

House District _____

Senate District _____

**THE TWENTY- FOURTH LEGISLATURE
HAWAI'I STATE LEGISLATURE
APPLICATION FOR GRANTS & SUBSIDIES
CHAPTER 42F, HAWAI'I REVISED STATUTES**

Log No: 63-0

For Legislature's Use Only

Type of Grant or Subsidy Request:

GRANT REQUEST – OPERATING

GRANT REQUEST – CAPITAL

SUBSIDY REQUEST

STATE DEPARTMENT OR AGENCY RELATED TO THIS REQUEST (LEAVE BLANK IF UNKNOWN): _____

STATE PROGRAM LD. NO. (LEAVE BLANK IF UNKNOWN): _____

1. CO-APPLICANT INFORMATION:

Hawai'i Beekeepers' Association
3081G Paty Drive
Honolulu, Hi 96822

University of Hawai'i, Department of Geography
2424 Maile Way
Honolulu, Hi 96822

CONTACT PERSONS

NAMES: MICHAEL M. KLIKS, HBA

MATTHEW McGRANAGHAN, UH DEPT. OF GEOGRAPHY

Titles: PRESIDENT/CONSULTANT/ ASSOC PROFESSOR

Phone # 988-72-3/956-~~2592~~ 7092

Fax # 988-5161/ 956-3512

e-mail mmkliks@hawaii.rr.com/ matt@hawaii.edu

3. TYPE OF BUSINESS ENTITY: HAWAI'I BEEKEEPER'S ASSOCIATION

NON PROFIT CORPORATION

FOR PROFIT CORPORATION

LIMITED LIABILITY COMPANY

SOLE PROPRIETORSHIP/INDIVIDUAL

4. FEDERAL TAX ID #: _____

5. STATE TAX ID #: _____

6. SSN (IF AN INDIVIDUAL): _____

7. DESCRIPTIVE TITLE OF APPLICANT'S REQUEST:

RETROSPECTIVE AND PROSPECTIVE GIS MAPPING OF FERAL HONEY BEE COLONIES AND SWARMS ON O'AHU FROM 1997 TO 2010 AS A TOOL FOR AREA WIDE SUPPRESSION OF VARROA DESTRUCTOR: DATA INPUT AND ANALYSES AND FIELD APPLICATION OF GLOBAL POSITION SATELLITE SYSTEM.

8. FISCAL YEARS AND AMOUNT OF STATE FUNDS REQUESTED:

FY 2008-2009: **\$66,700**

9. STATUS OF SERVICE DESCRIBED IN THIS REQUEST:

NEW SERVICE (PRESENTLY DOES NOT EXIST)

EXISTING SERVICE (PRESENTLY IN OPERATION)

SPECIFY THE AMOUNT BY SOURCES OF FUNDS AVAILABLE AT THE TIME OF THIS REQUEST:

STATE \$ _____

FEDERAL \$ _____

COUNTY \$ _____

PRIVATE/OTHER \$2,000 FROM HBA.

NAME AND TITLE OF REPRESENTATIVE: _____

MICHAEL M. KLIKS, PRESIDENT
NAME AND TITLE

1/30/2008
DATE SIGNED

AUAUTHORIZED SIGNATURE

MATTHEW McGRANAGHAN, ASSOCIATE PROFESSOR /CONSULTANT
NAME AND TITLE

DATE SIGNED

House District _____ Senate District _____		THE TWENTY-FOURTH LEGISLATURE HAWAII STATE LEGISLATURE APPLICATION FOR GRANTS & SUBSIDIES CHAPTER 42F, HAWAII REVISED STATUTES		Log No: _____ For Legislature's Use Only
Type of Grant or Subsidy Request <input checked="" type="checkbox"/> GRANT REQUEST - OPERATING <input type="checkbox"/> GRANT REQUEST - CAPITAL <input type="checkbox"/> SUBSIDY REQUEST				
STATE DEPARTMENT OR AGENCY RELATED TO THIS REQUEST (LEAVE BLANK IF UNKNOWN): _____ STATE PROGRAM I.D. NO. (LEAVE BLANK IF UNKNOWN): _____				
1. CO-APPLICANT INFORMATION: Hawaii Beekeepers' Association 3081G Paly Drive Honolulu, HI 96822 University of Hawaii, Department of Geography 2424 Maki Way Honolulu, HI 96822		CONTACT PERSONS NAMES: MICHAEL M. KLIKS, HBA MATTHEW McGRANAGHAN, UH DEPT. OF GEOGRAPHY Titles: PRESIDENT/CONSULTANT/ ASSOC PROFESSOR Phone # 988-72-3/956-3512 Fax # 988-5161/ 956-3512 e-mail mmkliks@hawaii.tr.com/ matt@hawaii.edu		
3. TYPE OF BUSINESS ENTITY: HAWAII BEEKEEPER'S ASSOCIATION <input checked="" type="checkbox"/> NON PROFIT CORPORATION <input type="checkbox"/> FOR PROFIT CORPORATION <input type="checkbox"/> LIMITED LIABILITY COMPANY <input type="checkbox"/> SOLE PROPRIETORSHIP/INDIVIDUAL		7. DESCRIPTIVE TITLE OF APPLICANT'S REQUEST: RETROSPECTIVE AND PROSPECTIVE GIS MAPPING OF FERAL HONEY BEE COLONIES AND SWARMS ON OAHU FROM 1997 TO 2010 AS A TOOL FOR AREA WIDE SUPPRESSION OF VARROA DESTRUCTOR. DATA INPUT AND ANALYSES AND FIELD APPLICATION OF GLOBAL POSITION SATELLITE SYSTEM.		
4. FEDERAL TAX ID # _____ 5. STATE TAX ID # _____ 6. SSN (IF AN INDIVIDUAL): _____		8. FISCAL YEARS AND AMOUNT OF STATE FUNDS REQUESTED: FY 2008-2009: <u>\$69,700</u>		
9. STATUS OF SERVICE DESCRIBED IN THIS REQUEST: <input checked="" type="checkbox"/> NEW SERVICE (PRESENTLY DOES NOT EXIST) <input type="checkbox"/> EXISTING SERVICE (PRESENTLY IN OPERATION)		SPECIFY THE AMOUNT BY SOURCES OF FUNDS AVAILABLE AT THE TIME OF THIS REQUEST: STATE \$ _____ FEDERAL \$ _____ COUNTY \$ _____ PRIVATE/OTHER \$2,000 FROM HBA		
AUTHORIZED SIGNATURE: _____ AUTHORIZED SIGNATURE: _____		NAME AND TITLE: MICHAEL M. KLIKS, PRESIDENT NAME AND TITLE: MATTHEW McGRANAGHAN, ASSOCIATE PROFESSOR /CONSULTANT DATE SIGNED: 1/30/2008 DATE SIGNED: 1/30/2008		

