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An Electronic Journal of Geography and Mathematics

25 YEARS, AND MORE, OF PUBLICATION!

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Articles

The word clouds (formed in Tagxedo, online) serve as a visual "abstract" of the adjacent article!

Small Hive Beetle, Animaps: Focus on Hawaii

Diana Sammataro and Sandra L. Arlinghaus

Introduction

In 1998, Sandra L. Arlinghaus, William D. Drake, and John D. Nystuen, with data and other input from Audra Laug, Kris S. Oswalt, and Diana Sammataro, wrote an article that appeared in *Solstice* called 'Animaps.' The first animated map ('Animap') that Arlinghaus imagined and created was based on data and maps from Drake, then-President of Community Systems Foundation; it involved materials associated with a project in-house at the time. When Nystuen saw the 'completed' original, he offered the fine suggestion of varying the time interval between successive frames of the animation, to match with the temporal distribution of the actual data, rather than to use a uniform time spacing in the animation--along with associated color coordination. He also suggested including Diana Sammataro and a map of the global distribution of varroa mites, a pest that attacks honeybees. Thus, one of the animaps that appeared in the original 1998 document was an animated map of the global distribution of the varroa mite. It was presented as an animated .gif on a Robinson projection, the default projection of one popular GIS package of the time. A copy appears in Figure 1.

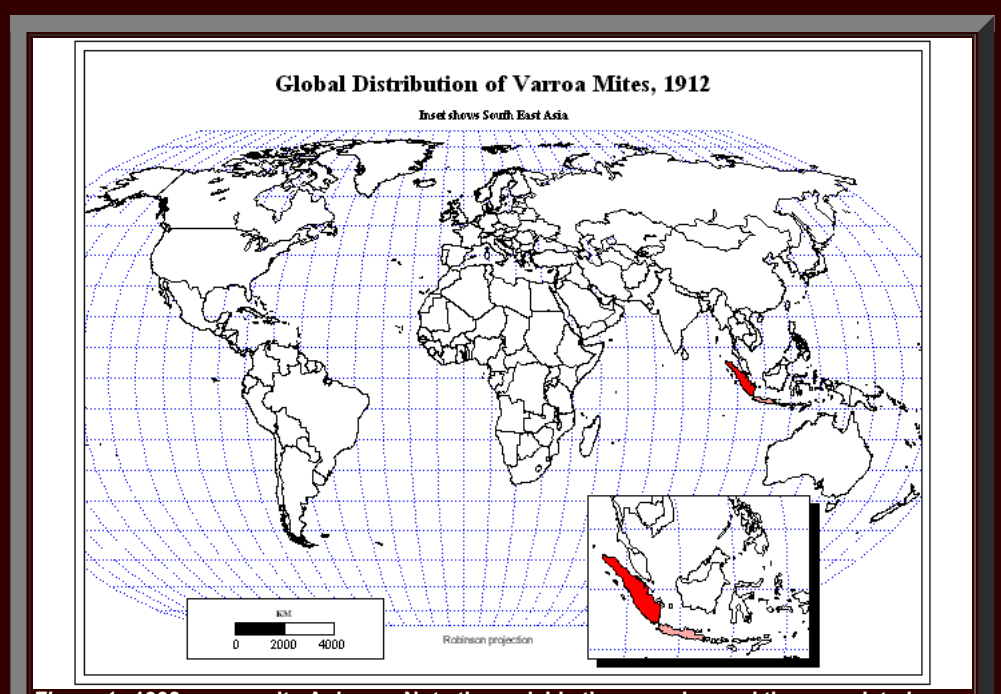

Figure 1. 1998 varroa mite Animap. Note the variable time-spacing and the associated change in color of the leading temporal edge of the distribution.

As the varroa mite has spread, Sammataro has sent new data, on a regular basis, for additional mapping by Arlinghaus. For many of the updates, Arlinghaus simply used a painting package to insert new frames in the animation in order to keep the visual appearance consistent from 1998 forward. For other reasons, Arlinghaus used 3D visualization as it became available. There are merits and drawbacks to each. It is far easier to comprehend varroa mite diffusion looking at the simple Robinson projection than it is looking at one side of a beautiful globe display. On the other hand, the beautiful globe display is eye-catching, shows good realistic detail, and works well for displaying regional studies covering less than half the globe. The set of updates, and variations in display, by Sammataro and Arlinghaus are included in the set of references (2001, 2006, 2007, 2009, 2010, 2011, 2012). These, as well as numerous other examples of styles of map animation are also available in *Solstice* and are listed in Table 1.

