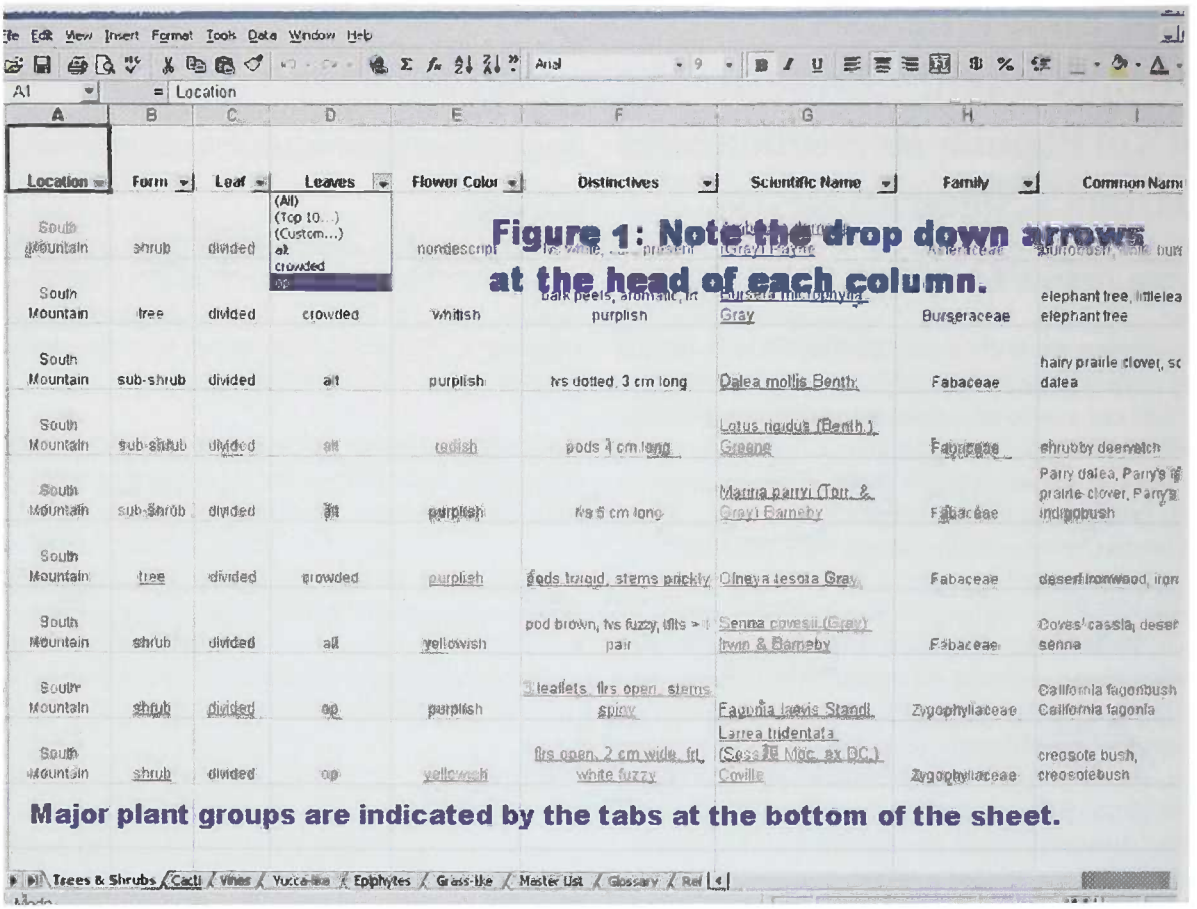
Figure 1: Note the drop down arrows at the head of each column.
Major plant groups are indicated by the tabs at the bottom of the sheet.