Will send in original signed page.

BUDGET REQUEST BY SOURCE OF FUNDS
(Period: July 1, 2008 to June 30, 2009)

APF KLIKS/McGRANAGHAN 2008-2009

BUDGET CATEGORIES	Total State Funds Requested (a)	(b)	(c)	(d)
A. PERSONNEL COST				
1. fees, per diem consultants/contractors	56,700	MMK, GRAD ASST		
2. Payroll Taxes & Assessments	0			
3. Fringe Benefits	0			
TOTAL PERSONNEL COST	56,700			
B. OTHER CURRENT EXPENSES				
1. Airfare, Inter-Island	0			
2. Insurance	0			
3. Lease/Rental of Equipment	0			
4. Lease/Rental of Space	0			
5. Staff Training	3,500	BEEKEEPERS		
6. Supplies	1,150	OFFICE, FIELD		
7. Telecommunication	750	HBA OFFICE, CELL		
8. Utilities	360	HBA OFFICE		
9. GIS SOFTWARE	550	HBA		
10. TRANSPORTATION COSTS	1,500	FIELD WORK		
11. GENERAL SUPPORT COSTS	1,740	FIELD WORK		
12				
13				
14				
15				
16				
17				
18				
19				
20				
TOTAL OTHER CURRENT EXPENSES	9,550			
C. EQUIPMENT PURCHASES	2,450	GPS DEVICE		
D. MOTOR VEHICLE PURCHASES	0			
E. CAPITAL	0			
TOTAL (A+B+C+D+E)	68,700			
SOURCES OF FUNDING		Budget Prepared By:		
(a) Total State Funds Requested	66,700	988-7203		
(b) HAWAII BEEKEEPERS Assn	2,000	Name (Please type or print) Phone		
(c)		MICHAEL M. KLIKS 988-7203		
(d)		Sign: [Signature] Date		
TOTAL REVENUE	68,700	Name and Title (Please type or print) MICHAEL M. KLIKS, PhD, PRESIDENT, HAB 1/30/2008		

BUDGET JUSTIFICATION PERSONNEL - SALARIES AND WAGES

Applicants: KLIKIS AND McGRANAGHAN

Period: July 1, 2008 to June 30, 2009

POSITION TITLE	FULL TIME EQUIVALENT	ANNUAL SALARY A	% OF TIME BUDGETED TO REQUEST B	TOTAL SALARY BUDGETED IN REQUEST A x B
SENIOR ENTOMOLOGIST (MMK)	1	\$92,000.00	25.00%	\$ 23,000.00
GRADUATE ASSISTANT (TBI)	1	\$38,000.00	25.00%	\$ 9,500.00
GRADUATE ASSISTANT (TBI)	1	\$38,000.00	25.00%	\$ 9,500.00
UNDERGRADUATE ASSISTANT (TBI)	1	\$20,000.00	10.00%	\$ 2,000.00
UNDERGRADUATE ASSISTANT (TBI)	1	\$20,000.00	10.00%	\$ 2,000.00
SENIOR CARTOGRAPHER (MMcG)	NA	NA	NA	\$ 0.000
				\$ -
				\$ -
				\$ -
				\$ -
				\$ -
				\$ -
				\$ -
				\$ -
TOTAL:				\$ 46,000.00

JUSTIFICATION/COMI MMK, on behalf of the HBA will provide overall coordination, data collection and management and fiscal management of the project

BUDGET JUSTIFICATION - EQUIPMENT AND MOTOR VEHICLES

Applicant: **KLIKIS AND McGRANAGHAN**

Period: July 1, 2008 to June 30, 2009

DESCRIPTION EQUIPMENT	NO. OF ITEMS	COST PER ITEM	TOTAL COST	TOTAL BUDGETED
ESRI Package No.1, includes a GPS receiver and ArcPad software	1.00		\$ 2,450	2450
			\$ -	
			\$ -	
			\$ -	
			\$ -	
TOTAL:	1		\$ 2,450.00	2,450

The ESRI includes a high quality Trimble Nomad ultra-rugged handheld GPS receiver and ArcPad software.

