The internal and external Deep-Sea Guide: Developing for the public versus an internal client

Erica Curles, University of California at Santa Cruz

Mentor: Brian Schlining

Summer 2012

Key Words: Deep Sea Guide, Scala, Web Design, VARS Knowledge-Base, External, Quality Control

ABSTRACT:

The Deep-Sea Guide (DSG) is an online presentation of the extensive data extracted from video footage of the deep sea, which is collected by ROVs (Remotely Operated Vehicles) and stored at the Monterey Bay Aquarium Research Institute (MBARI). It has been used as an internal tool for aiding the video laboratory in identification for several years. Now that it has been developed into a fully-functioning website, there is a desire to make it available to the public as well as a tool for education and outreach. Its relative simplicity of use makes it a good alternative to querying the public Video Annotation and Reference System (VARS) for members of the general public. The changes and additions to the DSG this summer were made to provide both further services to the video laboratory and entertaining ways for the general public to educate themselves about MBARI'S research. Developing a website for two different audiences is a complex task and all future changes to the Deep-Sea Guide will have to be made with these distinct uses in mind.

INTRODUCTION:

In recent years, the Internet has become arguably the best way to communicate with people, whether down the street or in another hemisphere. This means that web presence is increasingly important for businesses of all kinds, especially those with an educational mission, like the Monterey Bay Aquarium Research Institute (MBARI). The Internet is the fastest way for information to reach classrooms, independent learners, or hobbyists compared to books or conferences because it only takes the time to type and post the information, then it is instantly available without waiting for publishers and distributors. This instant distribution has revolutionized notions of collaboration, privacy, and marketing ("Digital Revolution").

With the exponentially increasing importance of a web presence in enticing people to learn more about a product or company, web design has become a kind of art including its own principles of design. One of the most interesting things that helped establish and support principles was a study conducted by Jakob Nielsen and Kara Pierce which used eyetracking to determine which areas of a webpage users focus on the most. It was found that most users read in an "F" shape where they scan horizontally across the top once, then vertically, then branch out from the vertical when another horizontally aligned element catches their attention. They may branch out more than once, making a pattern like lined notebook paper, but the main concept is that users skim instead of reading every word, so the page must be laid out in such a way that users will see the most important parts (Nielsen & Pernice, 2009). It was not mentioned in the study synopsis, but I assume this only applies to Western users, as I doubt people who grow up reading right to left would start in the upper left hand corner.

It is still relevant to my work because the Deep-Sea Guide is an American website and will likely get many of its visits from Western users.

Another important thing to keep in mind when designing for the general public is that web sites do not exist in a vacuum. The Internet has been around long enough that conventions have been securely established by large websites like Google, Facebook, and YouTube. These conventions have been proven to be successful and are widely known, so using similar conventions helps users feel instantly familiar with a site and reduce the chances of them getting frustrated. These conventions include quick loading, multiple ways to access the same information, certain keywords like “Search” and “Home,” and similar methods of navigation, like a navigation bar. It is suggested that people should be able to basically navigate your site, even if it’s written in another language (Friedman, 2008). These are all principles to keep in mind if a company wants their website to be successful at drawing in and keeping users.

The Deep-Sea Guide is a website that is currently only internally accessible, which means one must be connected to MBARI’s servers (through VPN or Ethernet connections) to access it. The DSG gets all of its data from two internal databases: the Video Annotation and Reference System (VARS) and the Expedition (EXPD) database. VARS contains millions of annotations, which are instances of a concept being observed in video and contain a timestamp and dive number, several properties including things like comments and references, and many times a “framegrab” (screenshot) of the video when the concept was in the frame. The EXPD database contains data grouped by dive including navigation data and physical data (temperature, salinity, etc.). These data are very important to scientific work, so the Deep-Sea Guide

being able to show errors in these data or where it is lacking entirely helps ensure any research done using these data is accurate.

The Deep-Sea Guide has retained and expanded on its original internal purpose, which is essentially helping the video laboratory manage annotations and ensure their accuracy. The DSG is used because it can provide different ways of displaying data that make it easier to accomplish certain tasks, like identification, than using the VARS query. The new features this year help catch errors in annotations and entries in EXPD by displaying the data and sorting it into tables. Using these tables, video lab staff can easily find errors, such as an incorrect depth or missing latitude and longitude, and quickly look up the annotation in VARS to fix it. These features, in addition to the old features, make the DSG a powerful tool for identification and quality control.

MBARI already has a significant web presence including their home page (mbari.org), a Facebook page, a Tumblr page, and a Twitter page. Activity on these pages is focused on informing the public about current research, the history of MBARI, and other articles of interest, like deep-sea videos and profiles of deep-sea organisms. Of these pages, Facebook is the most interactive and can provide in–depth answers to complex questions, but still people are limited in their learning by having to wait for a response to their questions. The external Deep-Sea Guide is designed to be an interactive learning tool where people can get many of their basic questions about deep-sea organisms (what depth does it live at, how is it related to similar animals), chemistry, and geology answered instantly by searching for a concept of interest. The DSG does not provide custom answers to the many questions people have, but it could answer some simpler questions for casual and younger learners and provide a ready-

made way to answer basic questions answered on MBARI's other pages. The Deep-Sea Guide would be a good extension of MBARI's public web presence because it provides more specific information and also allows the user to control what information they see through searching and interactivity.