Table 1: Pattern of animated maps appearing in, or linked to, Solstice (1998 to present).

1998:	1, 2, 3, 4
1999:	1, 2
2000:	1, 2, 3
2001:	1, 2
2002:	1, 2, 3, 4
2003:	1, 2, 3, 4
2004:	1, 2, 3, 4, 5, 6
2005:	1, 2, 3
2006:	1, 2, 3, 4, 5, 6, 7, 8
2007:	1, 2, 3, 4

2008: 1, 2, 3, 4, 5
2009: 1, 2, 3, 4, 5, 6, 7, 8
2010: 1, 2, 3, 4, 5
2011:
2012: 1, 2, 3, 4
2013: 1, 2
2014: 1, 2, 3
2015:

Recently, Arlinghaus was invited to participate in a revision of *McKnight's Physical Geography* textbook (Hess, 2016). She contacted Sammataro immediately, and they came up with a small piece for inclusion in the document. It derived from their earlier mapping, as an animated map, of the spread of the varroa mite; however, in the course of doing the work, others also wanted at least some brief discussion of the situation with the small hive beetle. Thus, we included a bit. The final submitted work, even though it is based on a dynamic 'animap', is of course static--as a textbook. That textbook opportunity, however, has led us to begin to consider a series of mapped materials, as animations, involving the small hive beetle.

In creating such maps, data acquisition is one issue. Method of visual presentation is another, that is equally important. There are decisions about data and maps that need to be made in unison; one does not drive the other.

Visual Presentation Decisions

To begin, we look at the history of decisions made in association with the varroa mite mapping effort. Table 1 is based on materials found directly in *Solstice* or linked in *Solstice* (it is a sample; not comprehensive). There are links on the timeline dates in Table 1 to the original online animated maps. So that one might see the clustering of these animated maps, the timeline is visualized as a vertical calendrical timeline (with no years missing) in the style of a "GEOMAT" (Geogaphic Events Ordering Maps Archives Timelines) as created by our colleague in Geography, Ann E. Larimore and others (Larimore, 2005, 2007, 2008). Both Nystuen's conception of spacing between successive frames of an animation to parallel actual temporal spacing, and Larimore's insistence on including all years in a time span, serve as important to tools to identify time gaps in spatial phenomena: years when no new varroa mite infestations were found or years when no new animated maps were displayed.

In the years from 1998 through the first decade of the 2000s, there is heavy use made of animated .gifs. Following that time, the proliferation of numerous types of visualization software becomes evident. Thus, one finds links in *Solstice* to .kmz files to visualize on a globe and wrl files to play in a 'player'. While both of these offer very attractive options in many ways, they do require the reader to engage with an extra piece of software. The lesson learned here is that some readers like to see the very latest in software used and are happy to go to a bit of extra effort; others, however, wish to be able simply to use only a browser and nothing else. So, a prudent approach in optimizing communication, for us at least, will be to use interesting visualization software as we wish, and to offer files for download that might employ offbeat formats, but to be certain to capture elements of all displays to create an animated .gif that makes the key visual points evident in a browser only...as has been done since the gap in 2011!

Data Acquisition Decisions

Global datasets on the spread of a pest are typically compiled over time from regional sightings at a local geographical scale. Datasets of this sort are often available by direct communication in advance of their publication. Thus, field study, travel, and conferences all with subsequent email follow up are important ways of getting information as it unfolds. Because data acquisition of this sort seems to advance at the regional level, it seems prudent to begin our small hive beetle animap project with a regional study for which we have recent information from the field. We have that for Hawaii, so we begin with a focus on Hawaii (Figure 2 shows a reference map and a photo of an adult small hive beetle).

