

**SUMMARY OF THE PROCEEDINGS OF THE
GEIS VECTORMAP WORKSHOP, OCTOBER 11-12, 2011**

SMITHSONIAN OFFICE OF POLICY AND ANALYSIS

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INTRODUCTION

VectorMap, a program under development within the Walter Reed Biosystematics Unit (WRBU), had reached the point at which it became necessary to think strategically about future directions and its place within the community of organizations, military and non-military, that addresses vectors and vector-borne diseases. To this end, VectorMap hosted a two-day workshop on October 11 and 12, 2011. The primary purpose was to solicit guidance on the shape of VectorMap's future from 36 experts representing 22 military and non-military organizations involved in the collection of vector-related data and the development of analytical tools that support the protection of humans from vector-borne diseases. The workshop was supported with a grant from the Global Emerging Infections Surveillance and Response System (GEIS), part of the Operations Division of the Armed Forces Health Surveillance Center (AFHSC). GEIS has been the core funder of the VectorMap team since 2006.

Specific goals of the workshop were to: understand the "state of play" in the community working on vectors and the distribution of vector-borne disease risks and their mitigation (called "the vector community" for purposes of this report); identify where VectorMap should invest its resources to best serve its customers; develop a roadmap for VectorMap's future; explore how the vector community can work together more synergistically and with greater collective impact; and start a conversation about the importance of vector surveillance data, how to improve its quality and interoperability, and how to address the priority gaps in data and understanding.

This report presents a summary of the discussions that occurred during the workshop.¹

¹ The full proceedings of the workshop are available in a separate report, "Proceedings of the GEIS VectorMap Workshop, October 11-12, 2011."

STATE OF PLAY IN THE VECTOR COMMUNITY

COMMON INTERESTS AND ENDEAVORS

- Data capture. Participants defined “data” to encompass species information, models, maps, other tools/products used to analyze and present data, and the results of analysis, including publications. Typically, the foci of the data being capture are narrowly defined, such as specific important disease vector mosquitoes and particular geographic areas. One result of this pattern of collecting is limited coverage of vectors other than mosquitoes and considerable variability in geographic coverage. Within this context, VectorMap is quite distinct for its global and multi-vector coverage.
- Data sharing, with strong support for open access with restrictions where appropriate. Incentives such as offering data submitters products that help them analyze the data they submit and credit for data submission are critical to getting people to submit data.
- Provision of resources and tools to support data capture, maintenance, and analysis, most notably data repositories, models (particularly occurrence, distribution, and risk/threat/hazard assessment and prediction), and maps.
- Growing use of collaborations to carry out work, advance the vector field more quickly and effectively, and leverage resources.

WHAT PARTICIPANTS SAID THEY WANT

- More and better data, particularly primary research-grade data. This was a priority across the board. However, the military also has a strong need for data and tools that support good decision making on protecting soldiers in the field from vector-borne diseases.
 - Of particular interest was data that fills priority gaps in vector species, underrepresented geographic areas, and temporal coverage; negative data (i.e. the absence of particular vector species); human infection; pesticide and drug resistance; and non-digital data that is inaccessible or at risk of loss. Some participants expressed strong support for the provision of data for the general public.
 - There was strong interest in pulling together some of the long-term datasets, such as those of mosquito control authorities and military base surveillance.
 - There was also strong interest in having models, whether developed by VectorMap or others, housed in VectorMap and made widely accessible for others to use.
- Good data management, particularly the application of standards for the metadata that should accompany data, with georeferencing a priority.

- Data sharing to the greatest extent possible, but with the ability to restrict data where appropriate.
 - There was support for time-limited restrictions when possible.
 - Many organizations currently encourage data sharing by offering incentives to data providers. Participants indicated interest in the idea of assigning GUIDs (i.e. unique digital identifiers) to data to enable citation, and in the PenSoft online publication of datasets being promoted by the Global Biodiversity Information Facility (GBIF), both new concepts to a number of participants.
- Popular resources/tools, including knowledge banks/repositories of high quality data; and analytic and decision-making tools such as models and maps, particularly ones that are dynamic and permit overlays of dimensions such as climate, host populations, human populations.
- Collaboration to support assembling the best datasets, avoid duplication and overlap, and leverage scarce resources. There was strong interest in developing a consortium to bring the vector community together to achieve synergies and better advance the vector field.