DESCRIPTION OF MOTOR VEHICLE	NO. OF VEHICLES	COST PER VEHICLE	TOTAL COST	TOTAL BUDGETED
			\$ -	
			\$ -	
			\$ -	
			\$ -	
			\$ -	
			\$ -	
TOTAL:			\$ -	

JUSTIFICATION/COMMENTS:

**DECLARATION STATEMENT
APPLICANTS FOR GRANTS AND SUBSIDIES
CHAPTER 42F, HAWAII REVISED STATUTES**

The undersigned authorized representative of the applicant acknowledges that said applicant meets and will comply with all of the following standards for the award of grants and subsidies pursuant to section 42F-103, Hawaii Revised Statutes:

- (1) Is licensed or accredited, in accordance with federal, state, or county statutes, rules, or ordinances, to conduct the activities or provide the services for which a grant or subsidy is awarded;
- (2) Comply with all applicable federal and state laws prohibiting discrimination against any person on the basis of race, color, national origin, religion, creed, sex, age, sexual orientation, or disability;
- (3) Agree not to use state funds for entertainment or lobbying activities; and
- (4) Allow the state agency to which funds for the grant or subsidy were appropriated for expenditure, legislative committees and their staff, and the auditor full access to their records, reports, files, and other related documents and information for purposes of monitoring, measuring the effectiveness, and assuring the proper expenditure of the grant or subsidy.

In addition, a grant or subsidy may be made to an organization only if the organization:

- (1) Is incorporated under the laws of the State; and
- (2) Has bylaws or policies that describe the manner in which the activities or services for which a grant or subsidy is awarded shall be conducted or provided.

Further, a grant or subsidy may be awarded to a non-profit organization only if the organization:

- (1) Has been determined and designated to be a non-profit organization by the Internal Revenue Service; and
- (2) Has a governing board whose members have no material conflict of interest and serve without compensation.

Further, the undersigned authorized representative certifies that this statement is true and correct to the best of the applicant's knowledge.

HAWAII BEEKEEPERS' ASSOCIATION

(Typed Name of Individual or Organization)



(Signature)

MICHAEL M. KLIKS

(Typed Name)

1/30/2008

(Date)

President

(Title)

Application for a Grant in Aid of Agricultural Research

I. Background and Summary

1. Applicants' background:

CO-PRINCIPAL INVESTIGATOR: Michael M. Kliks, PhD, President, Hawai'i Beekeepers' Association has conducted field and laboratory research in medical parasitology and entomology for more than 35 years and has been an active, commercial beekeeper in Hawai'i for nearly 2 decades (see ADDENDUM I, Curriculum Vitae).

CO-PRINCIPAL INVESTIGATOR: Matthew McGranaghan, PhD, is Associate Professor of Geography in the Department of Geography, University of Hawai'i where he has taught and conducted research in the fields of cartography and geographic information systems since 1985 (see ADDENDUM II, Curriculum Vitae).

2. Goals and objectives of the project:

On 6 April 2007 the devastating parasitic mite of honey bees, *Varroa destructor* was found by MMK to be infesting an abandoned managed honey bee colony in Makiki Valley, O'ahu. Since that time the mites have been detected in most locations where samples of honey bees have been collected in Honolulu County, but not on other islands. The goal of the apiculture industry in Hawai'i is to prevent the spread of *Varroa* beyond the island of O'ahu for as long as possible.

The only method to substantially suppress *Varroa* populations in managed or feral honey bee populations is to locate, sample, and exterminate as many colonies as possible in the shortest time possible and then replace them with healthy colonies. This effort **will require foreknowledge of the actual and probable locations** of honey bee colonies. On O'ahu the locations of most managed colonies and several dozen feral colonies are well known. However, the locations of the several thousand feral colonies believed to be present in urban, peri-urban, rural, and remote areas of the island are not known.

For the past 10 years the Hawai'i Beekeepers' Association (HBA) has kept a **continuous handwritten log of telephone calls and email reports** from the general public, related to the occurrence of swarms and feral hives on O'ahu, and notes on beekeepers' responses to them. It is proposed to transcribe the log data on approximately 800+ such cases, and their outcomes, into a digital format that can be used with Geographical Information System (GIS) and geographical mapping software, combined with Global Position Satellite (GPS) coordinates to map and graphically display the type, date and location of those reports on O'ahu.

Both managed honey bees and feral bees periodically reproduce and spread to new foraging territory by the process of swarming. Most natural swarms occupy a suitable habitation site within a few hundred meters of the mother nest. Therefore, by mapping the distribution of swarms and of known feral colonies on O`ahu it should be possible to focus on-the-ground suppression efforts in those geographic areas identified as feral bee "hot spots" by distribution patterns revealed on the GIS maps.

3. Public purpose and need to be served:

The public purpose of this work is to protect and promote the growth of local apiculture so that it can contribute to developing a sustainable agricultural base and a secure food supply by providing managed pollination services for diversified agriculture, as well as for the production of high quality honey products and queen bees in Hawai`i.

The contribution of the proposed collaborative research project will be to develop a database and methods for accurately **displaying swarm and feral colony locations** and for **analyzing dispersal patterns** on O`ahu over time and space. These data will be used to develop an inexpensive, field-deployable GPS mapping system that will be a valuable tool for both present and **future area wide management of *Varroa* mites** on O`ahu now, and in the future, on the other islands. The data base and GIS/GPS mapping software also can be used prospectively to continuously monitor and assess the future patterns of any recrudescence of feral colonies and/or *Varroa* infestations.

