

Proposal for Creation and Publication of Invertebrate Database and GIS Information

Submitted by:

Dr. James E. Parham
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Submitted in response to HePS Commodity Code # 920-29-00-000001

Solicitation #: Q2011000955

Submitted to:

Division of Forestry and Wildlife
Department of Land and Natural Resources
State of Hawaii

Introduction:

This proposal from Bishop Museum is in response to the request from the Division of Forestry and Wildlife (DOFAW) for the Creation and Publication of Invertebrate Database and GIS Information. Bishop Museum is uniquely positioned to accomplish this task in a timely and professional manner. Bishop Museum has highly experienced staff and supports the overall goal of this work.

The proposal is organized by directly following the description for the solicitation in Commodity Code (#920-29-00-000001) for the Solicitation #: Q2011000955 in HePS. The following information was requested in the solicitation and is provided in the following sections.

- 1) *Proposal shall be submitted through the Hawaii Electronic Procurement System (HePS).*
- 2) *At the time of awarding, the selected vendor shall be in compliance with Hawaii State Statutes and Regulations through the Hawaii Compliance Express (HCE). **Section 1***
- 3) *Provide narrative **Section 2** and timeline **Section 3** for the proposed work to accomplish tasks listed in the scope of work for the invertebrate database and associated Geographic Information System (GIS) layers.*
- 4) *Attach conceptual diagram of proposed multi-spatial invertebrate database. **Section 4***
- 5) *Provide list of project team members and their areas of expertise. **Section 5***
- 6) *Qualifications (please attach to your proposal): **Section 6***
 - a. *Documented experience with invertebrate species and data in Hawaii.*
 - b. *Documented experience with designing and developing relational databases.*
 - c. *Documented experience in Geographic Information System (GIS) analysis and database integration.*
 - d. *Documented history/background of successfully meeting project requirements and deadlines while working collaboratively with state and/or federal agencies.*
 - e. *Contractor must be familiar with online and offline digital insect data collections at Bishop Museum.*
 - f. *Contractor must have the authority to access and release information from online and offline digital insect data collections at Bishop Museum.*

Please include at least two references for past projects and their final reports of team members associated with each of the areas of expertise (a-d) above. Provide description of expertise with the different online and offline insect databases at Bishop Museum (e) and documentation of the authority to access and release the information (f). The overall cost for the proposed project is \$49,951 and includes all travel, meetings, salary, benefit, and incidental expenses (**Section 7**). The project will be completed by June 30, 2012.

Section 1: Compliance with governmental rules and regulations

Bishop Museum is in compliance with all governmental rules and regulations.

Section 2: Project Narrative

Narrative for proposed work to accomplish tasks listed in the scope of work. Tasks are listed in italics prior to the narrative on how to accomplish each task.

- 1) *Design and develop a spatially-hierarchical, geo-referenced database for invertebrate species throughout the Hawaiian Islands. The relational database will contain biological, taxonomical, ecological, physical, geographical, and source data including, but not limited to: temporal data (time, date), environmental data (weather conditions, temperature, wind, precipitation, moon phase), identification data (species, taxonomic classification, determined by), location data (locality, watershed, place name, elevation, GPS coordinates), habitat data (habitat type, habitat composition, host plant, plant-part), ecological data (behavior, associations with other organisms, parasitism, predation), land manager data (land manager, permit number(s), observer data (collector/observer, source, published, permission to publish required), museum data (location of specimen, accession ID).*

A geo-referenced database will be developed that stores collection and habitat information about Hawaiian invertebrates. The Hawaii Invertebrate Database will include a range of attribute fields for biological, taxonomical, ecological, physical, geographical, and source data of each invertebrate survey and also link to GIS layers that provide the sampling locations spatial relationship with the surrounding environment.

The database design will incorporate relational tables nested in a hierarchical fashion were possible so that scalable analyses of species distribution and their associated habitat will be strongly supported. Some examples of the hierarchical data structure include spatial hierarchies (point to local to regional to island habitats), taxonomic hierarchies (species to phylum), ecological (specific relationships to general functions).

