FINAL REPORT

for

Vertebrate Pest Control Research Advisory Committee

STUDY TITLE:

Ground Squirrel Best Management Practices Website-Expansion of Passive Extension Capacities

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EXECUTIVE SUMMARY

California ground squirrels have previously been estimated to cause $20 to $28 million in economic damage annually, although the economic impact of damage is likely much greater today. They consume fruits, nuts, and frequently girdle trees. Ground squirrel burrow systems are extensive and they cause damage to flood control and irrigation structures. These burrow systems can also increase soil erosion and damage farm equipment. Ground squirrels are reservoirs for disease.

Extension efforts are ongoing to help landowners and homeowners control ground squirrel populations. The "Ground Squirrel Best Management Practices" website was first set up in 2003 by the Wildlife Damage Lab under the direction of Terrell P. Salmon, Cooperative Extension Wildlife Specialist, Department of Wildlife, Fish, and Conservation Biology, U.C. Davis. This online resource was the go-to resource for advice on ground squirrel biology and management in the state of California. The website contained a comprehensive collection of information on ground squirrel biology and best management practices. It also had information on squirrel identification, damage, detection and monitoring, laws and regulations, and publications. This website has been an excellent resource for educating landowners and land managers on best management practices for California ground squirrels.

The website had not been maintained for several years, and some of the information was out-of-date. Additionally, many links within the website were no longer functional. There was a need to redesign this resource to make it more useable and to ensure the information is current and up to date.

The resulting redesign can be found at www.groundsquirrelBMP.com

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INTRODUCTION

According to the 2012 USDA Census of Agriculture, 69.6 % of farms in the US have internet access. In California, 93% of counties are above the national average with Tulare, San Benito and Merced just trailing behind. The fact that California farmer access to the internet is above the national average presents us with a great passive extension opportunity. Through information and communication (ICT)-based extension efforts, we aim to reach a very large audience, especially those who may not customarily seek out or be able to access more traditional extension mediums and services. Given the extent of access of farmers to the internet, the scope of this resource is immense.

Using passive extension approaches provides the opportunity to save both money and time for both the home- and landowner, as well as extension personnel. Given the proposed accessibility of information, homeowners, landowners, and pest control professionals will be able to consult this resource freely and have the opportunity to adopt best management practices quickly. This will be achieved by newly designed and easy to interpret content and graphics. Additionally, state, county, and extension personnel will be able to direct clients to this resource directly, thereby providing a valuable time-saving option for these individuals.

Although the current website is an excellent resource and provides the public with a range of knowledge on ground squirrel management, it has some downfalls. The website was developed over a decade ago and so the general aesthetics appear outdated. The user experience is not ideal due to volume and layout of information on the site. It is important to understand what the user needs and values and what the user's limitations and abilities are. The information needs to be useful, useable, desirable, searchable, accessible, and credible. The information architecture needs improving. Ensuring that a website has useful and usable content, that is well structured, and easily found, is vital to improving the usability of a website.

The graphics in the website provide the most useful and desirable information for the farmer and landowners. However, these graphics also need updating. We aim to redesign the graphics and make them interactive and very useable. These graphics will provide the backbone of the new website, and will provide the user with basic information that will be readily useable. If the user desires more information, they will be able to navigate to this information. The user will not be bombarded with information, however the information will be there and easily located if this information is desired.

We expect the end product to be a highly functioning, user-friendly passive extension tool for homeowners, landowners, and pest control professionals. This website will provide information on how to effectively and safely control ground squirrels. Often, the misuse of toxicants and misguided application can lead to public relation and registration problems for products and control techniques. This website will provide the user with information on how to safely apply toxicants in an effective, yet safe and environmentally responsible manner.

It is expected that users of this website will receive information on how to most effectively use ground squirrel baits. Better, and more successful control efforts, may lead to an increase in bait sales as well as a greater acceptance of the promoted baiting procedures.

This resource will provide reliable and independent advice specifically for the state of California but will be readily accessible for a nationwide audience. We hope that given the benefits of an online resource, this extension information will reach areas where more direct extension assistance may be limited. This website will meet the homeowner, landowner, and pest control professional needs. Information from

this redesigned website will be useful, useable, desirable, searchable, accessible, and credible. This resource will be readily available through mobile devices allowing users to access information on-site.

METHODS:

Discussed below are the various steps we took to address common challenges to web usability, such as text-heavy content, distracting navigational tasks, and high visual complexity. These potential issues can be addressed by developing content, site architecture, and an overall visual design that are conducive to the specific expectations and needs of a web audience.