Apiculture directly contributes approximately \$5 million to the economy of the state of Hawai`i in sales of honey, honey bee queens, and beeswax. Annually, at least 10 times as much additional farm gate value derives from the crops that require pollination by honey bees. Based on the volume of imported pollinator-dependant food products and honey, and other sweeteners, that enter the state annually, the value of apiculture in this state could reach \$200 million by the end of this decade. However, failure to achieve timely suppression and containment of *Varroa destructor* to O`ahu for the maximum time period will seriously jeopardize current and future farm gate value of crops. Experience on the Mainland has shown that the ravages of *Varroa* will discourage local beekeepers from maintaining, let alone expanding, their livestock assets to meet the present and future needs of growers of pollinator-dependant food, fodder, fiber and fuel crops in the post-*Varroa* period in Hawai`i.

It is estimated that *Varroa* will cost at least \$30 million in direct expenses and losses to apiculture on O`ahu. Statewide, direct losses to beekeepers alone could exceed \$300 million statewide within the next decade **if *Varroa* infestations cannot be contained** on O`ahu for 5 to 10 years (*vide* ADDENDUM III, MMK, *Draft economic analysis of the impact of Varroa in Hawai`i, 2007*). To effectively suppress *Varroa* populations in managed and/or feral honey bee populations in urban, peri-urban and remote rural areas of the island they must be located, sampled, and exterminated in the shortest time possible. This effort will benefit from the foreknowledge of the historical and contemporary distribution of feral honey bee colonies and swarms that will be gained by

accurately mapping the time, type, and location of the approximately 800 such calls that the HBA has recorded continuously over the past decade. Once these data are entered into a digital format and then linked to GPS coordinates and displayed on accurate maps using GIS software the site of each case can be located in the field using small computers. This system will greatly **increase the predictability, and reduce the cost**, of locating, sampling and exterminating feral colonies that are the sources of swarms that distribute both bees and *Varroa* mites across the island's landscape.

4, 5. Target population to be served and geographic coverage:

The results of this study will be used to determine the most **likely geographical locations of established feral colonies on O`ahu** that are the sources of honey bee swarms. This will permit the efficacious focusing of feral colony eradication work as part of an area-wide suppression program whose purpose it is to prevent, or delay, the spread of *Varroa destructor* mites from O`ahu to other islands.

The direct beneficiaries of this work will be **growers of pollinator-dependant crops and beekeepers** who produce honey and manage hives for crop pollination, now on O`ahu, and on the other islands in the future. However, all consumers of such crops, and of honey throughout the state, and those businesses that directly and indirectly support diversified agriculture, will benefit from the rapid, cost-effective control of *Varroa* on O`ahu. Providing optimum pollination for our food, fodder, fiber and fuel crops is an essential link in food security and food production self-sufficiency chain.

It is anticipated that the area wide feral *Varroa* suppression campaign will be carried out through a collaborative effort by the Hawai'i Beekeepers' Association, the State Department of Agriculture, Plant Industry Division, and the USDA, Agricultural Research Service, Pacific Basin Agricultural Research Center.

II. Service Summary and Outcomes

Expected results and outcomes: The immediate result of this project will be a digital database of the distribution and physical location of reported feral honey bee colonies and swarms on O`ahu over a 10 year period. The outcome products supported by these data will be accurate GPS-based maps and GIS analyses that allow visualization of the spatial and temporal distribution of honey bee swarms colonies in the past. . .and of *Varroa* infestations now and, and over the next decade. These baseline data will be useful for planning and executing present and future *Varroa* suppression efforts and for monitoring of the health and distribution of managed honey bee colonies on O`ahu. In the more distant future this GPS mapping system for honey bees can be used on the other islands to begin to monitor feral colonies and swarms now so that the data can be used to predict and to rapidly track the spread of *Varroa*, **and any other newly arrived**

pests, and their impacts on both managed colonies and feral colonies when the mites, or other pests, do succeed in escaping from O`ahu.

Another important result of the project will be to develop protocols for maintaining the currency of this and similar continuous spatial and temporal databases. In future applications of these methods we intend to train beekeepers, entomologists and hive removal services to use GPS-based system receivers, and/or inexpensive hive-embedded transponders, in the field to routinely enter the coordinates of managed and feral colonies and swarms and to share the data with others. Similarly the use of the coordinate information will be useful in finding previously reported colonies and in monitoring their current status.

As a preliminary example of such maps, with approximately 200 data points from the 2006-2007 swarm season see GIS/ GPS Map 1 below. Note that square GREEN "H" data points represent feral colonies, the BLUE circles represent swarms, and the red Arrows indicate a *Varroa* positive hive.

(SEE ATTACHED MAP 1)

MAP 1. HBA BEE LOG ENTRIES (~200 CASES) OF FERAL HIVE AND SWARM CALLS, 2006-2007, O`AHU (INCOMPLETE)

KEY TO MAP SYMBOLS

H = FERAL HIVE

S = SWARM

RED ARROW = *VARROA* POSITIVE 2007

Expected beneficial impacts: We believe that the application of rapid, inexpensive, robust field mapping methodologies will facilitate the location, sampling and extermination of feral honey bee colonies that are the sources of swarms that spread both honey bees and *Varroa* mites. Locating, sampling and exterminating feral colonies will **reduce the rate of expansion of *Varroa* on O`ahu and delay its spread to other islands in the state.** Protecting and promoting healthy populations of honey bees will result in **improved sales of our high quality pure local honeys and disease-free queens, and will encourage additional capital investment** in apiculture in Hawai`i. A healthy and growing apicultural enterprise will **assure the future pollination capability needed by our diversified agricultural enterprise to succeed.**

Anticipated negative impact if not funded: If infestations of *Varroa destructor* continue to spread on O`ahu, and if *Varroa* reaches other islands, it is very likely that many local beekeepers will go out of business. Should this occur growers of diversified

Map 1. HBA BEE LOG ENTRIES (~200 CASES) OF FERAL HIVE AND SWARM CALLS, 2006-2007, O'AHU (INCOMPLETE)



crops in the very near future would begin to suffer from a lack of adequate pollination. The ultimate outcome of this will be similar to that experienced on the mainland: markets full of cheap low quality honey of foreign origin and not enough honey bee colonies to meet the essential pollination needs of at least \$15,000,000,000 worth US food, fodder, fuel and fiber crops.