Figure 2. **Hawaiian Islands, reference map. Adult small hive beetle (source: USDA link).**

In addition, we begin to supplement that field information with mapped information from others. Information from online sources can help to create a base map for future global animation and for the insertion of regional datasets as they become available. To align the mapping decisions with the data decisions, whether at the local or global scale, we choose to map the data regionally in Google Earth and offer the associated .kmz file to readers to download, while at the same time presenting them with animated .gifs at varying geographical scales, so they can access the main content solely within a browser. As we move forward over time, we expect visualization software to change, but we hope that the mapping strategy, combining ease of reading with availability of contemporary visualization, is sufficiently general and conceptual to transcend the inevitable technological changes that will come along.

Focus on Hawaii--Animaps from Field Information

In early 2016, Sammataro met with colleagues in Hawaii. Following initial contacts, emails provided needed information.

From Sammataro to Rusert et al.: "Here is the map of varroa spread. I want to update the countries, and noted that the different islands got varroa at different times... If you could correct that (send me dates and which islands were affected) I will put that on.
Here is the map as it is now... I am also hearing from Maryann that Africa needs updating too...

My next project is to do the same for SHBeetle with possible soils info too, so any help you can give on that would be wonderful..."

Response to Sammataro from Rusert: "Varroa was detected on Oahu, April 2007 and on Big Island, August 2008. It is widespread on both of those islands and has yet to be seen on Maui, Kauai, Molokai, and Lanai. Small hive beetle is widespread on all the islands and was detected at the dates below.

Big Island: April, 2010

Oahu: Nov, 2010

Molokai: May, 2011

Maui: July, 2011

Kauai: June, 2012

Lanai: February, 2013

I'm not sure of the soil types, but can look into it."

Sammataro then forwarded the email to Arlinghaus who created an animated map from it (Figure 3). Custom icons were created to suggest the honeybee connection; time spacing between successive animation frames matches actual observation gaps (as in the 1998 animap and subsequent variations).