- Audience and Project Goals
- Building a Site Map
- Writing for the Web
- Solutions for text-heavy content
    - Lists and Tables
    - Links to Supplemental Material
    - Subheadings
- Navigation
- Cohesive design for lower visual complexity
    - Visual themes
    - Curating visual content

Web resources can lengthen the reach of extension programs that serve a large geographic area like California, where one University of California Agriculture and Natural Resources (UCANR) Human-Wildlife Conflict Advisor and one Wildlife Specialist are assigned to the entire state. Ground squirrel management in California is likely to draw a fairly niche crowd, but this audience includes several thousands of individuals from the agricultural sector and pest management industry. In addition to the 58,000 California farms with internet access, nearly 24,000 professionals are licensed by the California Department of Pesticide Regulation.

Our website is intended to offer ground squirrel BMPs to a California audience, with a focus on two common pest ground squirrel species (*O. beecheyi* and *U. beldingi*). In addition to control options, we want to provide information that would allow our audience to implement an integrated pest management (IPM) program that considers pest biology and risks to humans and non-target wildlife. An IPM approach encourages proper pest identification, routine monitoring, and the use of a combination of prevention and control techniques. To encourage proper identification and avoid harm to non-target wildlife, we will provide resources for distinguishing pest ground squirrel damage from other wildlife activity.

Another UCCE website for ground squirrel BMPs was originally established in 2003. This informative resource, aimed primarily at land managers, contains an overview of ground squirrel biology, management practices, laws and regulations, and publications. Though comprehensive in scope, the website has not been actively maintained, and some of the information is out-of-date. Additionally, many links within the website are no longer functional. There is a need to redesign this resource so that content is more navigable, current, and easier to update in the future.

The Statewide UC Integrated Pest Management program (UC IPM) offers a full webpage devoted to ground squirrels on their website (Salmon and Gorenzel 2010). This publication includes an overview of California ground squirrel biology, identification, damage, and management techniques. While thorough, the single web page on which it is presented is also text-heavy and lengthy in appearance.

This could hinder some users from quickly finding the specific content that they need. The web page also directs users to the Ground Squirrel Quick Tip page, a pithy fact sheet that uses approachable bulleted lists to share information. Both the UC IPM Pest Note and the Quick Tip, though titled "Ground Squirrel," focus primarily on *O. beecheyi* and do not provide resources specific to *U. beldingi*. As part of a larger Pest Note series, they are not as in-depth as the aforementioned UCCE website for ground squirrel BMPs—in fact, UC IPM directs users to this website for more information.

Building a Site Map

A clear, logical site map helps users to efficiently locate the information that they need. We began our design process by listing the individual topics that we wanted to include on the website and categorizing those topics under our main parent pages. We want the options in our navigation bar to be as simple and self-explanatory as possible so that visitors can quickly scan and make selections from the main menu.

It can be helpful to sketch the basic site map before actually building the pages and writing content. This allows content developers to write for a specific page and avoid unnecessary introductory text and tangential topics. Supplemental links can be included on the page for readers who want to learn more about a related subject. Having a well-organized site map will help website designers to easily redirect the user to the right page.

Adjustments will be made to the first draft of the site map. After writing and editing our ground squirrel content, we restructured many of our original child pages and added and removed others. It is useful to finalize content before finalizing the site map. Both will inevitably evolve over time, but it is much easier to reorganize pages before they contain content. By building a strong foundation before constructing actual pages, we hope to avoid the maze of links that could otherwise develop.

Writing for the Web

Web language is generally less formal than in other media. Material can be developed or revised so that it fits logically into the website architecture. In writing for the audience, consider why they have arrived at a webpage and address the topic that they have chosen to read about. On a webpage dedicated to physical ground squirrel characteristics, a paragraph about Belding's ground squirrel does not need to be accompanied by a description of the type of crops it damages. It is still important that related content be available somewhere on the site, but it does not all need to be one page.

We pulled material for our ground squirrel website from various sources, but the actual text we developed is original. It was drafted and reviewed by UCCE advisors, then revised and re-packaged by extension staff. Input from individuals who are not experts on the website topic can greatly improve the accessibility of the text.

Solutions for text-heavy content

Web-user tendencies to scan or skim, rather than read, can be problematic for text-heavy websites like our ground squirrel project. This issue can partially be mitigated in the content development stage, when writers and editors consider where the content will be on the site map. On individual pages, a number of design choices can make text more conducive to web reading.