- 2) *The invertebrate database will integrate available data from multiple existing databases which contain invertebrate data. A translation and import process will be developed to simplify collection of outside invertebrate data collections. Bishop Museum has been housing invertebrate data from State Collecting Permits. As a first step, the contractor will collect, translate, and import both online and offline digital insect collection data from Bishop Museum into the newly created invertebrate database.*

Bishop Museum currently houses a number of invertebrate data collections in a number of different databases. A translation and import process will be developed that will capture the fundamental collection information from each database while preserving the source location

information. At a minimum, the species, collection information (location, date, method, collector), and museum ID will be gathered and then imported into the database. This process will be useful for the collection of additional invertebrate information from other databases for aiding in integrating data in the future.

The importing of data from the Bishop Museum data collection will result in many of thousands (preliminary estimate of 30,000 species records) being added to the DOFAW invertebrate database. The location data can be used to link the information to spatial habitat characteristics.

- 3) *The focus of this contract is for the design and development of the backend of the invertebrate database that will be housed at DLNR. The database should be multi-user capable or upscaleable to multi-user capabilities with DLNR's longterm objective of supporting a web-based, searchable product that is freely accessible to the public, and which has the potential to grow and refine as additional data become available.*

The preliminary database design will be created in MS Access and then moved to a multi-user database in consultation with DOFAW biologists. MS SQL Server or PostgreSQL are two likely options depending on needs and requirements of DOFAW staff. MS SQL Server or PostgreSQL would satisfy the need for a multi-user database and support web access for future development needs.

- 4) *Public accessibility to sensitive data, such as specific locations of T/E species, should be limited by security features.*
- 5) *Voucher specimen photos and literature references will also be included and/or linked in the database.*
- 6) *Create project specific data entry tables, queries, forms, and reports to support management of native invertebrate research and collecting permits (scientific collection permits). The selected vendor shall lead meetings with DOFAW representatives to assure suitability of the invertebrate data entry tables, queries, forms, and reports.*

The development of specific project appropriate data entry and summary reports is an important part of any database development effort. Dr. Parham and Dr. Pyle have extensive experience developing data entry forms and output reports to support a range of management needs.

The specific requirements of for security of sensitive data, and the storage of voucher specimen photos and literature references will be included in the database design and will be discussed in meetings with DOFAW staff to make sure it meets agency needs. Dr. Parham will use modern web meeting software to allow a range of participation from DOFAW and Bishop Museum staff from different locations.

Section 3: Project Timeline

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8
Collect invertebrate data to include in the database	X							
Develop preliminary database design	X	X						
Meetings with DOFAW on preliminary design		X	X					
Finalize database design			X	X				
Construct database			X	X	X	X		
Lead meetings with DOFAW on multi-spatial habitat classification			X	X	X			
Finalize multi-spatial habitat classification				X	X	X		
Compile existing data into database					X	X	X	X
Complete and deliver database						X	X	X

Section 4: Conceptual diagram of proposed multi-spatial invertebrate database

Developing a multi-spatial classification system for Hawaii invertebrates is an important step in understanding the relationship between habitat quality, habitat distribution, and invertebrate species occurrences. In a one spatial classification, the sampling area can be divided into point location, immediate surrounding area, regional characteristics, and the island characteristics. An additional spatial classification can also be applied the views the landscape in context of its watershed characteristics and is dividing into local sample area, subbasin, watershed, region, and inland. This multi-spatial classification method would make the DOFAW invertebrate database comparative with the DAR stream database to facilitate inter-department data sharing efforts.

The general database schema for the two linked spatial hierarchies is shown in Figure 1. It includes the proposed linkages between required tables as well as multi-spatial overlap. The proposed classification areas allow habitat delineation and invertebrate collections to be appropriately segregated or aggregated into similar units as needed for the scale of the management issue. This ability supports the requested ability to compare and summarized invertebrate habitat data statewide.