.

MATERIALS & METHODS:

The Deep-Sea Guide is a complex web project that accesses data from the VARS database and displays it in the form of a web page. Several languages are needed to facilitate this interaction including Scala, Mustache, and HTML. The web pages are then formatted using CSS (Cascading Style Sheets) and interactive features, such as image galleries and sortable tables, are enabled using JavaScript or jQuery. Asynchronous JavaScript (AJAX) was used to connect to the server side database in order to display results for the autocomplete function. The DSG was tested using a local server powered by Jetty© ("jetty://"). Apache Maven© was used to build the project and compile the code ("Introduction"). For a more in-depth discussion of these elements, see my intern paper from 2011.

This year, changes to the DSG were focused on two main things: adding quality control features to help see errors in the databases VARS and EXPD and adding more features for the benefit of external users. Adding quality control features meant that more methods to access different parts of VARS and EXPD were needed. These methods also had to be optimized for speed because some concepts have thousands of annotations and have been seen on thousands of dives, and getting data from several places for each one can still take an extremely long time even with optimized methods.

Even with optimization, it was necessary to put a method in place that stops the page from even trying to load if the number of annotations is too great to prevent the DSG from hanging the server. These quality control pages will likely remain for internal use only because casual external users wouldn't want to see our raw data and scientists can use the public VARS query to get whatever data they need.

The features for external users focused on three main principles of design: interactivity, ease of use, and use of conventions. In line with these principles, the main addition this year in terms of coding was the use of the Google Maps© API in order to insert their interactive map applets into the "Data Products" and the "Annotations Map" pages. These applets use JavaScript, so users who do not enable JavaScript will not be able to see them ("Google Maps JavaScript API v3"). The Google Maps© API allows for easily customizable applets that are good for displaying any information involving locations because of their familiarity – almost everyone has used Google Maps©, which makes it easier for users to understand how to interact with the page.

With the basic framework of the Deep-Sea Guide already in place, the process this year focused on design and appealing to a wider crowd. This was accomplished by mostly following similar principles to the ones proposed by Friedman, especially simplicity, and ease of use by following conventions, keeping pages consistent, using formatting to draw attention to the most important parts of the page, and keeping everything short but clear. By having the video laboratory as my internal client, I was also able to receive instant feedback and had several testers who could test my changes as soon as they were made and tell what works and what doesn't. This allowed me to "test early and often," which saves a lot of time and hassle versus

displaying everything at once and trying to fix everything after it's finished (Friedman 2008).

RESULTS:

Modified Page:

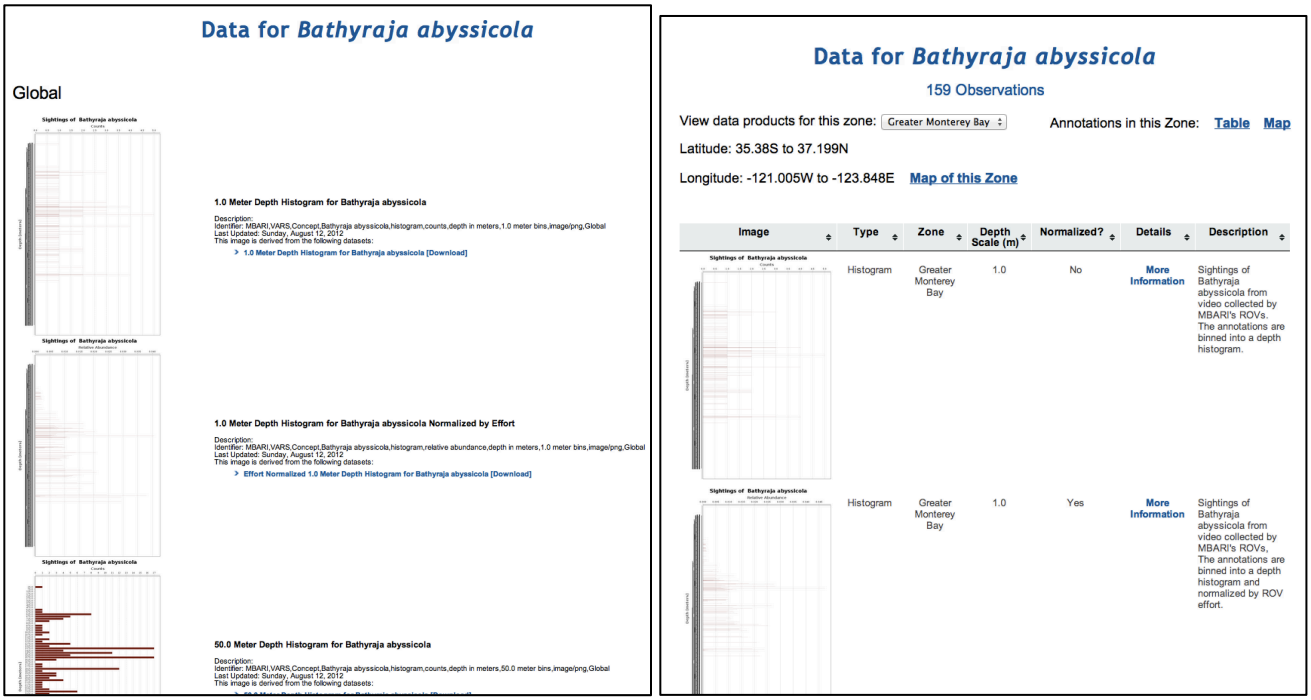

Figure 1. This shows the old "Data Products" page (left) versus the new "Data Products" page. On the new page, the user can select a zone and only see the products in that zone. When a zone is selected, it shows the latitude and longitude bounds along with a link to a map outlining the zone. On the right side, there is a link to the annotations table and map. The new page also has less information to keep the page simple.