1. Scope of work, tasks and responsibilities: The curriculum vitae of the co-principal investigators are attached herewith as ADDENDA I and II.

The work scope at the Department of Geography, including data base creation and management, GPS mapping and interpretation and printing, software application and development, and management of paid graduate students will be managed by Prof. McGranaghan.

Bee call log data transcription by undergraduate volunteers, and field work locating honey bee colonies, verifying GPS coordinates, meta-analyses of mapping accuracy, sampling for *Varroa* and exterminating feral honey bees by experienced beekeepers will be managed and supervised by Dr Kliks and other trained beekeepers. As "hot spots" of swam and feral colony reports emerge some will be evaluated using topographic maps and "eyes and boots-on-the-ground" to determine likely source colony locations and search for them. However, comprehensive search efforts to locate, sample, GPS locate and exterminate all likely sites of source hives is beyond the scope of this project. It is anticipated that the HDOA will soon have funds hire beekeepers to do this work

In addition to the co-principal investigators and beekeeper volunteers and volunteer undergraduate students, it is estimated that 2 part time graduate and 2 undergraduate students would be required to assist in data entry, technical geographical analyses and evaluation, and field verification work under the direction of Professor McGranaghan and Dr. Kliks.

2. Projected timeline, workscope and task performance schedule:

It is anticipated that during the first 12 months of the project (September 1, 2008 – August 31, 2009) all 800+ existing logged cases of feral hives and swarms will be entered into data base spread sheets and linked to the GIS software. It is expected that an additional 40 to 100 new feral cases will occur during this period. Using the GPS linked data on these cases to generate maps of their occurrence, over time and space, will be completed during this time frame as well. Further analyses and fine tuning of the creation and display of mapped data, by physically locating the sites and verifying the coordinates, and the continuous input of new data will continue for several years.

Application of this GPS-based system to record, locate and monitor feral and managed honey bees on the other islands should become feasible within 2 to 3 years. It will also be useful in the near future to create a similar data base for all managed colonies on this island and on other islands.

The projected timeline and performance schedule over the 12 month life of the present project are:

A) collection and processing of "Honey Bee Hotline" call log data by the Hawai'i Beekeepers' Association is continuous and accrued data will be added to the data base and GPS-linked as they become available (months 1 to 12)

B) initial transcription of hand written log entries and entry into Excel database spread sheets and GIS formats using paid undergraduate students and volunteers. (months 1 to 5);

C) geocoding of database cases using GIS-based address matching software to convert street addresses to map coordinates for locations of swarms and feral colonies. (months 3 to 5);

D) on-the-ground verification and calibration of the accuracy of linked addresses and coordinate data using a hand-held global positioning satellite (GPS) device by making site visits to approximately 5% of all mapped points (months 5 to 10);

F) temporal, spatial and topographical analyses of mapping patterns and fine tuning of actual reported feral hive map locations to determine probable location of those established feral hives that are the continuous sources of swarms that spread both bee colonies and mites (months 8-11);

G) application of mapping patterns to physically locate, sample and eradicate source hives on the ground (months 3 to 12); and,

H) Evaluation of results and preparation of reports (months 11 and 12).

3. Quality assurance, evaluation and improvement of results.

Transcription of the original hand written Honey Bee Hotline log data onto data entry sheets is the first critical step in this process. This work is carried out by MMK and student volunteers. An improved data collection form using an Excel spread sheet format will be used for present and all future call logs. Data entered include date of the call (YEAR, MONTH DAY), type of problem (feral swarm, established feral colon, managed hive), location of the bees (tree, wall, etc), physical address or site

description, outcome (none, sample taken, extermination, etc), result of sample testing for *Varroa*, if any, and GPS coordinates. Transcribed data entries will be cross checked by MMK and verified by calling back and/or by site visits using a GPS device by field volunteers. Entered cases will be geocoded and linked to maps sites using available software. Any case addresses that do not match with a geographical coordinate will be cross checked for address and visited to get the correct coordinates if necessary. At least 10% of all entries will be verified using a hand held GPS device.

Geocoding of entries, assignment of map symbols (for year, type of entry, etc), colors and related formatting will be supervised by MMcG. Periodic display, analyses and interpretation of geocoded map data will be done by both MMcG and MMK to evaluate their accuracy and usefulness. As "hot spots" of swam and feral colony reports emerge they will be evaluated using topographic maps and beekeeper volunteers as "eyes and boots-on-the-ground" to determine likely source colony locations and to search for them. However, comprehensive area-wide search efforts to locate, sample, GPS locate and exterminate all likely source hives is beyond the scope of this project. It is anticipated that the HDOA will soon have funds hire beekeepers to do this area-wide suppression and control work.

Continuous evaluation of data entry, geocoding, map production and field use of maps to verify coordinates and to locate known and unknown feral colonies will begin when at least 2 full years of retrospective data have been entered into the system. The field checks will provide feed back on how to improve the preparation and analysis of maps. As they become available, upgraded street address-GPS coordinated maps of O'ahu will be acquired for use by this project and future work.