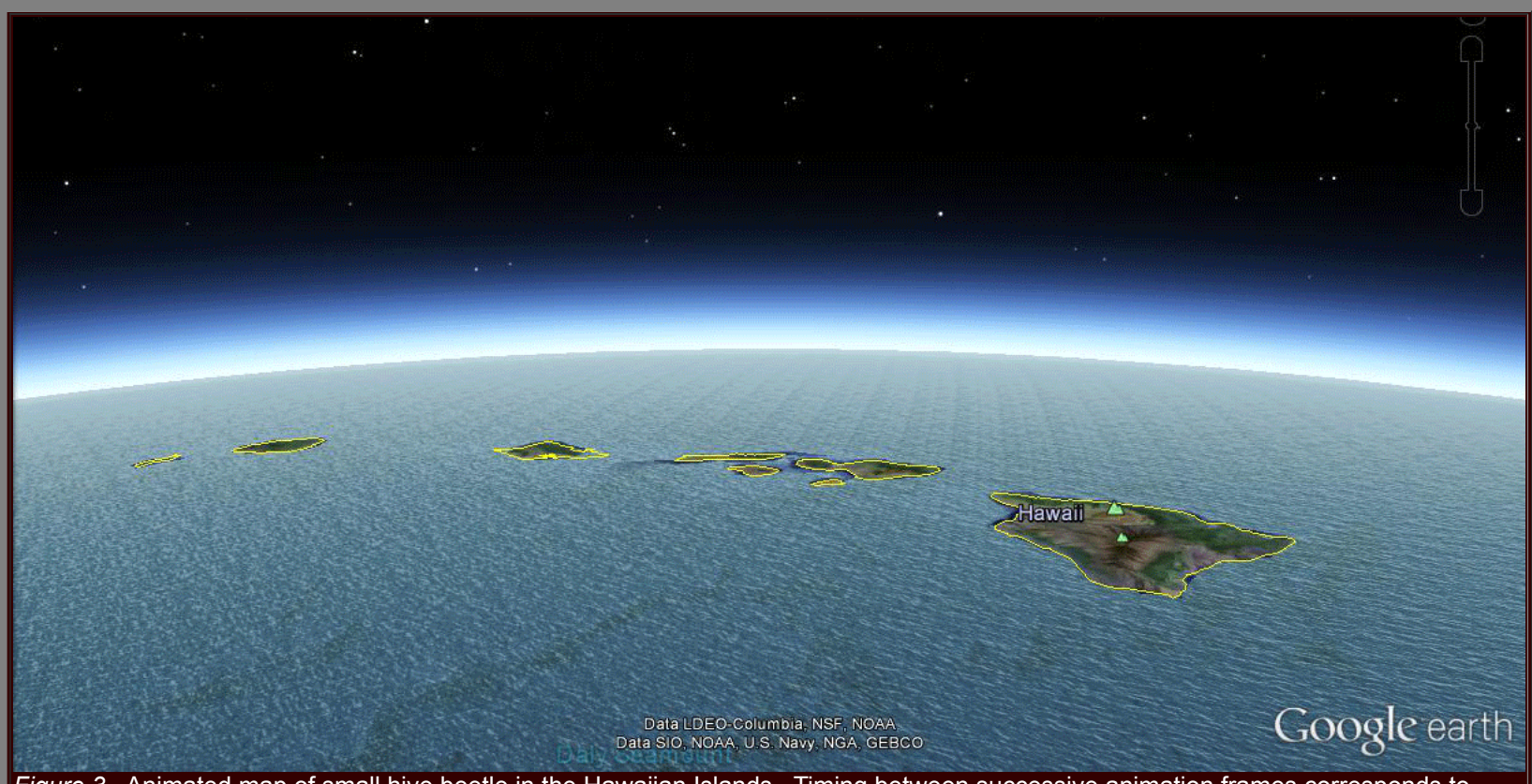

Figure 3. Animated map of small hive beetle in the Hawaiian Islands. Timing between successive animation frames corresponds to timing in the underlying dataset.

We show the steps in data acquisition here to indicate how much detail and work goes on behind the scenes of a single animated map. Here we focus on the initiation of the small hive beetle series of animaps. Readers of *Solstice* can look forward to seeing updates of these and of varroa maps, also mentioned in the emails, in future editions of *Solstice* as more datasets arrive.

Online sources

If one searches the Internet for maps and datasets involving small hive beetles, a number of interesting maps and related materials will come up. We show a few here, as they relate to our broader desire to make animated maps.

The University of Florida has a nice site that includes a map of the global distribution of the small hive beetle, by country, as of 2010. It is a static map that is a useful reference; it is shown here in Figure 4a. We envision a global animated map based on a static map of this sort, made on an equal area projection (the one in Figure 4a is not) that brings in the countries by date, with associated colored leading edge, much as was done in the 1998 varroa mite map. In Figure 4b, we see a move to local mapping, using the power of GIS software (from the Ontario Ministry of Agriculture, Food and Rural Affairs). We envision regional maps such as these coming to life with datasets accumulated over time. A number of attractive and useful regional maps are available on the Internet; this particular one attracted our attention because there are dates already associated with polygons so that one might imagine an animation coming to life simply from this map alone. The reader is invited to try it; as it there are many more steps with the datasets behind an animated map than one might imagine, so too there are many more mapping steps. The animated map is a powerful, yet elegant, tool because it compresses large amounts of data into an apparently simple display.