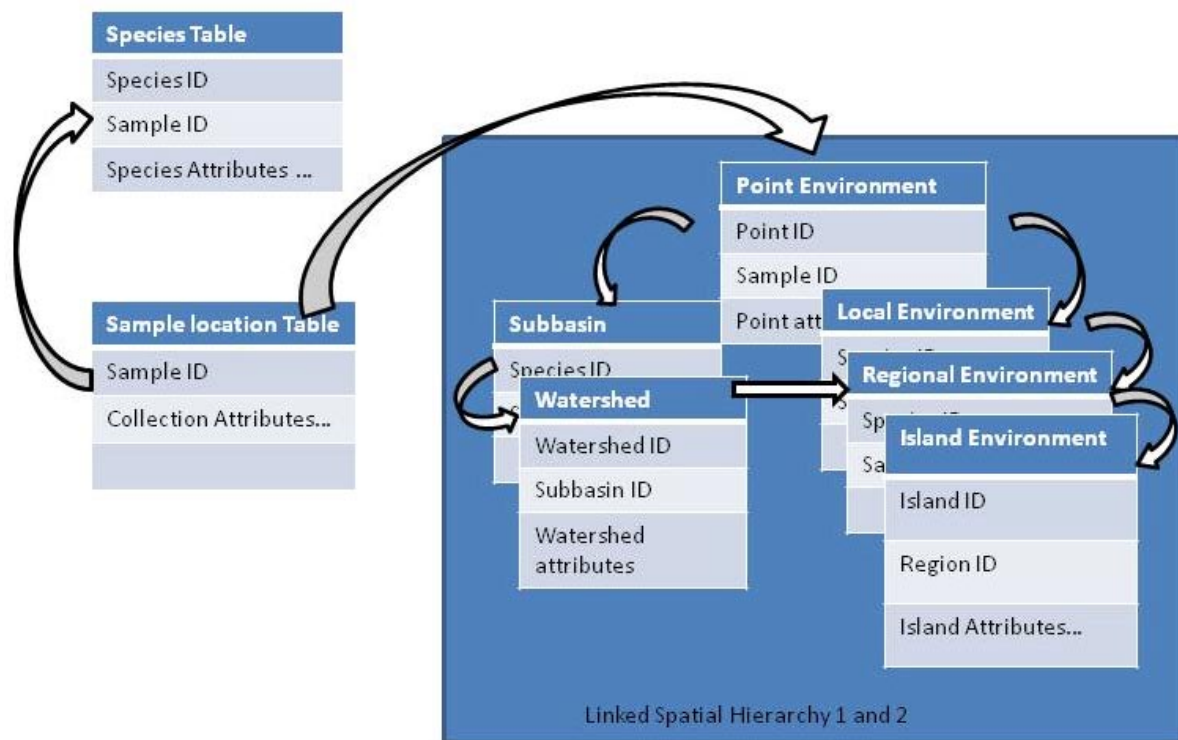


Figure 1. Proposed database schema for the multi-spatial aspect invertebrate database. Final schema will be developed in consultation with DOFAW staff. Additional tables for taxonomic information, collection information, biographical information, etc. are not shown.

Section 5: List of team members and qualifications:

Dr. James E. Parham

Hydrologist and Aquatic Biologist
Bishop Museum, Honolulu, HI, 96817

Dr. Parham is currently a research hydrologist and aquatic biologist with Bishop Museum in Hawaii. Dr. Parham's expertise is in the area of the development of Geographic Information System (GIS) models for use in hydrological and habitat availability studies. GIS-based multi-spatial models have been created by Dr. Parham which addresses many important components of hydrology, geomorphology, and ecology to allow for improved use of water while protecting the natural environment. In addition to the GIS modeling expertise, he has extensive experience in database design, development, and implementation within an organization. The databases provide an effective way to integrate the results of the more complex GIS models with the field survey information.

In terms of field experience, Dr. Parham has wide ranging experience throughout the continental United States and has a strong focus in Hawaiian and Pacific Islands and has studied habitats, distribution, and habitat connectivity of the native animals. During the course of these field investigations, Dr. Parham has worked in collaboration with a wide variety of people and institutions, including international, federal, state, and municipal governmental agencies, university researchers, NGO's, private entities, and Native American groups. He has taught at the university level, led field crews, advised students, moderated conferences, facilitated group modeling efforts, and given interviews for newspaper and radio media. He has been responsible for project management including grant acquisition, budgeting and purchasing, employee hiring and supervision, and project completion, presentation, and publication.

Most recently, Dr. Parham has completed the development of the Hawaiian Stream Habitat Evaluation Protocol which provides a systematic method to assess stream animal habitat. Also, Dr. Parham was the lead author on a 4,500 page, ten volume *Atlas of Hawaiian Watershed and Their Aquatic Resources* published in collaboration with the Hawaii Division of Aquatic Resources, Bishop Museum, and the US Fish and Wildlife Service. He has developed automated database reporting tools for characterizing watersheds and summarizing results from multiple different survey methods. In the past few years, Dr. Parham has jointly authored results for over 20 different surveys of aquatic animals. Overall, Dr. Parham's goal is to design and deliver coherent projects using the latest technologies to provide solutions to difficult resource management conflicts.