WHAT WORKS WELL

- Data capture, particularly from published and grey literature.
- Data management, particularly those instances where standards have been developed (e.g. GBIF and VectorMap). There was some interest in the idea of distributed databases vs. centralized ones.
- Data sharing, for which workshop participants expressed a high level of support. Four factors have been important in pushing data sharing: the compelling need to share, given the magnitude of needed data; incentives that reward sharing; funder requirements; and the ability to automatically harvest other people's online data.
- Resources/tools, principally maps and models.
- Collaboration, particularly to advance data capture, data sharing, and data management (standards). The partnership between VectorMap and the University of Kansas (via Townsend Peterson) has worked very well and has been very important. VectorMap has benefited greatly from its access to the university's distribution modeling expertise and from its maintenance of the VectorMap server.

WHAT WORKS LESS WELL

- Data capture, particularly with respect to the availability of sufficient primary research-grade data; filling priority gaps (e.g. insecticide resistance; veterinary entomology and parasitology; temporal data; human infection; vectors other than mosquitoes; and negative data); increased field collecting; and digitization of non-digital data.
- Data management, especially the lack of standards for recording and describing data and resistance to adopting standards where they exist. There was concern about the variability of data in terms of quality, metadata, resolution, and sustainability.
- Data sharing, which still faces considerable obstacles.
- There was discussion of a number of key misconceptions, such as military control over data and data use (much of the data the military uses comes from the private sector).
- Maps/models in terms of being static, subject to misinterpretation, and not having been validated.
- The absence of any community-wide group for the vector community.
- A lack of understanding of the importance of the vector field.

FUTURE DIRECTIONS IN THE FIELD

- Technological, analytical, and procedural aspects are evolving constantly, making it hard to keep up. Significant developments include: movement toward preserving a set of rules rather than the map or model; allowing anyone to access others' models; movement toward more dynamic models; the decreasing cost of digitization; acceleration in collaboration; growing use of distributed databases; and development of data management standards.

VECTORMAP'S CUSTOMERS AND THEIR NEEDS

- VectorMap serves two groups of customers: military and non-military.

MILITARY

- Military needs are primary and must be satisfied ahead of any other customers.
 - Four groups of military customers are key – theater entomologists; decision makers in the field; decision makers at headquarters; and non-specialists responsible for collecting specimens and implementing control measures. There was disagreement about which of these groups of customers is most important for VectorMap.
 - At an organizational level, VectorMap was seen as important to the following: AFHSC; US Army Public Health Command (USAPHC); National Center for Medical Intelligence (NCMI); Armed Forces Pest Management Board (AFPMB); Defense Threat Reduction Agency (DTRA); and WRBU of the Entomology Branch, Walter Reed Army Institute of Research (WRAIR).
- VectorMap needs to be linked more closely with WRBU's website, Defense Occupational Environmental and Health Readiness System (DOEHRS), and AFPMB Literature Retrieval System (LRS).

NON-MILITARY

- Non-military customers run the gamut, including government agencies at all levels, including the Smithsonian; intergovernmental organizations; non-governmental organizations; programs and organizations doing work similar to VectorMap's; and the general public.

