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At the request of 21 AMDS/SGPB, the U.S. Air Force School of Aerospace Medicine/Epidemiology Consult Services (USAFSAM/PHR) entomologist, two USAFSAM/Public Health Education entomologists, and the chief entomologist from the Air Force Aerial Spray Flight (USAF Reserve Command, Youngstown, OH) conducted a base-wide mosquito vector survey on 13 June - 1 July 2012. One species of mosquitoes, *Aedes impiger*, was collected and more than 3000 were processed for virus testing. Active mosquito breeding sites were located throughout the base and surrounding valley. The USAFSAM/PHR entomologist and a U.S. Army Human Resource Command, Ohio State University graduate student conducted molecular testing on the mosquitoes for arboviruses. Two pools of mosquitoes from Thule AB were positive for an *Orthobunyavirus*; however, DNA sequencing of the viral amplicons was not complete enough to fully identify the agent. No vector surveillance or control programs are in effect at Thule AB. Based on the history of mosquito pest problems and the potential for mosquito-borne viruses, we recommend that these be established.

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**DEPARTMENT OF THE AIR FORCE**
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
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21 November 2013

MEMORANDUM FOR 821 SPC/SG
Thule AB
APO AE 09074-5000

FROM: USAFSAM/PHR
2510 Fifth Street
Wright-Patterson AFB, OH 45433

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2013-0026, Thule AB, Greenland, Mosquito Survey and Arbovirus Surveillance, 2012

1. EXECUTIVE SUMMARY: At the request of 21 AMDS/SGPB, the U.S. Air Force School of Aerospace Medicine/Epidemiology Consult Services (USAFSAM/PHR) entomologist, two USAFSAM/Public Health Education entomologists, and the chief entomologist from the Air Force Aerial Spray Flight (USAF Reserve Command, Youngstown, OH) conducted a base-wide mosquito vector survey on 13 June - 1 July 2012. One species of mosquitoes, *Aedes impiger*, was collected and more than 3000 were processed for virus testing. Active mosquito breeding sites were located throughout the base and surrounding valley. The USAFSAM/PHR entomologist and a U.S. Army Human Resource Command Ohio State University graduate student conducted molecular testing on the mosquitoes for arboviruses. Two pools of mosquitoes from Thule AB were positive for an *Orthobunyavirus*; however, DNA sequencing of the viral amplicons was not complete enough to fully identify the agent. No vector surveillance or control programs are in effect at Thule AB. Based on the history of mosquito pest problems and the potential for mosquito-borne viruses, we recommend that these be established.

2. BACKGROUND:

a. Thule AB is located more than 700 miles north of the Arctic Circle on the northwestern coast of Greenland. The installation sits in the Greenlandic coastal plain and is bordered by the Greenland ice sheet and northern Atlantic Ocean in a region named the Thule Defense Area. The installation has numerous separated facilities throughout the region. The climate is arctic with the possibility of freezing weather throughout the year. Mosquito season starts in late June, peaks in July-August, and stops with the end of summer (August-September).

b. Vector-borne diseases continue to be emerging threats to U.S. military personnel worldwide. Thule AB had not submitted mosquitoes for pest identification or surveillance prior to 2011. There were no cases of mosquito-borne disease reported from Thule AB or Greenland; however, numerous arboviruses threaten humans throughout the Arctic in Canada, Alaska, and northern Europe. The hospital at Thule AB does not report through the Air Force Reportable Events System; thus, the USAF public health component has no visibility or records of past

reportable disease cases or deaths. There is a concern that with significant mosquito populations at Thule AB, the population could be exposed to mosquito-borne viruses. With no background data on mosquitoes or medical events, a need to establish a baseline mosquito and virus assessment was determined.

3. SURVEILLANCE METHODOLOGY AND LABORATORY PROTOCOLS:

a. Adult and larval mosquitoes were surveyed by sampling standing water, ditches, and low areas throughout the base and from rock pools, snow pools, and tire tracks in the valley above Thule AB near the BMEWS and Det 1 (Figures 1-3). Larval mosquitoes were collected using hand dippers and a plankton-net. Adult mosquitoes were collected with hand nets and a mouth aspirator. Mosquito larvae were collected on 14 June, but blood-feeding adult mosquitoes were not noted until 28 June 2012. On 28 June, adult mosquitoes were more active on base than off base. By the 30 June, adult mosquitoes were actively biting in the valley off base. Mosquito larvae were reared to adults in breeding cups, and adults were killed after emerging by freezing. Fifty representative larvae were killed and preserved in ethanol for laboratory identification. On 30 June, all surviving larvae were counted and killed with acetone and dried in a chemical hood. The dried larvae and dead adults were packaged for shipping.