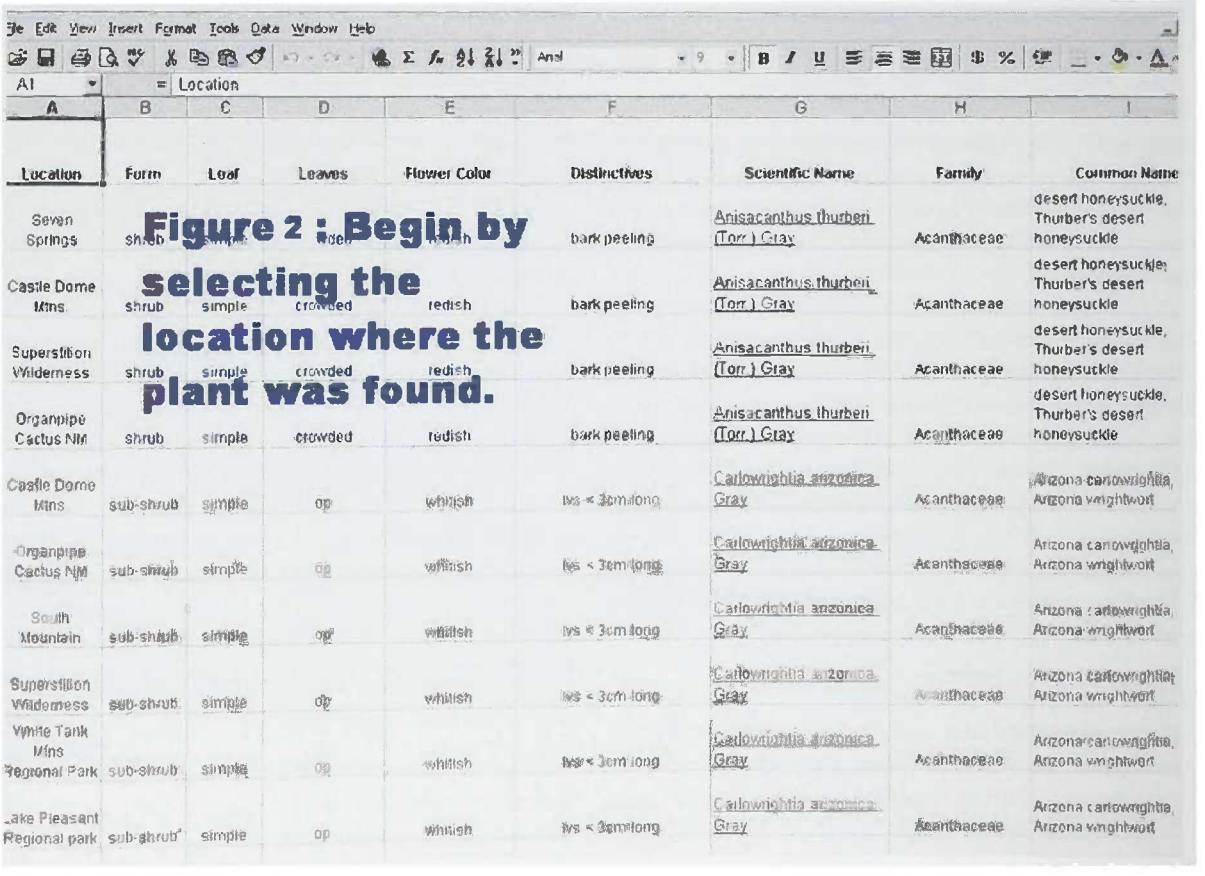
Figure 2 : Begin by selecting the location where the plant was found.