VECTORMAP'S VALUE ADDED

STRENGTHS

- General
 - Mandate to help protect the health of US soldiers and the broader public health community by providing information, analyses, decision support, and other resources.
 - Global scope and multi-vector coverage.
 - Open access to VectorMap's data, with restrictions as needed.
 - Web-based architecture.
 - Insistence on quality control.
 - Flexibility and capacity to expand based on user needs.
- The range of resources available in one place, including:
 - Knowledge repository of and portal to high-quality, trustworthy, wide-ranging data, particularly multiple vectors, pathogens, hosts, reservoirs, location, time, and resolution.
 - Data management, particularly quality control; curation, identification, and biosystematics work; standards; and value adding to data, e.g. georeferencing and many information fields.
 - Functionalities, including accessible vector distribution models (with an emphasis on ecological niche models); pathogen distribution maps; VectorSurv for long-term surveillance data; maps of collection events (MosquitoMap, TickMap, SandflyMap); Mal-Area Calculator for quantifying overlap of vectors, pathogens, and humans; and GIS-like web architecture for visualizing the overlap of environmental layers relevant to vector-borne disease.
 - Decision support tools for deployments, with a focus on preparedness; rapid access to data; and support for protecting the health of soldiers in the field (e.g. vector identification and known and potential distribution).
 - Other: collaboration with the Smithsonian and others; incentives for data sharing; and association with WRBU, which has an excellent reputation for mosquito systematics study and other resources.

LIMITATIONS

- VectorMap is not fully operational, one consequence of which is that it not well-known, even within DoD, and has not had time to build a track record to prove its value or to build supportive constituencies.
- Uncertainties about VectorMap, e.g. exactly who it serves and how it should serve them; where it should be moving in the future; what its target product profile should be; whether it is sustainable; and what its organizational structure and position within DoD are.
- Data capture, including inadequate data coverage of certain vectors (ticks and sand flies) and geographic areas, and post-1985 and real-time data.
- Data submission, including a complicated and sometimes slow process for adding new data.
- Functionalities, e.g. they do not reflect seasonal and yearly dynamics but often are based on multi-year averages of habitat suitability for occurrence (not abundance); lack of model validation; insufficient space for expert opinion and country occurrence maps; and, according to some participants, a centralized vs. distributed database.
- Usability, in particular, the GIS-like platform that offers increased functionality but is not always easy to use; an interface that could be better designed; and access problems for some users that result from VectorMap's software (Silverlight) and size of the bandwidth issues.
- Some overlap with the work and resources of other organizations because of limited time for collaboration.
- Limited resources in terms of full-time paid staff, funds, and partners.
- Uncertain organizational structure and position with DoD, and failure to capitalize on the relationship with WRBU.
- Sustainability, particularly the need to diversify funding sources.

FUTURE DIRECTIONS FOR VECTORMAP

EXISTING VECTORMAP PLANS

- Strengthen existing features: expand the database; complete the tools under development (VectorSurv, mark-up collaboration tools, and a raster area calculator tool like the Mal-Area Calculator, with scaling up to provide potentially thousands of overlays); provide non-spatial data visualization tools (graphing vs. mapping); incorporate the potential impact and implications of climate change; and validate the models.
- Add new features: mobile capabilities (Smartphone, apps, and mark-up capability); a host mapping service; at least one ecological niche model for each major vector species, and improvements to these models by validation and other means; reporting of predicted vector hazard for a selection of sensitive/vulnerable locations; possibly a shift to a distributed database model; and incorporation of layers or links to resources that provide forecasts of disease risks.
- Marketing to raise VectorMap's visibility, including incorporating VectorMap into military entomologist and other training and developing a systematic outreach plan.

RECOMMENDATIONS/SUGGESTIONS FROM WORKSHOP PARTICIPANTS

- Customers: maintain a focus on the military as the primary user, but also serve non-military users.
 - Open questions: Who are VectorMap's customers within the military? Should non-military customers, including the public at large, be served?
- Roles
 - Existing
 - Data capture and repository, including preservation of expert opinion maps; expanded data collecting to include vertebrate and reptile threats (one-stop threat shop); pesticide and drug resistance; human cases; expansion of the global vector distribution data by pulling in large datasets from around the world (which will also strengthen preparedness); expansion into collection of data on other vectors, etc. when collecting sand flies and *Anopheles* mosquito specimens; multi-vector and global coverage; historical and real-time data coverage.
 - Data management, with continued emphasis on standards; quality control; and continued species identification, including the development of tools that allow non-specialists in the field to make identifications, e.g. by employing extremely high resolution imaging camera technology.

