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Geovisualization for Pollinator Decision Support with Beescape NexGen

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Abstract:

Understanding and mitigating threats to pollinator health is a key contemporary spatial decision support challenge. Pollinators ensure that environments of all types are capable of regeneration, and they provide crucial services in support of modern agriculture to enable food security. Pollinator species face a range of human-induced threats, however, and urgent action is needed in order to characterize and remediate those threats (Potts et al. 2010). Spatio-temporal data are inextricable from this problem domain, as pollinators circulate in and intersect with a variety of ecological spaces.

We present here the results of iterative, user-centered design (UCD) of a new pollinator health spatial decision support geovisualization called *Beescape NexGen*. Multiple iterations of UCD and evaluation research began with a usability and utility assessment of an early prototype for *Beescape* that had been produced via a consulting arrangement with a software company, and which had not involved UCD practices for its initial development. The results of that prototype evaluation suggested that Beescape's original design goals required deeper elaboration with multiple stakeholder groups, which led to a comprehensive needs assessment study (Robinson et al. 2021). The results of that work set the design parameters (Fig. 1) for the development of *Beescape NexGen*, a geovisualization system for pollinator decision support.

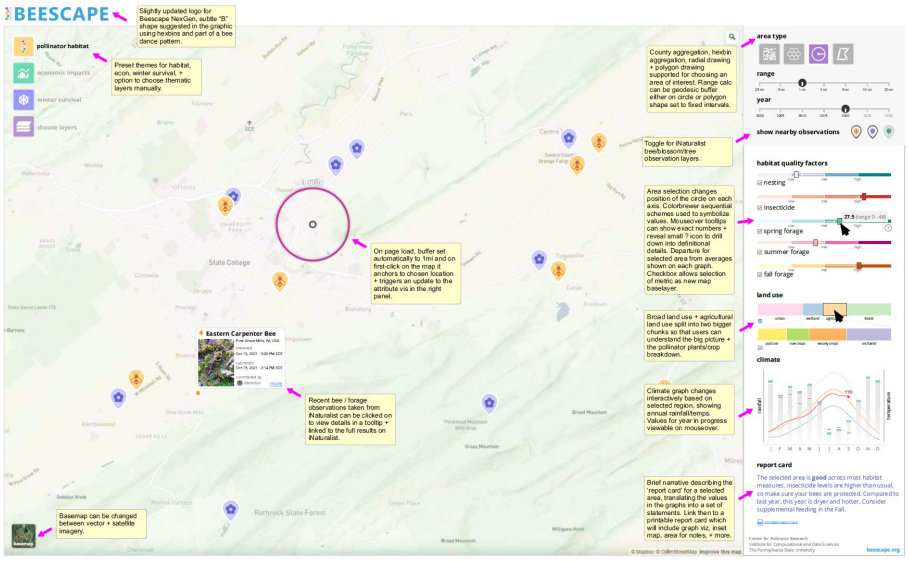

Figure 1. The Beescape NexGen interface concept was designed following results from a comprehensive needs assessment with stakeholders from beekeeping, agricultural, conservation, and science communities.

The Beescape NexGen platform integrates modelled pollinator habitat factors with recent citizen science observations of pollinator and plant species, and it also includes land use and climatological data. The Beescape NexGen interface allows users to select from multiple areal query types to look at spatio-temporal intersections across each data layer. Modelled habitat factors that describe seasonal resources, nesting suitability, and pesticide prevalence are key layers by which Beescape NexGen users can understand pollinator habitat suitability for a given area. For example, from the perspective

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of a beekeeper, one might use the Beescape NexGen interface to select a 5km range around a point that represents the location of one of their apiaries. Beescape NexGen can then reveal recent nearby citizen science observations of plants and pollinator species, as well as to provide comparison information regarding pollinator health and habitat measures versus what might be otherwise expected across the entire dataset extent.

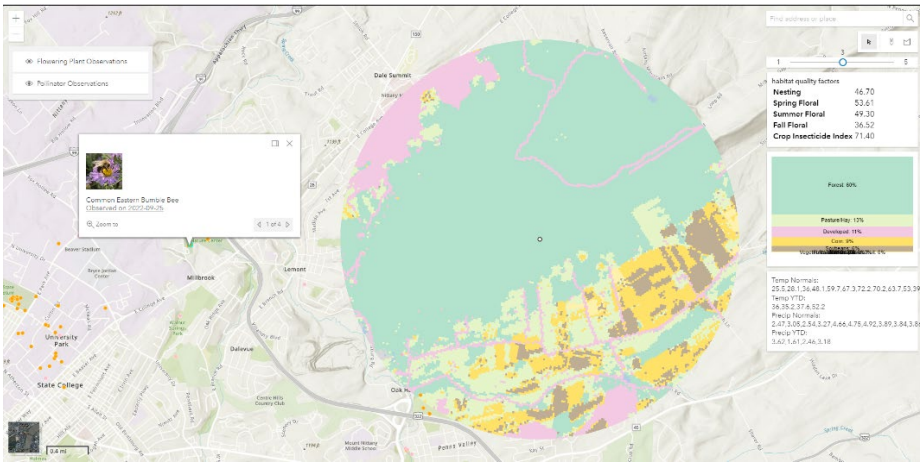

Figure 2. The Beescape NexGen prototype is in development, and major elements of the concept in Figure 1 are being implemented.

Several significant cartographic challenges remain for the development of Beescape NexGen (Fig. 2). Modeled habitat factors are presented as raster layers that can be queried and compared with landuse rasters. While overlay calculations are relatively easy to perform, it is difficult to visually represent overlays that include multiple rasters, and this is further complicated by the fact that our stakeholders often prefer their basemaps to show satellite imagery. New visual approaches are needed in order to interactively blend and visualize multiple rasters together. Queries can be used to generate graphs and pop-ups to show raster values from multiple layers, but understanding the spatial variation in these layers is crucial, and spatial context is not readily summarized by a table or pop-up.

In addition, the Beescape NexGen concept proposes a shareable report card feature. The development of an exportable report card presents challenges to distill the essence of a state in an interactive geovisualization to preserve its most essential aspects and to provide portable, actionable information that can be taken onwards and used by practitioners. This report card should be useful once it is fully disconnected from the Beescape NexGen interface, and it must also be easily shared via digital and printed formats. Sharing and saving results from interactive geovisualizations has presented an ongoing challenge for researchers.

We have also learned in earlier needs assessment research that stakeholders for this type of system are likely to question and debate the modelled environmental factors that they encounter in decision support systems like Beescape. Its interface needs to be able to prompt and accept this kind of feedback, building on earlier work to develop argumentation features in public participation mapping contexts (Rinner and Bird 2009).

A user study is planned for completion once the prototype for Beescape NexGen is fully implemented. In addition to evaluating its usability and utility, we will elicit ideas from users regarding potential solutions for the cartographic challenges listed above. Challenges like these are likely to emerge in other contemporary geovisualization contexts where complex spatial data need to be visualized and rendered actionable for stakeholder communities.

Acknowledgements

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