Additions:

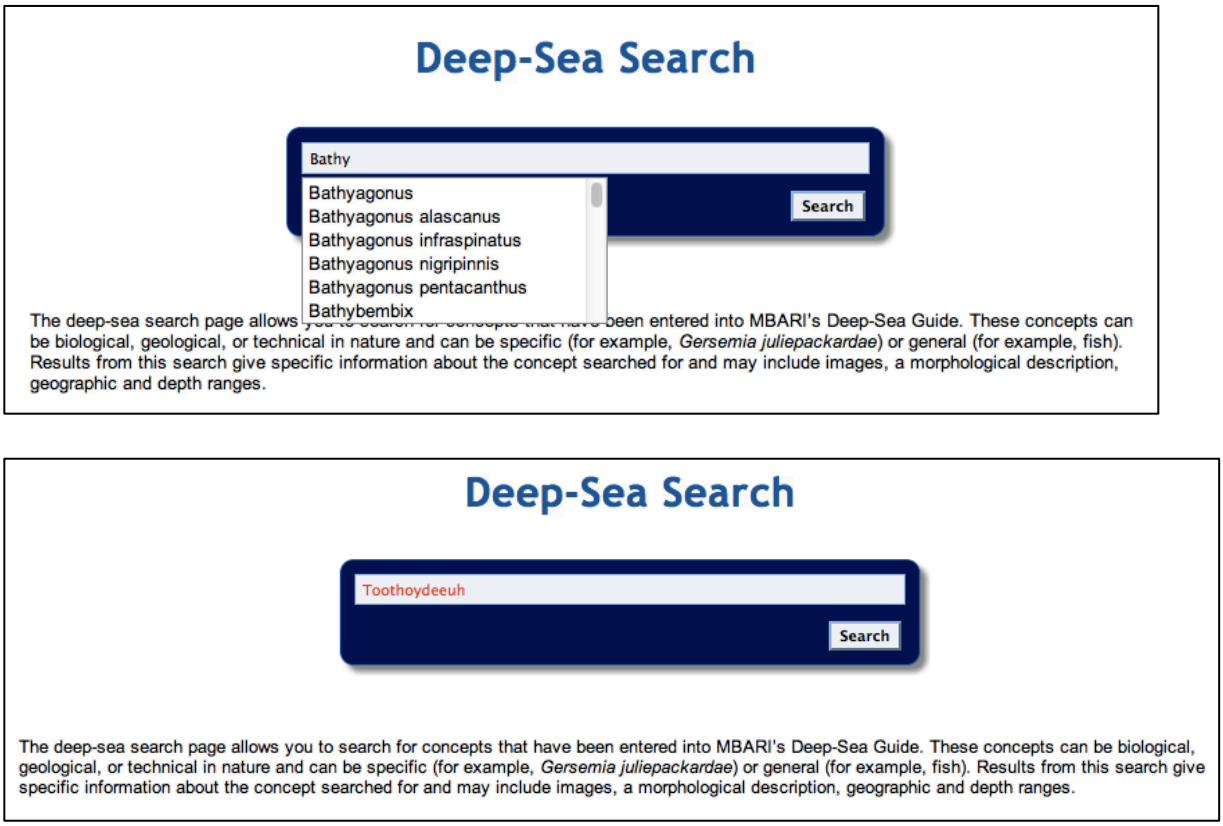

Figure 2. These screenshots show the newly added autocomplete feature. It starts displaying possible results (every result that includes the group of letters in its scientific or common name) after entering 3 letters. If there are no search results for a term, it displays the text in red with no window below the box.

Date and Time	Tape Name	Associations	Depth (m)	Latitude	Longitude
00:00:00 PDT 06/03/2011	D0234-05HD	identity-gender | self | femaleswimming | nil | nil	2,891.86	36.614	-122.436
00:00:00 PDT 04/28/2009	D0018-02HD	identity-gender | self | malecomment | self | observer won't change to lindahabitat | self | flat mud	1,843.47	36.704	-122.1
00:00:00 PDT 09/13/2001	T0358-02	identity-gender | self | female	2,864	36.611	-122.486
00:00:00 PST 11/17/2000	T0240-06	identity-gender | self | femaleidentity-reference | self | 37	1,497.15	36.701	-122.029
00:00:00 PST 12/19/2007	T1162-02HD	identity-certainty | self | maybehabitat | self | flat mud near whale fallidentity-gender | self | male	2,892.65	36.613	-122.436
00:00:00 PDT 10/04/2001	V2077-04	comment | self | shows animal using walking legs to touch downidentity-reference | self | 15	1,380	36.726	-122.016
00:00:00 PST 02/06/2002	T0391-03	identity-gender | self | femalelife-stage | self | young	2,917.6	36.608	-122.46
00:00:00 PST	T0246-04	perspective | self |	2,057.98	36.591	-122.237

Figure 3. This is an image of the annotations table, which displays data about all the annotations for a given concept (one annotation per row). The data displayed are date/time, tape name (used to look up the tape containing the moment when this concept was annotated), associations (like comments), depth, latitude, and longitude. It indicates which zone these annotations are and how many there are (if there are too many, this page will not load and a message will be displayed saying there are too many annotations for that concept to display this page).