**Figure 1. Mosquito Breeding Sites on Thule AB**

b. Medical entomology teams collected and recorded information on other potential pest insects and interviewed long-term Thule residents about the history of the mosquito problem.

**Figure 2. Mosquito Larvae from a Snowmelt Pool**

c. Mosquitoes were hand carried back to USAFSAM at Wright-Patterson Air Force Base, Ohio. They were identified and pooled for testing. Initially, all mosquitoes were tested for *Orthobunyavirus* by molecular techniques by the U.S. Army Ohio State University graduate student and the USAFSAM/PHR entomologist (Figure 4). Putatively positive pools were tested with separate redundant tests for *Orthobunyavirus*. All pools of mosquitoes were also tested for *Flavivirus*. All potentially positive results were characterized by DNA sequencing.

4. FINDINGS:

a. One species of mosquito, *Aedes impiger*, was found throughout the Thule area. Winter weather and adverse conditions made mosquito collecting difficult until late June. Annually, adult mosquitoes are unlikely to be pests until late June to early July. Mosquito larvae were present in almost all permanent standing water around base and in the valley above the base. Based on the extensive breeding habitat throughout the entire ice-free region, the potential for large, relatively synchronous emergence of mosquitoes is a threat to the Thule area. No single site was likely to produce a mosquito swarm; however, improved drainage of the base and valley could reduce mosquito populations. Several blood meals were identified in mosquitoes during the virus screening. These mosquitoes had fed on both humans and arctic fox.