- Provision of a range of resources/tools – models, e.g. ecological niche, hazard/risk assessment, and prediction; maps, including ones that show where organizations are doing projects, with links to a contact person and a brief description of the work being done; risk assessment tools for looking at different components of what geographic risk might be; development of transmission risk maps for DoD planning and operations; synthesis and analysis of data over time; and fusing of VectorMap data with climate information to see how it varies over time.
 - Suggested new features: operate a vector alert system; and forensic evaluation of unexpected disease occurrences (natural vs. malicious).
 - Open questions: What roles should VectorMap play, in particular, what should VectorMap do itself and what should it leave to others? Should VectorMap focus on data capture, management, and access, and leave the value adding to others, just providing a home for the results of their work; or should it pursue both roles, as well as being a home for value-added products developed by others? Should VectorMap be a one-stop or multi-channel shop?
- Collaboration
 - Planning collaboration from the start as VectorMap builds itself into a data management and analysis system.
 - Connect with the Malaria Atlas Project (MAP).
 - Engage with the Vector Ecology and Control Network (VECN) with respect to capturing data from the literature; providing VECN with opportunities to mine VectorMap for bionomic behavior information; and joint work on epi data collection.
 - Take a leadership role in forming a consortium to explore and implement collaboration within the vector community.
- Sustainability: define it broadly to encompass not just diversification of funding streams, e.g. fee-based services, but also direct in-kind contributions; partnerships and collaborations to leverage resources; creation of a support and advocacy network, e.g. through marketing and engagement of users in developing VectorMap's resources/tools; leveraging of VectorMap's reputation for excellence and association with WRBU; and dissemination of evidence of VectorMap use to prove its value added.
- Other points
 - Pursue partnerships with the military and civilian sectors both as users and contributors (data and model providers), but with the military always the primary target audience.
 - Test VectorMap with diverse users or potential users.

- Get user feedback.
- Explore the best method for rolling VectorMap out: build it and they will come; or use the Google model of rolling out tools/features before full development and get input from users.
- Ensure that services for the target audience work well before taking on anything else.
- Figure out how to maintain quality of and trust in data as VectorMap scales up data capture.

NEXT STEPS

AS STATED BY VECTORMAP

- Phase 1: establish a working group of core military players to define and answer key questions about VectorMap's future (who the military customers are and what they need, what VectorMap's target product profile should be, and how VectorMap can be sustainable); begin to tie the military players together; and develop a strategic plan.
- Phase 2: expand VectorMap beyond DoD.

AS SUGGESTED BY WORKSHOP PARTICIPANTS

- Convene a workshop of key military commands, etc. to answer the key questions raised at the workshop, provide guidance, and decide whether and how to better support VectorMap's development and roll-out. In parallel and from the beginning, engage with non-military customers and partners to understand the opportunities and needs.
- Collapse boundaries wherever possible:
 - Convene a collaboration workshop/working group of stakeholders/strategic advisory group/advisory board to get down to the nuts and bolts, including definition of the interface between military and non-military partners/collaborators, and development of VectorMap for both audiences.
 - Establish a consortium, beginning with the list of possible players generated at the workshop plus others such as the National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), and World Health Organization (WHO); and people and groups who have experience developing consortia. The military and/or the Smithsonian should take on the leadership role.
- Diversify VectorMap's funding stream.
- Other suggestions:
 - Define clear outputs with milestones and due dates.
 - Develop a plan for assessing how useful VectorMap has been for decision making and use in the field.
 - Understand who currently uses VectorMap, how, and why.
 - Involve users in developing VectorMap products, including testing VectorMap with diverse actual or potential users.
 - Raise awareness of VectorMap.

- Implement the following quick fixes:
 - Build the database by pulling in datasets that are already digital and being shared and that fill in the big holes, and prioritize the capture of existing isolated or analog data.
 - Create a Darwin Core extension for vector data and make it a standard with TDWG.
 - Move to a distributed database model.
- To improve the usefulness of maps and models over the longer term, incorporate:
 - Continuous updating.
 - Nested-scale analysis.
 - Time-specific analyses to determine the times when the same mosquito is more or less severe in the same location.
 - Dispersal.
 - Links to host distributions.
 - Forensics.