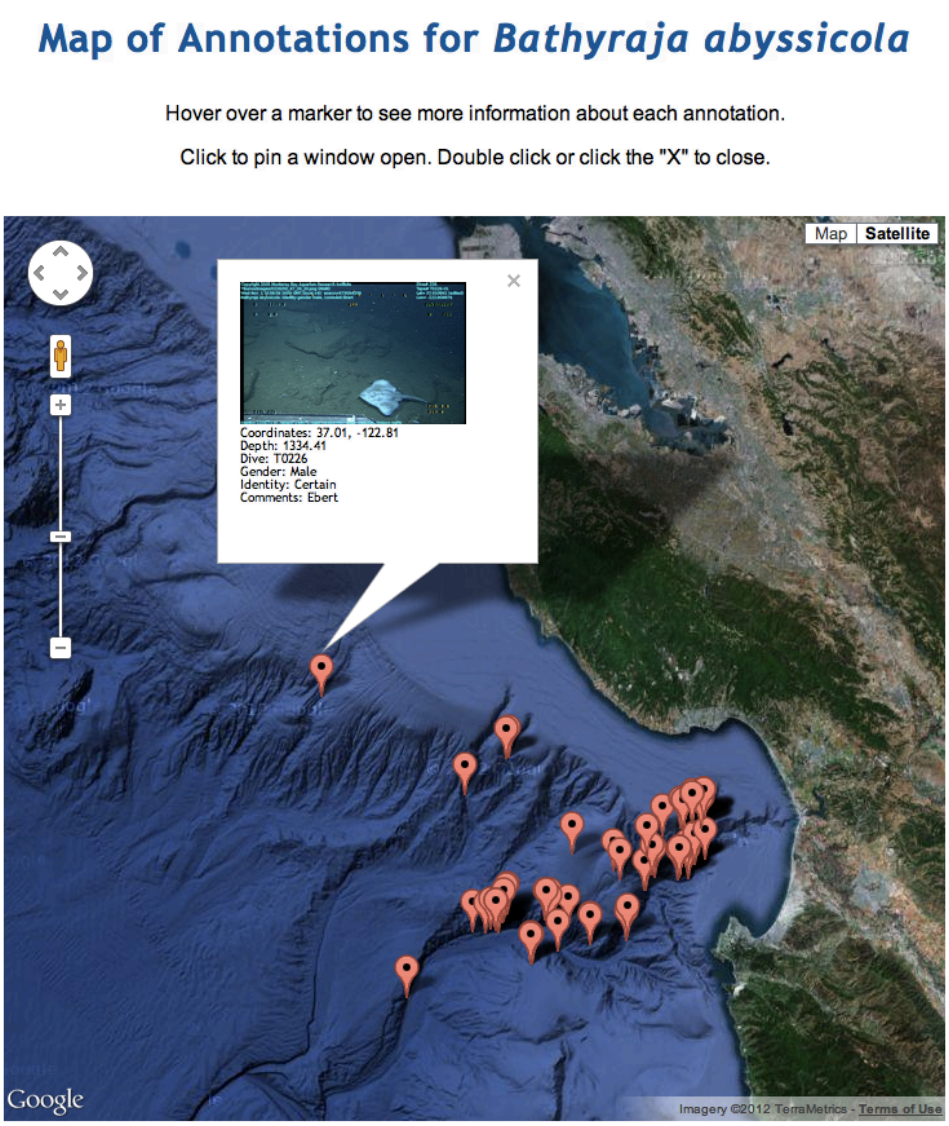

Figure 4. This is an image of the Google Maps© applet for displaying annotations. Each marker is an annotation with a valid latitude/longitude and the zone is the Greater Monterey Bay. The markers display information when hovered over and stay open when clicked. The image can be clicked on to bring up a larger image (Appendix Figure 2).