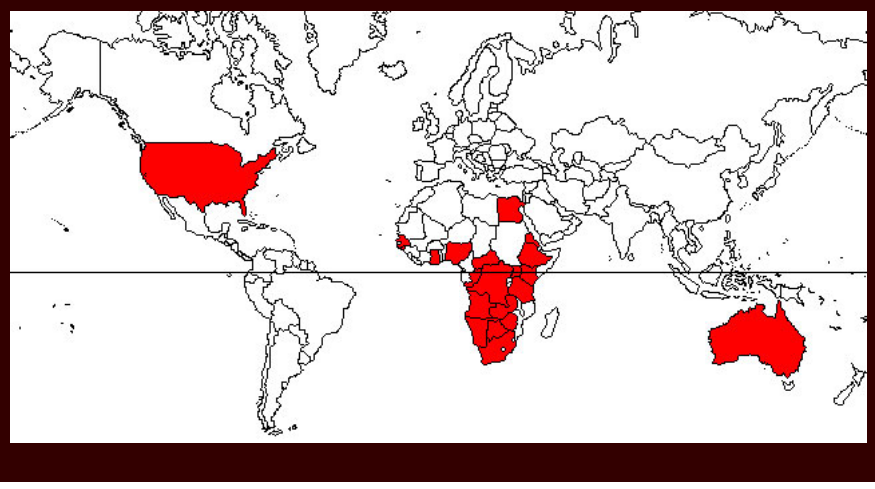

Figure 4a. **Small hive beetle distribution as of 2010 (Ellis and Ellis).**

Figure 4b. **2011 Ontario Provincial Apiarist Annual Report.**

The Invasive Species Compendium has a number of useful maps and datasets. One of the maps available for download is a .kml file for Google Earth. When we downloaded that file, it did not, at least from that particular download, display reasonably in a current version of Google Earth. The .csv file available for download, did however appear quite well in Microsoft Excel (Figure 5). We look forward to the day when there is a single central source for all such data with regional datasets from around the world included in a single file, as well as separated files, so that analysis and mapping can become more straightforward. Certainly the work of this Compendium seems a fine start in that direction!

small hive beetle infestation [Read-Only] - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J
1	<!--This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License (http://creativecommons.org/licenses/by-nc-sa/3.0/) The data presented in this file MAY NOT include all records shown on the datasheet.									
2										
3	Region	Latitude	Longitude	Extent	Last Repo	Origin	First Reported	Invasiveness	References	Notes
4										
5	Australia	-25	135	Present	-	-	-	-	OIE, 2009	-
6	New South Wales	-33	146	Present	-	Introduced	-	Invasive	FERA, 2010	First found in 2002.
7	Queensland	-20	145	Present	-	Introduced	-	Invasive	FERA, 2010	First found in 2002.
8	Victoria	-37	145	Present few occurrences	-	Introduced	-	-	Annand, 2008	-
9	Western Australia	-25	122	Localised	-	Introduced	-	-	FERA, 2010	-
10	Canada	60	-96	Present	-	-	-	-	OIE, 2009	-
11	Ontario	49.2501	-84.4998	Localised	-	Introduced	-	-	Kozak, 2010; Kozak, 2012	Detected in 2010. Restricted to a quarantine area in southern Ontario.
12	Quebec	52.0002	-71.9991	Present	-	Introduced	-	-	FERA, 2010	Detected in 2008. As of 2010 not yet well established.
13	Italy	42.8333	12.8333	Localised	-	Introduced	2014	-	Mutinelli et al., 2014	Calabria (plus one migratory apiary in Sicily)
14	Jamaica	18.25	-77.5	Present	-	Introduced	-	-	FERA, 2010; OIE, 2009	Confirmed in 2005.
15	Kenya	1	38	Present	-	Native	-	-	Torto et al., 2010; OIE, 2009	-
16	Mexico	23	-102	Present	-	Introduced	-	-	FERA, 2010; OIE, 2009	Confirmed in 2007.
17	Nigeria	10	8	Present	-	Native	-	-	Akinwande et al., 2013; OIE, 2009	-
18	South Africa	-30	26	Present	-	Native	-	-	Spiewok et al., 2007; OIE, 2009	-
19	Sudan	15	30	Present	-	Native	-	-	El-Niweiri et al., 2008; OIE, 2009	-
20	Uganda	2	33	Present	-	Native	-	-	Roberts, 1971; OIE, 2009	-
21	Florida	28.7505	-82.5001	Present	-	Introduced	-	Invasive	FERA, 2010	First reported in 1998.
22	Hawaii	20.7503	-156.5	Present	-	Introduced	-	Invasive	FERA, 2010	First reported in 2010.
23	USA	39.76	-98.5	Widespread	-	Introduced	-	Invasive	FERA, 2010; OIE, 2009	First reported in Florida in 1998; now very widespread.
24	Zimbabwe	-19	29	Present	-	Native	-	-	Papadopoulo, 1964; OIE, 2009	-

Figure 5. **Dataset from the Invasive Species Compendium.**

Combining the Global and the Local

To offer a suggestion of our vision for the future, we have mapped the dataset in Figure 5, using only columns of complete data, in Google Earth. We used the same placemark icon for each entry in the spreadsheet as we used for our animated map of the field study data for Hawaii. Thus, we were able to seamlessly, in terms of icon representation, integrate datasets at the regional and global scales. Figure 6 shows an animated versions of screenshots of this combined file: local Hawaii with global data from the Invasive Species Compendium. As such spreadsheets fill in with data, and as more local datasets become incorporated, our map will continue to grow and visual transitions will become smoother as dated material becomes widespread!