4. Measures of effectiveness; assessment of the program's accomplishments.

The first milestone of effectiveness will be the completed data entry of between 800 and 1000 "bee calls" to the Honey Bee Hotline that occurred between 1997 and 2007. The next measure will be the geocoding of those data entries into a geographic information system. The third goal will be the generation of a series of maps for temporal and spatial display of these data. Thereafter, the GPS maps displaying these data will be assessed in the field as to their utility, cost effectiveness and accuracy in predicting where feral honey bee colonies are located. Lessons learned from the field deployment phase in months 5 through 11 will be used to refine both data display and geographic detail and accuracy of land coordinates.

III. Financial: see attached budget. Additional funding for our feral honey bee mapping studies is being sought from the National Honey Board's research fund and from the Hawai'i Farm Bureau Federation. The HBA will make available \$2000 in cash and approximately \$25,000 in "in-kind" contributions of labor, office support, materials and supplies and field support costs.

Anticipated quarterly funding requirements for the fiscal year 2008-2009:

FIRST	SECOND	THIRD	FOURTH	ANNUAL
TOTAL				
\$25,000	\$15,000	\$15,000	\$12,000	\$67,000

VI. Experience and Capability: see also Curricula Vitae of co-principal investigators attached as Addenda II and III

A. Skills and experience of Co-Principal Investigators:

Michael M. Kliks, PhD, President, Hawai'i Beekeepers' Association has conducted field and laboratory research in medical parasitology and entomology for more than 35 years and has been an active, commercial beekeeper in Hawai'i for nearly 2 decades. See also ADDENDUM III, Curriculum Vitae.

Matthew McGranaghan, PhD, is Associate Professor of Geography in the Department of Geography, University of Hawaii and has been on the faculty since 1985. He is interested in representational issues in cartography and Geographical Information Systems, including perceptual and cognitive issues in map displays, the cartographic systems which produce those displays, and technical issues in information representation in spatial databases. His research has included reaction-time studies of map cognition as well as efforts to write software to automate the interpretation of verbal descriptions of locations. He has taught Geographical Information System technology and remote sensing methodologies, often integrating the use of GPS technology. His work has included preparing georeferenced aerial photographs of the state of Hawai'i. Professor McGranaghan has taught in these areas for more than two decades and has the expertise needed to design a method of GIS data base management, to allow efficient access and display of the feral honey bee colony locations to workers in the field. His efforts on this project are pro bono

B. Facilities

The **Department of Geography** of the University of Hawai'i, Manoa, is well equipped to do GIS-based spatial analysis. It has computers, ArcGIS and other GIS software, a variety of GPS devices, experienced support staff, and a cadre of well-trained students. The emphasis in the lab has been to provide a resource for exploration and innovation.

The **Hawaii Beekeepers Association (HBA)** has more than 15 members on O`ahu who are adequately trained to locate, sample and exterminate all swarms and feral colonies called in to our "Honey Bee Hotline" telephone number and email address, or that are proactively located in the field. The association's office has computer systems and printers, scanners and software and maintains an active Web site (www.hawaiibeekeepers.org). HBA members have all of the special protective equipment and tools, skills and experience needed to effectively locate, sample and exterminate feral colonies and swarms.

V. Personnel: Project Organization and Staffing: see above Sections I and IV and attached Curricula Vitae (Addenda I and II).

VI. Other-NA

A. Litigation- NA B. Licensure or Accreditation-NA

ADDENDA

ADDENDUM I: CURRICULUM VITAE. Matthew McGranaghan, PhD, Associate Professor; Department of Geography, University of Hawaii, 2424 Maile Way, Honolulu, HI 96822. Tel: 808-956-7092; Fax: -808-956-3512; Email: matt@hawaii.edu.
Education: B.A., Philosophy and Geography, State University of New York, Albany, 1979; M.A., Geography, State University of New York, Albany, 1981; Ph.D., Geography, State University of New York, Buffalo, 1986.

Research interests: representational issues in cartography and GIS, including perceptual and cognitive issues in map displays and the GIS and cartographic systems which produce those displays, and technical issues in information representation in spatial databases. I have secondary interests in algorithms, techniques, and the logic of processing spatial data.

Courses Taught:

GEOG 340 Geography of North America; **GEOG 366** Geography of Honolulu; **GEOG 387** Computer- Assisted Cartography; **GEOG 470** Remote Sensing; **GEOG 487** Advanced Computer-Assisted Cartography; **GEOG 488** Geographic Information Systems ; **GEOG 695** Concepts and Theories in Geography; **GEOG 696** Research Design / Methods in Geography ; **GEOG 761** Research Seminar in Cartography; **GEOG 762** Research Seminar in Remote Sensing

Partial list of publications

FERAL HONEY BEE MAPPING: KLIKS AND McGRANAGHAN, GIA FY2008-2009

1993 McGranaghan, M., "A Cartographic View of Data Quality Visualization", *Cartographica*, 30(2 & 3), pp. 8-19.

1989 McGranaghan, M., "Ordering Choropleth Map Symbols: The Effect of Background", *The American Cartographer*, 16(4), pp. 279-285.

1988 Nullet, D., and McGranaghan, M., "Rainfall Enhancement Over the Hawaiian Islands", *Journal of Climate*, August 1988, pp.837-839.

Mark, D.M., and McGranaghan, M., "Map Use and Map Alternatives: An Experiment in an Intraurban Environment", *Canadian Geographer*, 1988, 32(1).

1987 Mark, D.M., Gould, M.D. and McGranaghan, M., "Computerized Navigation Assistance for Drivers", *The Professional Geographer*, 1987, 39(2), pp. 215-220.