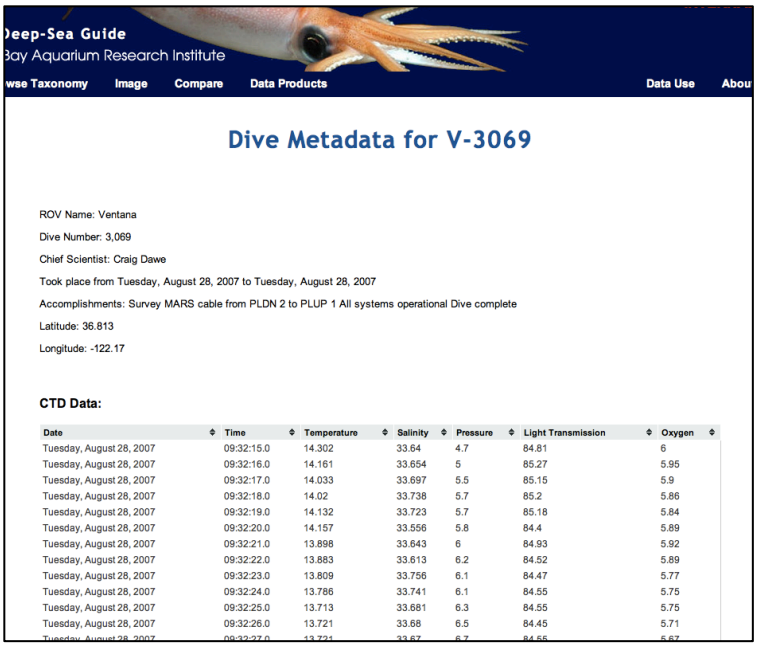

Figure 5. This was the original dive metadata page. At first, the video laboratory thought they wanted data about each individual dive that each ROV made, so this page was created containing every piece of data associated with a single dive. It took an excessively long time to load and was too large of a page to get any significant information out of, so this design was scrapped and the new dive metadata page was created.

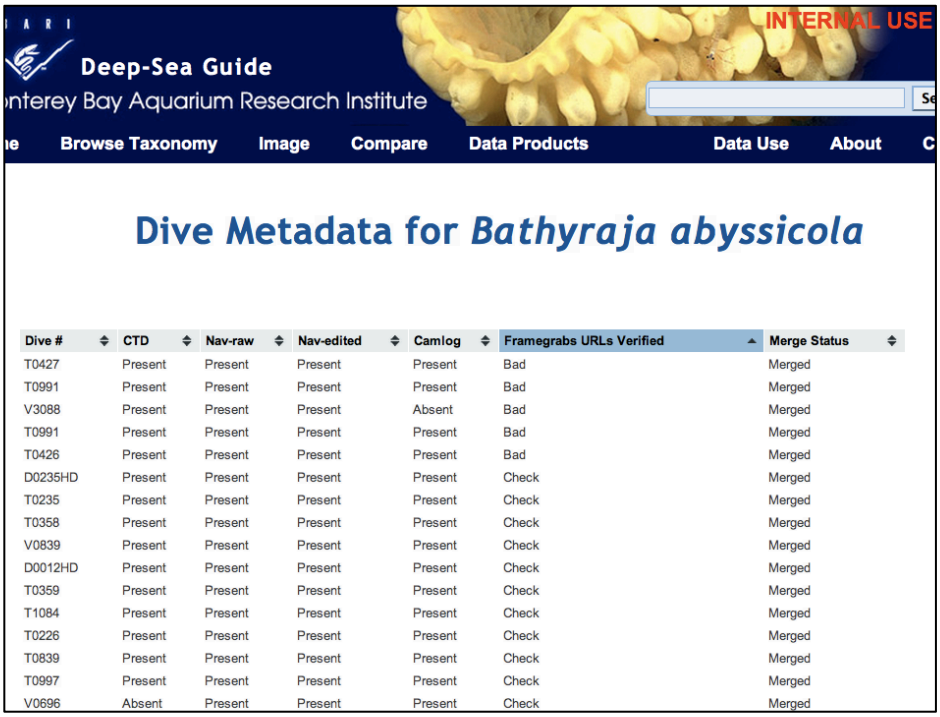

Figure 6. This is the current dive metadata page. It provides basic information about whether or not certain data associated with a given dive is present (CTD and navigation data) or if it is in a valid format (the Framegrab URLs must match a certain style). Sorting capabilities allow staff to quickly see which dives have problems. This page could be modified to be able to see specifics of the problems by clicking on the dive or could redirect the user to that dive in the database to further inspect it themselves.

DISCUSSION:

The work on the Deep-Sea Guide this summer focused on providing services to the video laboratory while also increasing the public appeal of the DSG through using visually appealing and interactive pages to display data.

MODIFICATIONS:

Beginning in January 2012, significant modifications were made to the “Data Products” page (Figure 1). The first major modification was to put the products into a table format to make them sortable and easy to manipulate with JavaScript. Then the dropdown box was installed in order to allow users to limit the page to one zone at a time to reduce information overload and easily focus on their specific interest, if they have one. Then the exact content of each of the columns was determined and some content was removed from the main data products page to simplify it (but the information is still available under the “More Information” link). After that, the annotations table page was added and linked to through this page, then the annotations map was added in a similar fashion. Finally, a section to display the latitude and longitude bounds of the selected zone was created that changes when the user selects a different zone. This section also has a link to display a Google Maps© map of the area with the zone outlined, for users who do not have an innate grasp of what latitude and longitude numbers mean (Appendix Figure 1). This manipulation is almost entirely accomplished with JavaScript, which means again that users who do not enable JavaScript will not be able to see the applet.

ADDITIONS:

One significant addition was creating the autocomplete feature and attaching it to every search box. This autocomplete is essentially (in code and display) a pre-emptive search – it executes a search command and fills a below the search box with the results. This lets the user know if there will be what, if any, results they will get for a given search term (if there are none, the text will turn red) (Figure 2). Functioning this way allows the user to use autocomplete as a spell checker or as a way to see the scientific name corresponding to a common name. The user can still search by the common name, but this can possibly get causal users more accustomed to scientific names because they are instantly associated with the familiar common name. Spell checking of scientific names is useful for everyone, seeing as not even an expert can remember the spelling of every scientific name, and it saves the user from having to open another page to search for how to spell their concept of interest.