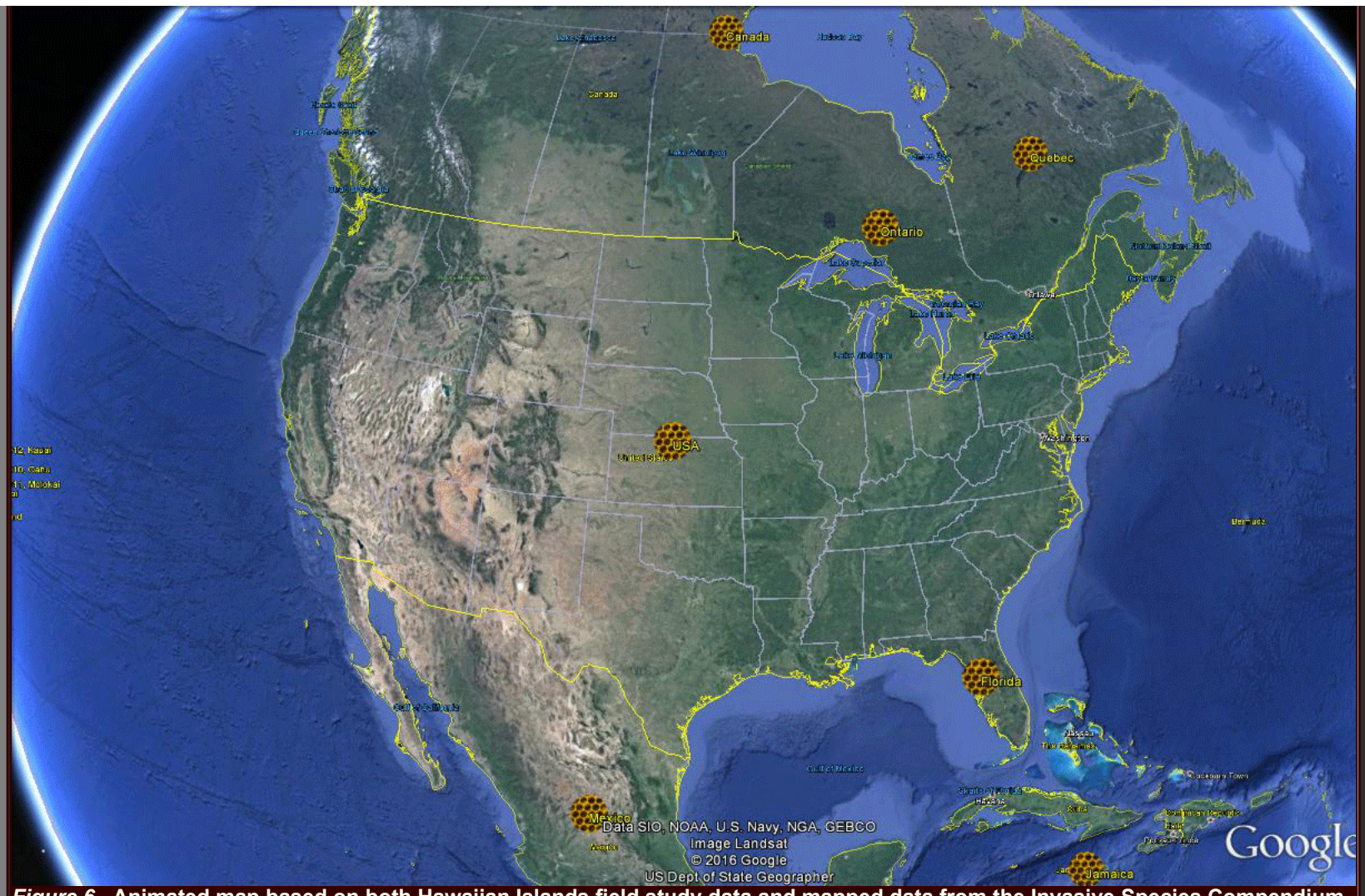

Figure 6. **Animated map based on both Hawaiian Islands field study data and mapped data from the Invasive Species Compendium--local and global scales are unified in this animap.**

Download the kml file, from which this animated map is created, and add to it yourself!