McGranaghan, M., Mark, D.M. and Gould, M., 1987, "Automated Provision of Navigation Assistance to Drivers", *American Cartographer*, 14(2) pp. 121-138.

1985 McGranaghan, M., 1985, "Pattern, Process and a Geographic Language", *Ontario Geographer*, no. 25, pp. 15-28.

Book Chapters

1998. "Urbanization", with Jon Goss, in *The Atlas of Hawaii*, 3rd ed.

1996 "Urbanization in Hawaii", with Jon Goss, in Joseph Morgan, *Geography of Hawaii*, Bess Press, 1996. "An Experiment with Choropleth Maps on Monochromatic LCD Panels", in Clifford Wood and Peter Kellor (editors), *Cartographic Design and Research*.

1994 "Schema and Object Matching as a Basis for Interpreting Textual Specifications of Geographical Locations", in D. M. Mark and A. U. Frank, (editors), *Cognitive and Linguistic Aspects of Geographic Space*, Kluwer.

1993 "Artificial Intelligence in Extracting and Refining Locality Information", in Renaud Fortuner (editor), *Advances in Computer Methods for Systematic Biology: Artificial Intelligence, Databases, Computer Vision*, Johns Hopkins University Press.

ADDENDUM II: CURRICULUM VITAE. Michael M. Kliks, MSc, PhD, President Hawai'i Beekeepers' Association, Member National Honey Board Nominating Committee, Member Commodity Advisory Board, Hawai'i.

EDUCATION: Grammar school in Portland OR. University studies at Willamette U, Salem OR (1960-62); Portland State U, Portland, OR (BA, Biology, 1965); Tulane U School of Tropical Medicine and Public Health, New Orleans LA (1965-68) under Prof PC Beaver (MSc, Medical Parasitology 1967); UCLA Dept Medical Microbiology and Immunology under Prof M Voge 1969-70; U California, Berkeley Dept of

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Entomology and Parasitology (1974-78) under Profs FL Dunn and D Heyneman (UC San Francisco) and CJ Weinmann (PhD **Medical Parasitology and Entomology 1978**) and Sheldon Margen (Nutritional Sciences).

TEACHING, RESEARCH AND MANAGEMENT POSITIONS:

1964: Lab Asst in experimental parasitology to Dr. RW Macy, Portland State University; 1967-69: Teaching Asst in med parasit, Tulane University School of Tropical Medicine, Dept Parasit 1967: Summer Research Fellow, International Center Medical Research, Cali, Columbia; 1970-1974: Lecturer in med parasit, clinical lab parasit; grad advisor, Dept. of Parasitology, Faculty of Medicine, Chiang Mai University, Thailand (Special Grade Civil Servant); 1974-78: Teaching Assoc, UC Berkeley, Depts Entomological Sciences, Biology, Zoology; Res Asst, Depts Plant Path, Entomological Sciences (Prof J Anderson); 1976: Spring; Lecturer med/vet/wildlife parasit, Humboldt State Univ. Dept Biology, Arcata CA; 1976-1977: Assoc. Researcher, Centro de Investigaciones Ecológicas del Sureste (CIES), San Cristobal, Chiapas, Mexico; 1978: Project consultant, Med. College of Wisconsin, Chagas' Disease Project, Argentina
1979-1982: Asst. Researcher, Dept Trop Med, U Hawaii; FDA-funded research on anisakiasis and food-borne parasites of man and animals in Hawaii; 1983-1984-1986: Assoc. Researcher, Basic Sciences, Cancer Research Center of HI.
1983-1993: Visiting Investigator, Division of Comparative Medicine, Univ. Hawaii; cancer and helminths ; seroepidemiology of parasitic diseases.
1983 (Sept)-1984(Aug): Indo-US Research Fellow, US Fulbright Commission and National Science Foundation, at National Institute of Communicable Diseases, Delhi, India; field and lab studies on serodiagnosis/epidemiology of dracunculiasis.
1985-1986: Collaborating Scientist, Office of the Director, CDC; and the WHO Collaborating Center for Research, Training and Control of Dracunculiasis; developing immunoassays assays (at the Cancer Research Center of Hawaii).
1987 to 1991: Laboratory Director, private clinical diagnostic laboratory, Confidential Testing Services, Inc.
1988-1994: President, Director of Laboratories, CTS Foundation, Hawaii.
1989-1990: Senior Research Fellow, US Fulbright Commission, African Regional Research Program, Burkina Faso, Liberia, Nigeria on dracunculiasis serodiagnostic project.
1990-91: Affiliate Professor, Institute for Circumpolar Health Studies, University of Alaska, Anchorage; echinococcosis in Chukotka.
Nov. 1993-August 1994: Senior Fulbright Professor; September 1994-95, Visiting Senior Professor, Institute of Zoology, National Academy of Sciences, Republic of Kazakstan; studies on the persistence of dracunculiasis in Central Asia..
1994-1995: Founding Member, Vice President, Board of Directors, and Executive Director of NGO, *Eko Fond*, "Environmental Research and Education for Central Asia", Almaty, Republic of Kazakstan.
1995-96: Environmental Consultant, Chevron Overseas Company, Almaty, Republic of Kazakstan; Coordinator, **Red Data Book of Kazakstan** Project.
1995-Present: Consulting Parasitologist, National Marine Fisheries Service, Kewalo Research Lab, Honolulu; Hawaiian Monk Seal Helminthology Survey.