Lists and Tables

Utilize bulleted lists or simple tables wherever possible, particularly when repetitive, extraneous text is found within a single-subject paragraph. For example, descriptions of the

physical characteristics of two pest ground squirrel species were originally presented in paragraph form (Figure 1). But this type of information does not need to be detailed in complete sentences. We placed California ground squirrel and Belding's ground squirrel in separate column headings and listed characteristics like length, weight, and coloring in the rows below. This simple solution condenses two paragraphs into one table, reducing word count and allowing users to easily compare the two species.

The pros and cons of two toxic baits were originally presented in individual bulleted lists. This is better than paragraph form, but we can make further improvements to this presentation. The pros and cons lists covered the same subjects: one material has an antidote, the other does not; one has a high risk of non-target toxicity, the other does not. Placing the information side-by-side, in a table where materials constitute the headers and criteria are listed in rows, enables users to easily weigh one material against the other.

Ground Squirrel Identification

How to Distinguish California from Belding's Ground Squirrel

	California ground squirrel	Belding's ground squirrel
Size	• Total adult length: 14-20 inches • Weight: 21-31 oz • Males somewhat larger than females	• Total adult length: 8.5 inches • Weight: 9-19 oz • Males somewhat larger than females
Color	• Mottled, light and dark brown fur with white and gray on their back • Belly/underside has a combination of lighter browns, grays, and white	• Brownish-gray to reddish-brown
Markings	• White ring around each eye	• No stripes, mottling, or markings
Tail	• Somewhat bushy • 5.7-9 inches long	• Tail is not bushy • 2.5 inches long
Ears	• Tall and conspicuous, with some exceptionally long hairs at the tips	• Small, not very prominent

Visit www.groundsquirrelbmp.com for more information about ground squirrel management.

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Figure 1 Example of table as solution for text-heavy context

Links to Supplemental Material

When writing new content for a webpage, it can be tempting to include as much related information as is available. But even if this extra material is related to the page topic, it is important to ask whether it is essential or merely supplemental.

Users reading a page about zinc phosphide baits, for example, may be curious as to why we recommend a certain bait application method. Some users may also want to read about other available methods. This is optional, supplementary material that will not influence their ability to use the recommended application method. For users who wanted to focus on zinc phosphide, the inclusion of extra text increases the page's word count and makes it less readable.

Instead, a hyperlink within the text or in the right-hand column can direct users to a page that specifically discusses different bait application methods. Users can then decide for themselves if they are interested in more detail. Many websites employ these "learn more" or "related content" links to avoid cluttering pages with non-essential material, to minimize large blocks of text, and to promote greater connectivity within the site.

Subheadings

For some topics, it may be more practical to keep users on a single page. Use subheadings to break up multi-paragraph pages, and design these subheadings to stand out from the paragraph text. Bold and or larger type is often used to distinguish subheadings—just make sure that this format is used consistently throughout the website. Consistency allows users to become more familiar with the site and improves usability.

When formatting subheadings, page titles, and other distinctive text, avoid adding text properties that increase visual complexity. This may include decorative typefaces or brightly colored text. Subheadings should be able to catch the user's eye without distracting them from inhibiting them from focusing on content.

Navigation

Navigation within the website should be simple and logical. This is greatly improved by a thoughtful site map design, as discussed above, as well as effective link and page titles that balance clarity and brevity.

Web designers also have a choice between top-navigation (horizontal menu at the top of the page) and left-navigation (vertical menu on the left-hand side). There are arguments in favor of each, but ultimately, page structure should be designed based on its content. Some designers argue that a long left-nav menu works better for more widespread audiences with a broad range of topics and interests. A subject with a very specific target audience—i.e. Californians who want to manage ground squirrels—benefits from top-nav menu, which allows users to spot high priority items more quickly and effectively (Nielsen 2010a).

We use a top-nav menu, primarily because this keeps users from encountering a long and unnavigable list of sub-pages to scroll through. Long side bars also take up unnecessary visual space in one of the most valuable on the webpage: studies have shown that users spend twice as much time looking at the left side of a page as the right (Nielsen 2010b).

Figure 2 Example of top-down navigation

Cohesive design for lower visual complexity

Users prefer websites with higher prototypicality because they look and feel more familiar, and thus are easier to use. This does not mean that all prototypical websites look identical. But a familiar website structure does encourage cognitive fluency, i.e. the ease with which we process information. Cognitive fluency can also be improved within a website by using consistent color and graphic themes. It is important to be selective when using graphics and other visual elements; they are meant to enhance, not decorate, website content. Purposeful employment of graphic elements also helps to minimize visual complexity. For our ground squirrel website, we aimed to establish a cohesive design of low visual complexity through the use of recurring design elements and well-curated graphics and images.