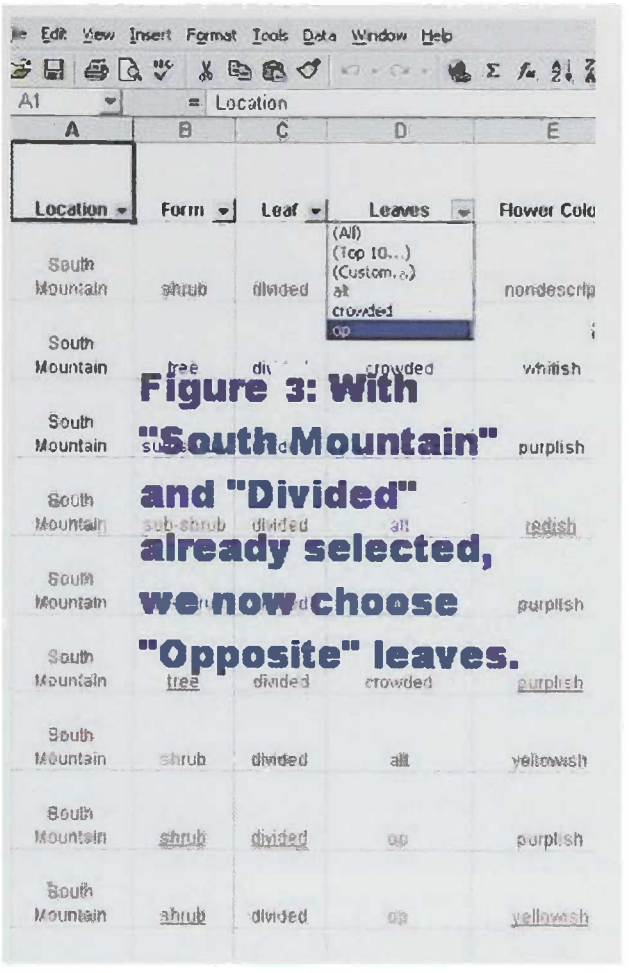

Figure 3: With "South Mountain" and "Divided" already selected, we now choose "Opposite" leaves.

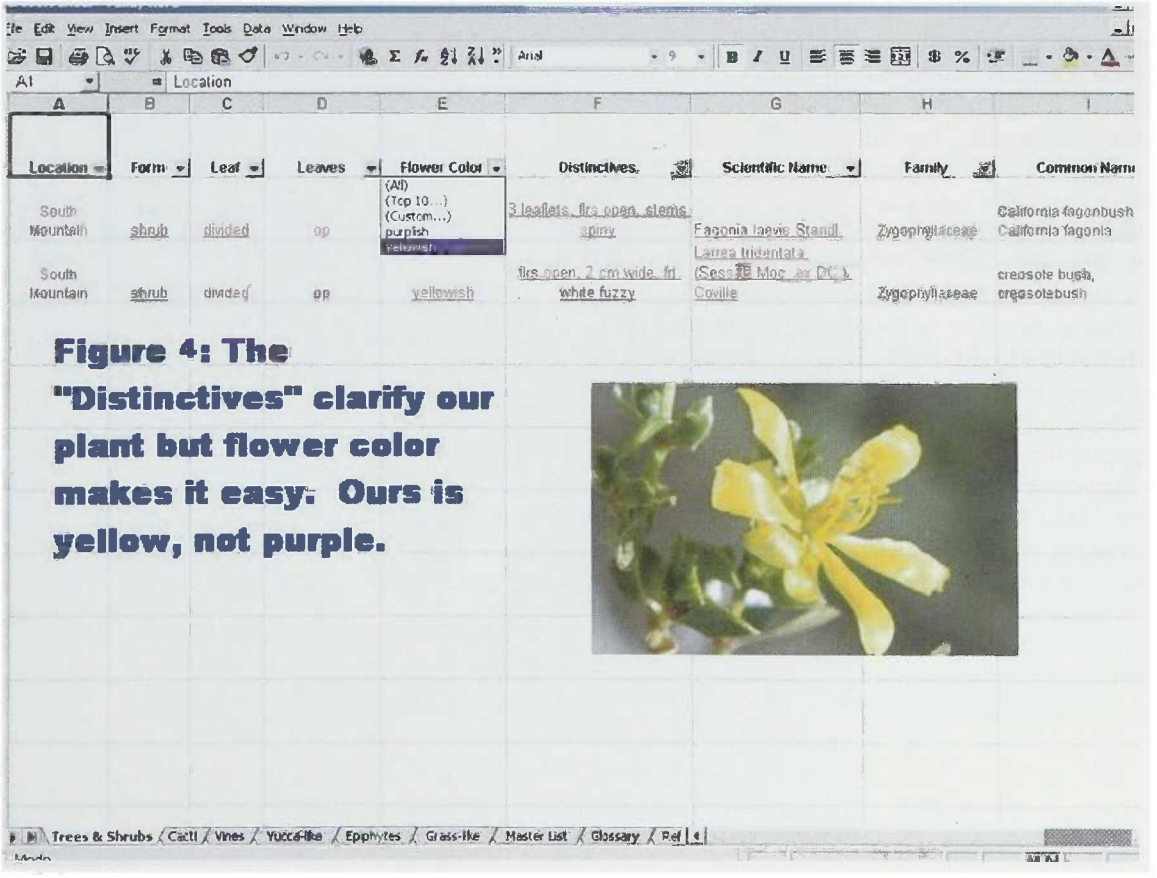

Figure 4: The "Distinctives" clarify our plant but flower color makes it easy. Ours is yellow, not purple.