NON-SCIENCE POSITIONS: Manoa Valley Neighborhood Board (1999-2003); Point Panic Bodsurfing Association, Director (1995-Present); Royal Gardens Association of Property Owners, Director (1998-2002), President, 2005-present; Hawai'i Beekeepers' Association, Director, President 1998-2000, 2004-present, Vice President 1997-8, Secretary 2003); Hale Manoa Association of Home Owners' Director (1980-2003 President 1997-99, VP 2002); President, Island Pollination Services (1997-Present), President, Manoa Honey Company, 1985-Present); Department of Agriculture, State of Hawai'i, Commodities Advisory Group, member 2002-present; National Honey Board, USDA, Nominating Committee member (2004-2007); Sierra Club, O'ahu Group, Executive Committee, Vice Chair (2004-present).

SELECTED PUBLICATIONS (author of more than 50 scientific, technical and general interest research papers, review articles, laboratory manuals and textbook chapters):

- Kliks, M. M., Kroenke, K. and J. Hardman. 1982. Eosinophilic radiculomyeloencephalitis: an angiostrongyliasis outbreak in American Samoa related to ingestion of *Achatina fulica* snails. **American Journal of Tropical Medicine and Hygiene** 31:1114-1122.
- Deardorff, T., Kliks, M. M., Desowitz, R. S. et al. 1982. Larval ascaridoid nematodes from fishes the Hawaiian island with comments on pathogenicity experiments. **Pacific Science** 36:187-200.
- Kliks, M. 1983. Anisakiasis in the Western United States: four new case reports from California. **American Journal of Tropical Medicine and Hygiene** 32:526-532.
- Deardorff, T., Kliks, M. M., and R. S. Desowitz, 1983. Histopathology induced by larval *Terranova* (Type HA) (Nematoda: Anisakidae) in experimentally infected rats. **J. Parasitology** 69(1):191-195.
- Kliks, M. M. 1983. Paleoparasitology: On the origins and impact of human-helminth relationships. In: **Human Ecology and Infectious Disease**, pp 291-313. Ed. J. H. Cross and N. A. Croll. Academic Press, New York.

- Raybourne, R., Desowitz, R.S., and M. Kliks. 1983. Inhibition of mitogen induced lymphocyte blastogenesis by excretory-secretory products of larval anisakid parasites. *Experimental Parasitology* 55:289-298.
- Gee, G., Lau, W.K. and M.M. Kliks. 1984. Clinical spectrum of eosinophilic meningitis due to *Angiostrongylus cantonensis* with confirmation by counterimmunoelectrophoresis. *J. Clinical Research.* 32:43.
- Kliks, M.M., and C.K. Rao. 1984. The development of an ELISA for early serodiagnosis of Guinea worm infection. *Journal of Communicable Diseases* 16:287-294.
- Kliks, M. M. 1985. Studies on the traditional herbal anthelmintic *Chenopodium ambrosioides* L.: ethnopharmacological evaluations and clinical field trials. *Social Science and Medicine* 21(8):879-886.
- Kliks, M M. 1986. Human anisakiasis in the U. S.: an update. *J Am Med Assn* 225(19):May 26.
- Oshima, T. and M.M. K. Kliks, 1986. Effects of marine mammal parasites on human Health. In *Parasitology, Quo Vadis?*, Howell, M. J. ed, pp 415-421. Australian Academy of Sciences.
- Kliks, M. M. 1990. Helminths as heirlooms and souvenirs: a review of New World Paleoparasitology. *Parasitology Today* 6: 93-100.
- Garate, T., Kliks, M. M., Cabrera, Z. and R.M. Parkhouse. 1990. Antigenic specificities and cross reactions of sera from subjects infected with *Onchocerca volvulus* and *Dracunculus medinensis*. *American Journal of Tropical Medicine and Hygiene* 42(2): 140-147.
- Kliks, M. M. and N. E. Palumbo. 1992. Eosinophilic meningitis beyond the Pacific Basin: the global dispersal of a peridomestic zoonosis caused by *Angiostrongylus cantonensis*, the nematode lungworm of rats. *Social Science and Medicine* 34(2):199-212.
- Kliks, M. M. 1992. **Dracunculiasis** (Guinea-worm disease). *MEDICINE INTERNATIONAL* 108: 4568-4569. The Medicine International Group Journals, Oxford, UK.
- Kliks, M. M., Bigaliev, A. B. and Siderov, Y. G., 1995. **THE CASPIAN SEAL AS AN INDICATOR OF ECOLOGICAL CHANGE**: Concentration of metals in tissues of newborn Caspian seals. *ECOSTAN NEWS*, Vol. 3, Number 10; October 1, 1995
- Kliks, M. M. 1996. **Guinea-worm disease**: human dracunculiasis; Chapter 7.14.3, pp. 924-928. In: Weatherall, DJ, et al., eds., *Oxford Textbook of Medicine, Third Edition, Volume 1*, Oxford University Press, Oxford.
- Dailey, M. D., Kliks, M. M., and R. S. Demaree, 2004. *Heterophyopsis hawaiiensis* sp. n. (Trematoda: Heterophyidae) from the Hawaiian Monk Seal, *Monachus schauinslandi* Matschie, 1905 (Carnivora: Pinnipediae). *Comparative Parasitology* 71(1):9-12
- Kliks, M. M., et al., in preparation 2006. Prospective coproparasitological survey of the Helminth Fauna of the Hawaiian Monk Seal in the Northwestern Hawaiian Islands, 1998-2002.
- Reif, J. S., Kliks, M. M., et al., 2006. Gastrointestinal helminths in the Hawaiian monk seal (*Monachus schauinslandi*): associations with body size, hematology, and serum chemistry. *Aquatic Mammals* 32(2): 157-167 (DOI 10.1578/AM.32.2.2006.157).