There were two additions made that are for mostly, if not entirely, internal use: the annotations table page (Figure 3) and the dive metadata page (Figures 5 & 6). The annotations page can quickly show staff whether there are obvious problems with the annotations for a certain concept using a sortable table of key properties. For example, if a skate has an annotation with a depth of zero meters, there is obviously a problem with that annotation. There have also been instances of the year 1979 being used as a placeholder date, but that is obviously an incorrect date because MBARI ROVs did not operate in 1979. Displaying these key properties in one place makes it easy to spot problem annotations that can then be fixed quickly in VARS.

The second internal addition was the dive metadata page. The concept of this page went through two stages. The first is shown in Figure 5 – the video laboratory potentially wanted all of the data about a single dive on one page, but that turned out to be more information than necessary, so that page wasn't included on the DSG. The second idea (Figure 6) was to check for the presence of data (like CTD data) and the format of specific and important things, like the URLs for the framegrabs, which were sometimes put in incorrect locations. This turned out to be much more useful, and there are many possible ways to expand this page. There are several other potential columns that the video laboratory staff have expressed interest in having on this page, but there wasn't enough time to code them this summer. This page takes an extremely long time to load because it fetches a lot of data from different databases, which is one reason why it will remain internal.

The last main addition was made mostly for external users: the "Annotations Map" page (Figure 4). This page features a Google Maps© applet that displays the location of each annotation. When a user hovers over a marker, it displays an "InfoWindow" containing a small image, the depth, latitude, longitude, gender, whether or not it's certain that the species is identified correctly, and any comments. The small image can be clicked on to bring up a larger image and several windows can be opened at once. This provides an interactive way to experience the VARS database and gives context to each individual annotation, making it easier for casual learners to understand the significance of specific data.

CONCLUSION:

Over time the Deep-Sea Guide has evolved into a website that incorporates many essential principles of design to appeal to the general public in addition to providing valuable tools for internal use. Quality control pages provide the video laboratory an easy way to spot problems with annotations, which leads to less time being spent finding errors and more time spent fixing them, ensuring greater accuracy in our data. Interactive maps provide the casual user with an entertaining and familiar way to explore the annotations in VARS while different kinds of graphs provide more scientific-minded users with a wealth of summary information about a concept. This variety of ways to use the DSG allow it to have an impact on more people, which is the goal of any educational website. Making it available to the public is a big hurdle, but one that will hopefully be overcome soon so that the rest of the world can see the amazing research that goes on here at MBARI and learn more about the deep-sea.

FUTURE RECOMMENDATIONS:

A lot of time this summer was spent focusing on implementing ideas and improving functionality with design sometimes being put on the backburner in order to simply get everything complete and on a page, so the design for the pages created this summer could certainly be improved on. The “Data Products” page is a little cluttered, but may get less so if there are different versions made for external versus internal access (having only the map and only the table respectively). The “Annotations Table” and “Dive Metadata” are relatively plain, but this is acceptable if they are not made external because they are used for quality control, not entertainment. Also there are

several data columns missing on the “Dive Metadata” page because it remained undecided how the DSG would access that data, so adding in those columns and maybe methods to make the metadata load faster would be helpful to the video laboratory.

Another obvious future recommendation is to finish whatever is necessary to allow the DSG to be released to the public. There have been some questions of what data to show, which pages should be displayed, and whether the code is production ready. I’m not sure if an intern can work on these problems, but if there were anything an intern can do, like testing, this would be a great thing to get finished.

A recommendation that continues from last year is the recommendation to put code in place that allows for users without JavaScript (JS) to still use the basic functions of the DSG. Some things will remain impossible for users to use without JavaScript, like the Google Maps© applet and the autocomplete feature, but other things can have extra code built in for when the user doesn’t have JavaScript enabled to do a basic version of the same thing. A good example of this is the “Browse Tree” page where it submits a form if a user doesn’t have JS. This allows them to open one node of the tree at a time, so it’s not fully functional, but it’s the best that can be done without JS. Many of the changes this year were JS-intensive and there was not enough time to program alternative code in many places, so this is an aspect that can definitely be improved.

An interesting recommendation was raised at the Intern Symposium, which is the lack of development for mobile platforms. It is predicted that by 2015, tablet computers and smartphones will be used more often than PCs to access the Internet (Bertolucci, 2011). In order to reach this crowd, the DSG needs to be optimized for mobile

platforms, which is an entirely different kind of programming and design than what has been done here. Perhaps even an app could be made with simplified versions of many of the pages focusing on appealing data display (images, video, etc.) and other “fun” features. This would help reach more people, especially young people outside of the classroom who may not have their own PC.

ACKNOWLEDGEMENTS:

I would like to thank my mentor, Brian Schlining, for all his help January through this summer and last summer. Whenever I needed a method to access a new part of the database for the video lab, or I didn’t understand how the structure of something worked or why I was getting an error, Brian was there to help me. He also fixed the DSG who knows how many times this summer when it would go down because of a hang, which I didn’t know how to fix. He also taught me a lot more about database and project structure, which I’m sure will be helpful in the future. Brian has helped me in so many ways and I’m very grateful to have had a mentor like him.