Dr. Richard L. Pyle

Database Coordinator and Ichthyologist
Bishop Museum, Honolulu, HI, 96817

Dr. Pyle is the database coordinator for the Department of Natural Sciences at Bishop Museum. He oversees, designs, and develops databases for a range of disciplines including entomology databases. His fields of expertise involve the development of computer database systems (and associated data standards) for managing biodiversity information, the taxonomy and biogeography of coral-reef fishes, and the use of advanced diving technology to document biodiversity inhabiting deeper regions of tropical coral reefs.

He earned his PhD under the guidance of John E. Randall, and has worked in the Department of Natural Sciences at Bishop Museum since 1986. He has authored over a hundred scientific, technical, and popular articles, has been featured in dozens of documentary films, and has received a number of significant awards for his achievements.

Dr Pyle is actively involved in developing data standards for support of biodiversity informatics and development of relational databases. He is actively involved in the international Biodiversity Information Standards group (aka, Taxonomic Databases Working Group; TDWG), and he serves as Convener for the Taxon Names & Concepts working group. He also established and

continues to develop ZooBank (<http://zoobank.org>; the international registry for all new animal names), and is one of the primary architects of the emerging "Global Names Architecture" -- an architecture for interlinking the world's biodiversity data through taxon names and concepts, currently in development through a partnership between major taxonomic data initiatives (including PBIN, GBIF, Encyclopedia of Life, Catalog of Life, and many others). His professional service in this context includes:

2008-Program Committee, International Conference on Biodiversity Informatics (eBiosphere)
2007-present Steering Committee, World Registry of Marine Species (WoRMS)
2007-present Member, Informatics Advisory Board, Encyclopedia of Life (EoL)
2006-present Commissioner, International Commission on Zoological Nomenclature (ICZN)
2006 Active Participant in the Global Biodiversity Information Facility (GBIF) Globally Unique Identifiers (GUID) Workshop Series
2005 Active Participant in the development of the Taxonomic Concept Schema (TCS),

Section 6: Qualification documentation:

The following are a selected list of publications that demonstrate expertise in the various areas. At least 3 reports are provided in each section. More publications by Dr. Parham and Dr. Pyle can be provided in each category if necessary.

a. Documented experience with invertebrate species in Hawaii.

Parham, J.E., G.R. Higashi, R.T. Nishimoto, S. Hau, D.G.K. Kuamo'o, L.K. Nishiura, T.S. Sakihara, T.E. Shimoda and T.T. Shindo. 2009. The Use of Hawaiian Stream Habitat Evaluation Procedure to Provide Biological Resource Assessment in Support of Instream Flow Standards for East Maui Streams. Division of Aquatic Resources and Bishop Museum. Honolulu, HI. 104 p. **Includes information of the invertebrate species found in streams**

Parham, J.E., G.R. Higashi, E.K. Lapp, D.G.K. Kuamo'o, R.N. Nishimoto, S. Hau, D.A. Polhemus, J.M. Fitzsimons, and W.S. Devick. 2008. Atlas of Hawaiian Watersheds and their Aquatic Resources. Division of Aquatic Resources, DLNR, Hawaii. 5 volumes. 4,500+ pgs. **Includes information on the extent of invertebrate stream species surveyed in them for over 400 watershed statewide**

Pyle, RL. and A. Allison. 2004, 2005, 2006. Development of geographic, taxonomic, specimen, and image data for online access. Pacific Basin Information Node (PBIN) of the National Biological Information Infrastructure (NBII).

b. Documented experience in designing and developing relational databases.

- Parham, JE.** 2008. Development of a Database Modeling Tool to Predict Aquatic Species Distributions within Hawaiian Streams. Division of Aquatic Resources, DLNR, State of Hawaii. 56 p.
- Parham, JE.** 2008. Development of Database Reporting Tools and Results from DAR Rapid Bioassessment Surveys Conducted on Nine North Shore Streams, Oahu, Hawaii. Division of Aquatic Resources, DLNR, State of Hawaii. 55 p.
- Kuamo'o, D. G. K., G. R. Higashi, and **J. E. Parham.** 2007. Structure of the Division of Aquatic Resources Survey Database and use with a Geographic Information System. In: Biology of Hawaiian Streams and Estuaries, N. L. Evenhuis & J. M. Fitzsimons, eds. Bishop Museum Bulletin in Cultural and Environmental Studies 3:315-322.
- Pyle, RL.** 2007. Development of a Species Portal for Pacific Islands, Pacific Basin Information Node (PBIN) of the National Biological Information Infrastructure (NBII).
- Pyle, RL.** and S. Blum. 2007. Catalog of Fishes 2.0: Improving Services and Preparing for Community Participation, National Science Foundation (NSF DBI-0642321).
- Pyle, R.L.** 2004. Taxonomer: a relational data model for managing information relevant to taxonomic research. *Phyloinformatics*, **1**:1-54

c. Documented experience in Geographic Information System (GIS) analysis and database integration.