**Figure 3. Standing Water on Base with Mosquito Larvae and Trash**

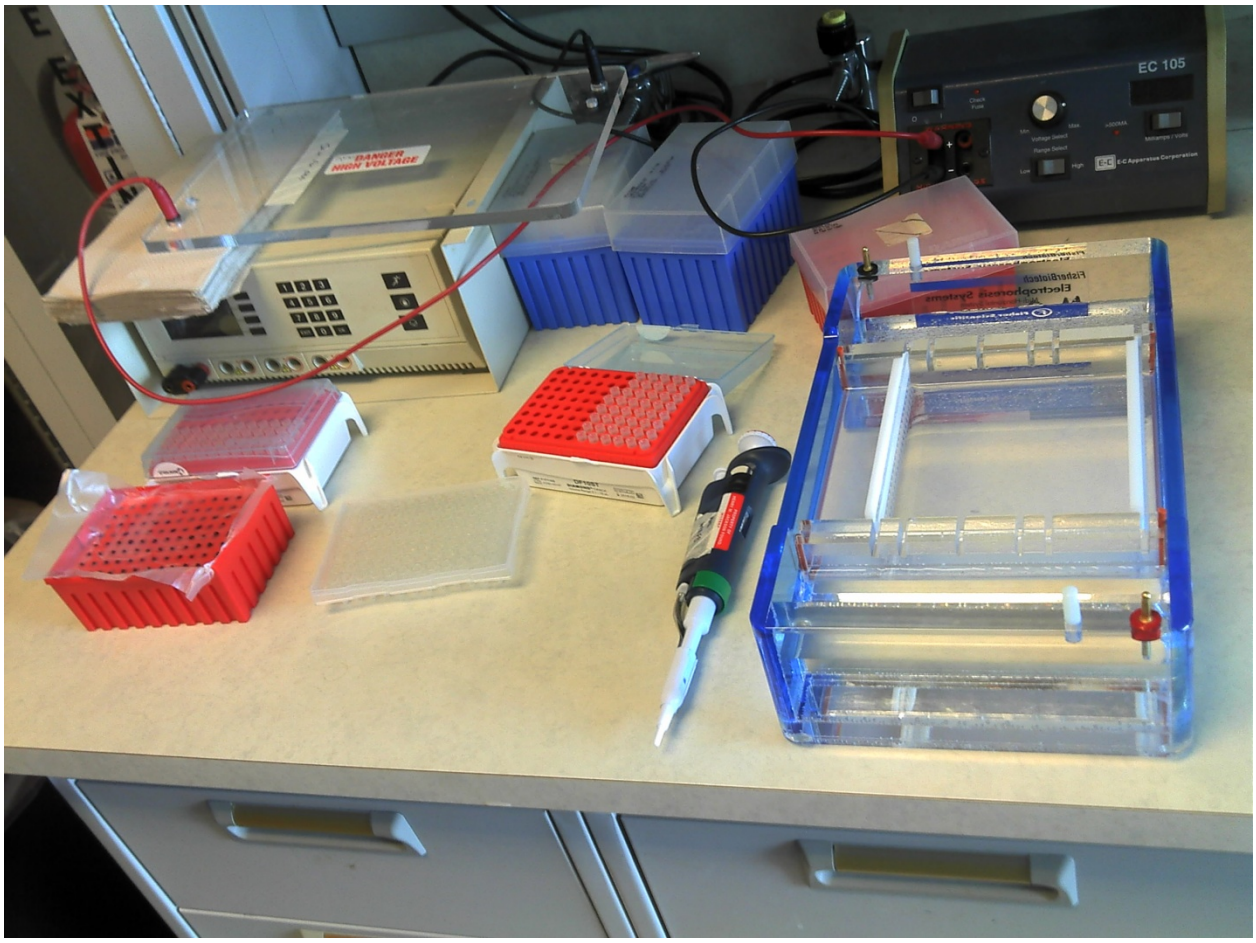


**Figure 4. Ohio State University Molecular Testing of Mosquitoes for Arbovirus**

b. None of the mosquito pools tested positive for *Flavivirus*. Two pools of larvae tested positive for *Orthobunyavirus* on three independent tests, but only one test for a single pool could be verified as virus. The DNA sequence was unfortunately unequivocal due to DNA artifacts and debris, and the exact nature of the virus remains unknown.

c. Swarms of northern blue bottle flies (*Protophormia terraenovae*) were active when the sun was shining but not during overcast hours. They swarmed in and around the garbage dumpsters, especially behind the main dining hall. These flies feed on garbage, dead animals, and feces. They can contribute to gastrointestinal illness if they contaminate food. They also congregated inside the roof of some relatively deserted buildings near the dump or in shelters outside of base.

5. DISCUSSION:

a. Mosquito populations on Thule AB could easily exceed the pest threshold and adversely impact both the working conditions and morale of personnel stationed in the area. Outdoor work could be severely impacted when mosquito populations exceed the pest level, and work in computer facilities can be adversely affected when mosquitoes invade buildings. Dozens of crushed mosquitoes were noted on the walls inside several buildings. Thule AB should consider a mosquito management program to protect the working conditions and overall morale. Both medical entomology and mosquito management guidelines are outlined in AFI 48-102, AFI 32-1053, and DoDI 4150.07. An effective but well-regulated mosquito management program will include surveillance and probably applications of insecticides such as larvicides and adulticides. The species of mosquito found at Thule AB has only one generation per year, and optimal control will probably involve early treatments of larval breeding sites before adult mosquitoes emerge. Insecticides could be spread by hand, backpack, truck, or aircraft. A large portion of the valley would need to be treated to control the mosquito populations. The environment at Thule AB is unique compared to most temperate and tropical environments. Broad area mosquito control could reduce mosquito populations for more than 1 year. If aerial sprays are requested, either the U.S. Air Force or a contractor could provide that service (see AFI 32-1074, Aerial Application of Pesticides). Identifications of pest or vector mosquitoes and consultations can be provided by the USAFSAM/PHR entomologist. Guidelines for sample submission can be found at the USAFSAM website at https://gumbo2.wpafb.af.mil/epi-consult/entomology/ [available to those with access].

b. An arbovirus was detected in at least one pool of larvae. The virus was an undetermined *Orthobunyavirus*. Many *Orthobunyavirus* cause disease in humans and wildlife, but some are not known to be pathogenic. The risk posed by this virus is likely low, but based on the reported number of mosquito bites, the exposure to infected mosquitoes is likely to be high. It is suggested that, if a patient presents with undiagnosed high fever or encephalitis during the summer or has pregnancy complications, screening for *Orthobunyavirus* infections could be relevant.

c. The garbage dumpster sitting behind the food loading dock and rear entrance to the Dundas Dining Hall could be moved during the summer months further from the doors to reduce the potential of fly-borne gastrointestinal disease. At the very least, the doors of the dining hall should be kept closed in accordance with paragraph 5-501.13 of the U.S. Public Health Service FDA 2005 Food Code.

6. RECOMMENDATIONS: The 21 AMDS/SGPB from Peterson AFB or AFSPC 821 SPTS/SG should establish a mosquito vector surveillance and management program. This program should use $CO_2$ traps placed at three to five locations on base to determine baseline mosquito numbers and pest seasons. Trapping could be performed once or twice a week during the summer months. Pre-season (mid-June) larvacide should be applied throughout the valley and base, either by airplane or by hand and vehicle, to all standing water. If after pre-season treatments the mosquitoes reach significant pest levels during the summer, an adulticide spray could be necessary.

7. If you have questions concerning this consultative letter or additional needs, please feel free to contact Dr. Will Reeves at will.reeves@wpafb.af.mil, DSN 798-3071, Commercial 937-938-3071. We sincerely appreciated the opportunity to provide assistance on these issues and would like to extend our gratitude to all of the Public Health staff at Thule AB and the 21 AMDS/SGPB and AFSPC 821 SPTS/SG for their cooperation and support.

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Entomologist