Visual themes

Color is an easy way to establish a site-wide visual theme. However, it should be used sparingly. Multiple colors can make a website feel more cluttered (Reinecke et al. 2013). In text, color is most often used to distinguish hyperlinks, which should be distinct and obvious to the user. Color can provide emphasis for other text elements (e.g. headings, warnings) as long as that particular color consistently sends the same message throughout the entire website.

The graphics designed for the ground squirrel website draw from the same color palette. "Timing wheels" were created for each control method, mating and hibernation periods, and seasonal changes in diet (figure 1). The information featured in these individual wheels was compiled into one "timing chart." In both the wheels and the summary chart, "effective" treatment periods for the control methods are indicated by the same shade of green. While the graphics are also labeled and accompanied by a legend, we hope that users who visit multiple pages will become familiar with the wheels, associate the color with the attribute, and process the information offered in the chart with greater ease and speed.

Curating visual content

If too much color is distracting to users, then an excess of graphics and photographs could be overwhelming as well. Avoid visual distractions to minimize visual complexity. Every image on the page should have a clear function. ClipArt is problematic because it is often used decoratively, rather than for explication. It also tends to clash with other images and with the visual theme on the rest of the website.

Graphs and images should be carefully curated and correctly formatted so that they complement, rather than distract from, the informational content. Unless a page or section is specifically intended to be a photo gallery, it is more effective to select one or two high-quality, impactful images to display rather than a collection of tiny, pixelated thumbnails. Take advantage of the lightbox options (clicking on an image to view a larger version) available in most site builders.

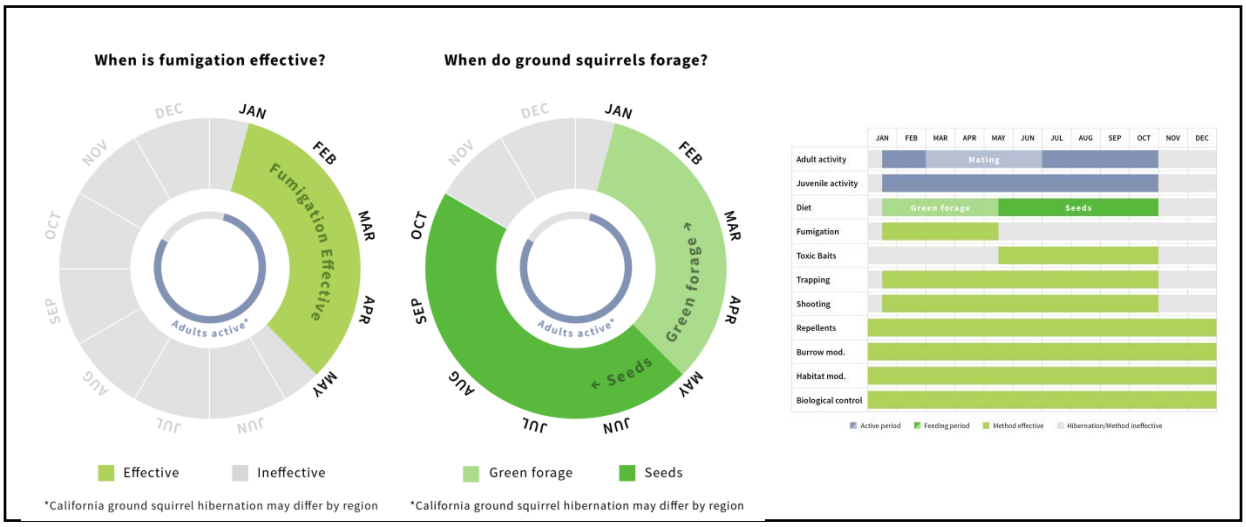

Figure 3 Examples of visual themes and curating visual content in the ground squirrel best management practices website

DISCUSSION

The content of the website has been peer-reviewed but can be updated at any time. As a web-based extension resource, the ground squirrel website has the ability to be "under construction", allowing for updates and improvements. So far, our efforts to maximize site usability have focused on content development, site architecture, and cohesive visual design. We would still like to address responsiveness (website's ability to be viewed on multiple devices, e.g. smartphones), accessibility for dyslexic users, and resources for Spanish speakers. Extension websites are not a mere digital copy of print publications. They are dynamic documents that have the ability to more efficiently reach a wider audience. But as the internet audience continues to grow, so do their expectations for the websites they use. Effective web extension requires both well-designed content and informative design, which are best achieved by considering the specific needs of the end-user.

Additional funding will be required to add additional functions as well as to maintain host subscription and domain name.

ACKNOWLEDMENTS

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