References

Arlinghaus, Sandra L.; Drake, William D.; and, Nystuen, John D. with data and other input from Audra Laug,Kris S. Oswalt, and Diana Sammataro. 1998. Animaps. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume IX, Number 1. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Arlinghaus, Sandra L. and Sammataro, Diana. 2009. Bee Ranges and Almond Orchard Locations: Contemporary Visualization. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XX, Number 1. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Ellis James D. and Ellis, Amanda. 2010. 'Featured Creatures', University of Florida, Entomology & Nematology http://entnemdept.ufl.edu/creatures/misc/bees/small_hive_beetle.htm

Hess, Darrell. 2016. *McKnight's Physical Geography: A Landscape Appreciation*, 12th Edition. Pearson Publishing.

Invasive Species Compendium. 2012. http://www.cabi.org/isc/datasheet/109537

Larimore, Ann (with Sandra Arlinghaus and Robert Haug) GEOMAT: Geographic Events Ordering: Maps, Archives, Timelines. An Historical-Geographical Method for Aiding Conflict Resolution. University of Michigan Course, 2005, 2007, 2008.

Ontario Provincial Apiarist Annual Report. 2011. Ontario Ministry of Agriculture, Food and Rural Affairs. http://www.omafra.gov.on.ca/english/food/inspection/bees/11rep.htm

Rusert, Lauren M. Personal communication to Sammataro

Sammataro, Diana. 2001. Update from Diana Sammataro: Varroa Mite Animated Map. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XII, Number 1. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Sammataro, Diana. 2006. Update on the Varroa Mite Map. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XVII, Number 2. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Sammataro, Diana. 2007. Update on the Varroa Mite Map. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XVIII, Number 1. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Sammataro, Diana, and Arlinghaus, Sandra L. 2010. The Quest to Save Honey: Tracking Bee Pests Using Mobile Technology. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XXI, Number 2. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Sammataro, Diana. 2011. Varroa Mite Project. Note in *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XXII, Number 2. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

Sammataro, Diana. 2012. Update on Varroa Mite Spread. *Solstice: An Electronic Journal of Geography and Mathematics*. Volume XXII, Number 2. Ann Arbor: Institute of Mathematical Geography, http://www.imagenet.org

United States Department of Agriculture, Agricultural Research Service. http://www.ars.usda.gov/Research/docs.htm?docid=18993

In the In

1. ARCHIVE
2. Editorial Board, Advice to Authors, Mission Statement
3. Awards

1.
2.
3.

RECENT NEWS...

1. *Quaestiones Geographicae*, Special Issue
2. Chene Street History Project.
3. ***Spatial Mathematics: Theory and Practice Through Mapping***. Sandra L. Arlinghaus and Joseph Kerski, (2013), CRC Press. Linked video. Published July 2013,
4. The work above is the first volume in a series of books to be published by CRC Press in its series "**Cartography, GIS, and Spatial Science: Theory and Practice**." If you have an idea for a book to include, or wish to participate in some other way, please contact the series Editor, Sandra L. Arlinghaus.
5. Virtual Cemetery with William E. Arlinghaus; an ongoing project that continues in development run in the virtual world in parallel with the trust-funded model of a real-world cemetery.

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Institute of Mathematical Geography (IMaGe).

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Solstice **was a Pirelli INTERNETional Award Semi-Finalist, 2001 (top 80 out of over 1000 entries worldwide)**

One article in Solstice was a Pirelli INTERNETional Award Semi-Finalist, 2003 (Spatial Synthesis Sampler).

Solstice **is listed in the Directory of Open Access Journals maintained by the University of Lund where it is maintained as a "searchable" journal.**

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Congratulations to all *Solstice* contributors.

Remembering those who are gone now but who contributed in various ways to *Solstice* or to IMaGe projects, directly or indirectly, during the first 28 years of IMaGe:

Allen K. Philbrick | Alma S. Lach | Donald F. Lach | Frank Harary | William D. Drake | H. S. M. Coxeter | Saunders Mac Lane | Chauncy D. Harris | Norton S. Ginsburg | Sylvia L. Thrupp | Arthur L. Loeb | George Kish |

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