- Parham, J.E.,** G.R. Higashi, R.T. Nishimoto, S. Hau, D.G.K. Kuamo'o, L.K. Nishiura, T.S. Sakihara, T.E. Shimoda and T.T. Shindo. 2009. The Use of Hawaiian Stream Habitat Evaluation Procedure to Provide Biological Resource Assessment in Support of Instream Flow Standards for East Maui Streams. Division of Aquatic Resources and Bishop Museum. Honolulu, HI. 104 p.
- Kuamo'o, D. G. K., G. R. Higashi, and **J. E. Parham.** 2007. Structure of the Division of Aquatic Resources Survey Database and use with a Geographic Information System. In: Biology of Hawaiian Streams and Estuaries, N. L. Evenhuis & J. M. Fitzsimons, eds. Bishop Museum Bulletin in Cultural and Environmental Studies 3:315-322.
- Parham, JE.** 2002. Spatial models of Hawaiian streams and stream fish habitats. Ph.D. Dissertation. Louisiana State University. Internet location: <http://etd.lsu.edu:8085/docs/available/etd-0419102-000538/>

d. Documented history/background of successfully meeting project requirements and deadlines while working collaboratively with state and/or federal agencies.

Parham, J.E., G.R. Higashi, R.T. Nishimoto, S. Hau, D.G.K. Kuamo'o, L.K. Nishiura, T.S. Sakihara, T.E. Shimoda and T.T. Shindo. 2009. The Use of Hawaiian Stream Habitat Evaluation Procedure to Provide Biological Resource Assessment in Support of Instream Flow Standards for East Maui Streams. Division of Aquatic Resources and Bishop Museum. Honolulu, HI. 104 p.

Parham, J.E., G.R. Higashi, E.K. Lapp, D.G.K. Kuamo'o, R.N. Nishimoto, S. Hau, D.A. Polhemus, J.M. Fitzsimons, and W.S. Devick. 2008. Atlas of Hawaiian Watersheds and their Aquatic Resources. Division of Aquatic Resources, DLNR, Hawaii. 5 volumes. 4,500+ pgs.

Parham, J.E. 2008. Development of a Database Modeling Tool to Predict Aquatic Species Distributions within Hawaiian Streams. DAR, DLNR, State of Hawaii. 56 p.

e. Contractor must be familiar with online and offline digital insect data collections at Bishop Museum.

Dr. Pyle is the database coordinator for the Department of Natural Sciences at Bishop Museum. He oversees, designs, and develops databases for a range of disciplines including entomology databases. His field of expertise involves the development of computer database systems (and associated data standards) for managing biodiversity information. He is very familiar with all data collections at the Bishop Museum

f. Contractor must have the authority to access and release information from online and offline digital insect data collections at Bishop Museum.

Both Dr. Parham and Dr. Pyle are employee's of the Bishop Museum. Dr. Pyle is the database coordinator for the entomology (insect) databases and has access to the data contained within the databases. The Hawaii Biological Survey (HBS) of Bishop Museum is an ongoing natural history inventory of the Hawaiian archipelago. It was created to locate, identify, and evaluate all native and non-native fauna and flora within the state, and to maintain the reference collections of that biota for a wide range of uses. In coordination with related activities in other federal, state, and private agencies, the HBS gathers, analyzes, and disseminates biological information necessary for the wise stewardship of Hawaii's rich natural heritage. Data for the DOFAW database will include all information associated with State Collection permits and will include collection information, taxonomic descriptions, as well as references to the Museum's collection and specimen identification numbers.

Section 7. Project Budget

	Total Budget
Salary for Dr. Parham and Dr. Pyle	\$30,600
FICA/Fringe Benefits (@ 48.4%)	\$14,810
Indirect Costs (@ 10% over direct costs)	\$4,541
Total Costs	\$49,951

Proposed budget does not include any licensing costs or fees associated with software required at DOFAW to maintain the database.