I would also like to thank my other unofficial mentor, Nancy Jacobsen-Stout. She shared my office and was often the only one I needed to ask if I ever had a question about how something worked in VARS or whether I was getting an incorrect output because she is so knowledgeable about VARS and EXPD. She would also look at proposed changes I made and let me know if they were useful or if I should try a different approach, especially on the quality control pages. She provided me with a lot of invaluable advice about life, the universe, and everything and the DSG wouldn’t be as useful without her guidance.

I'd like to thank all of the video lab staff: Susan Von Thun, Kyra Schlining, Lonny Lundsten and especially Linda Kuhnz. Linda used the DSG frequently and as such was an invaluable testing resource – if there was an error, she'd find it and report it to me, saving me a lot of time. She also had many suggestions for me over the course of developing the DSG, the Comparison Tables being one prominent example. Having the video lab staff in house was very helpful in figuring out what worked quickly, giving me more time to program pages they actually would use.

Last but certainly not least, I'd like to thank George Matsumoto for coordinating this amazing internship every year! He has done an incredible job securing housing, scheduling fun activities, and keeping on top of everyone's work while still doing his own. I hope to have managing skills as good as his one day. He also wrote recommendations for me when I applied to Master's programs, which I am very grateful for. I couldn't have come this far without all of George's help and support, so thanks again!

REFERENCES:

Bertolucci, Jeff (2011). "Tablets, Phones to Surpass PCs for Internet Use in Four Years." *PCWorld*. Retrieved August 17, 2012 from http://www.pcworld.com/article/239870/tablets_phones_to_surpass_pcs_for_internet_use_in_four_years.html

"Digital Revolution." *Wikipedia*. Retrieved August 17, 2012 from http://en.wikipedia.org/wiki/Digital_Revolution#cite_note-13

Friedman, Vitaly (2008). “10 Principles of Effective Web Design.” *Smashing Magazine*. Retrieved August 17, 2012 from http://uxdesign.smashingmagazine.com/2008/01/31/10-principles-of-effective-web-design/

“Google Maps JavaScript API v3” (2012). *Google Developers*. Retrieved August 17, 2012 from https://developers.google.com/maps/documentation/javascript/

“Introduction.” *Apache Maven Project*. Retrieved August 17, 2012 from http://maven.apache.org/

“jetty://” (2011, April 12). *Codehaus Foundation*. Retrieved August 17, 2012, from http://jetty.codehaus.org/jetty/

Nielsen, Jakob & Pernice, Kara (2010). *Eyetracking Web Usability*. Berkeley, CA: New Riders.

APPENDIX:

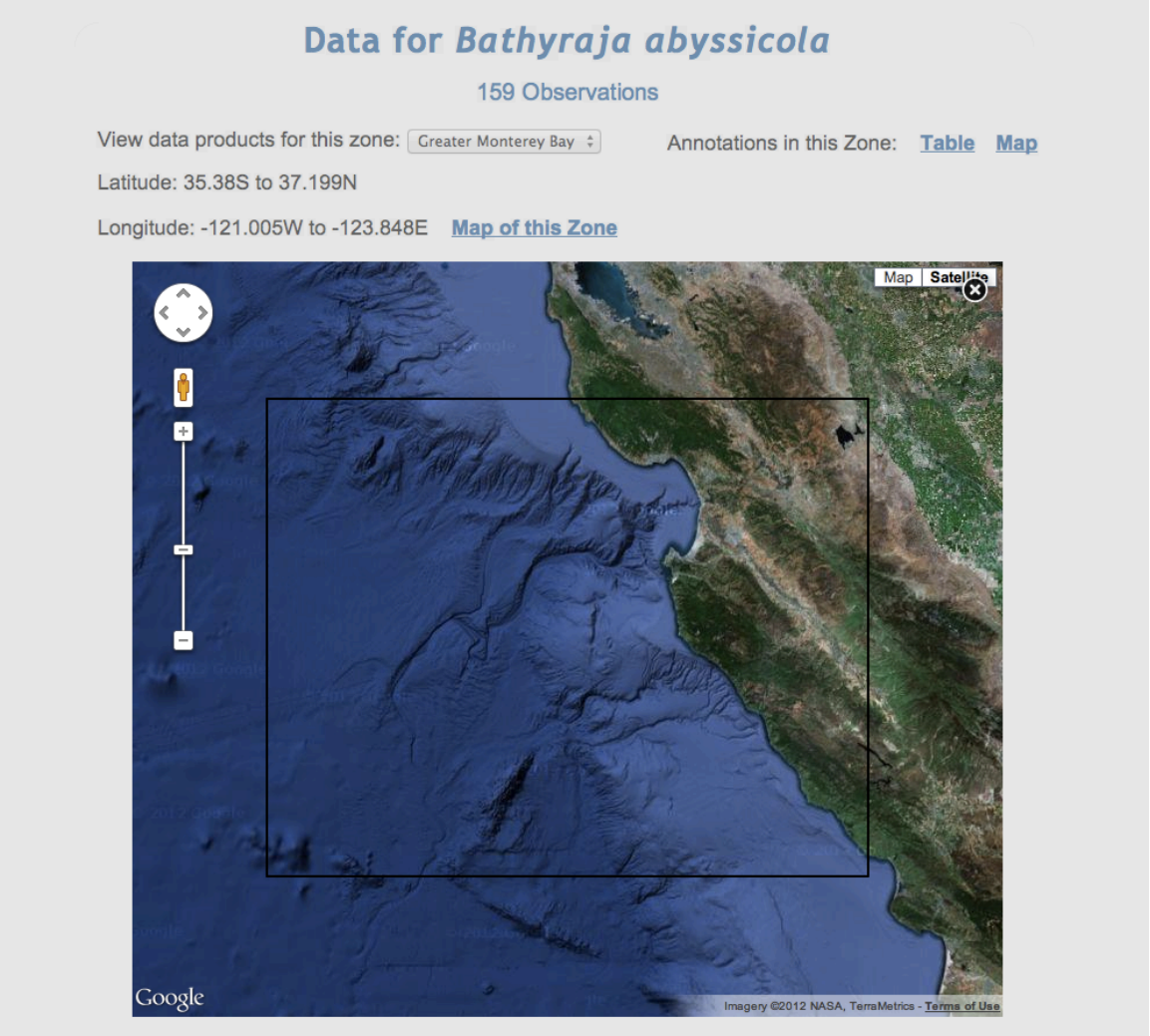

Figure 1. This is an image of the map displayed when “Map of this Zone” is clicked (with JS enabled) for the zone “Greater Monterey Bay.” The zone is outlined by a black rectangle.

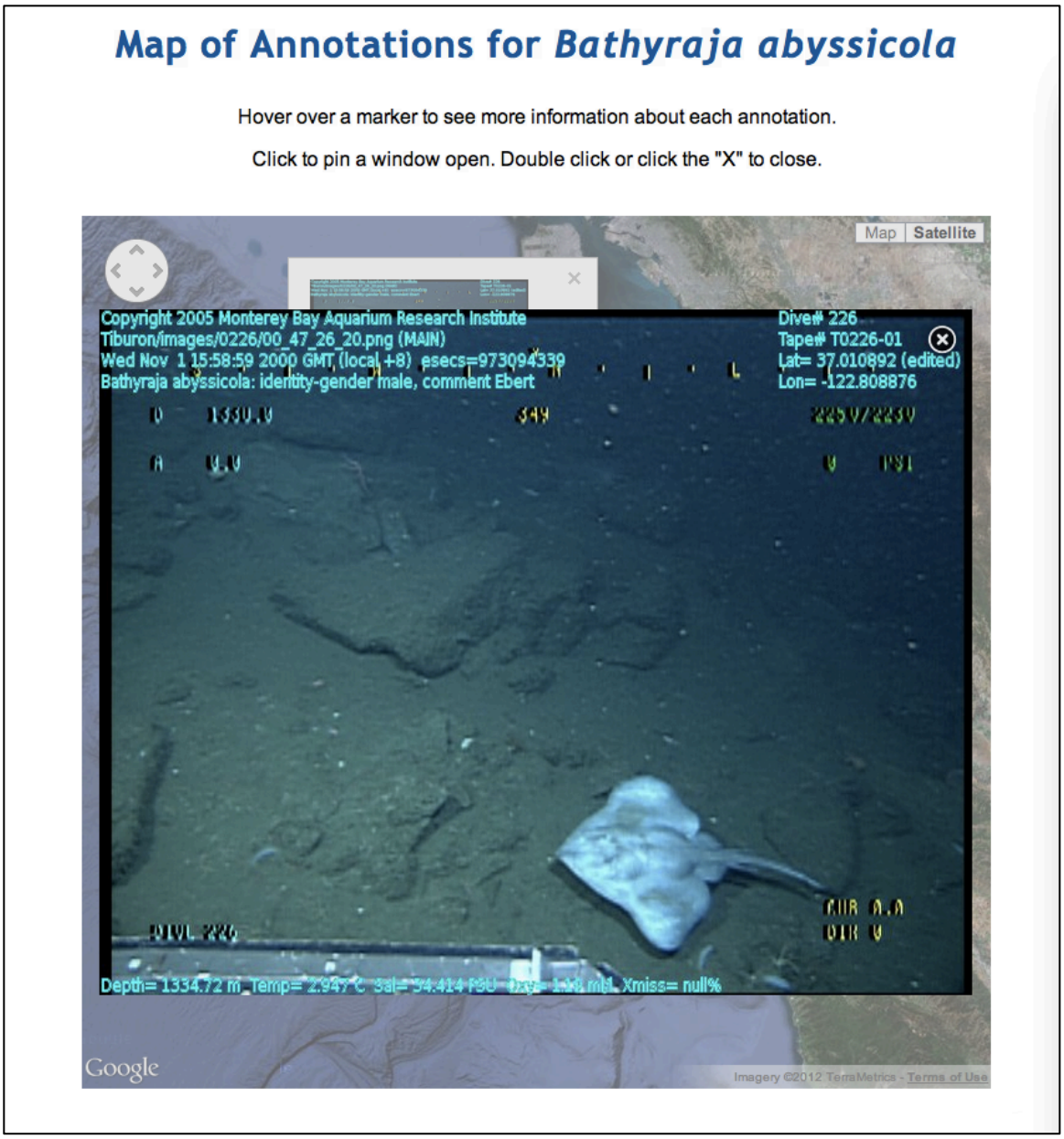

Figure 2. This is an image of the larger image displayed when an image in an InfoWindow is clicked. This is on the “Annotations Map” page, a page meant to display annotation data in a more interesting and relevant fashion.