

Morphological or Molecular Mosquito ID: Selecting the Right Path for your Program or Project

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HOW IMPORTANT IS MOSQUITO IDENTIFICATION?

Identification of problem species is the KEY (basic component) for a targeted and cost effective control program!

Steps in having a highly effective mosquito control program are analogous to a visit to the Doctor's office

A visit to the Doctor's Office

➤ Surveillance: MD looks for signs, symptoms, blood samples, other samples to submit to Lab. We collect samples from the field when we suspect a problem.

➤ Identification: laboratory IDs pathogen, MD checks his surveillance to see if it agrees with ID

We match our IDs to sites and habitats to target.

➤ Diagnosis/Decision: is made, a pathogen/species is targeted

➤ Curative Plan/Methods of Control: selected

➤ Antibiotics/Pesticides: prescribed/selected

➤ TREATMENT AND FOLLOW-UP!

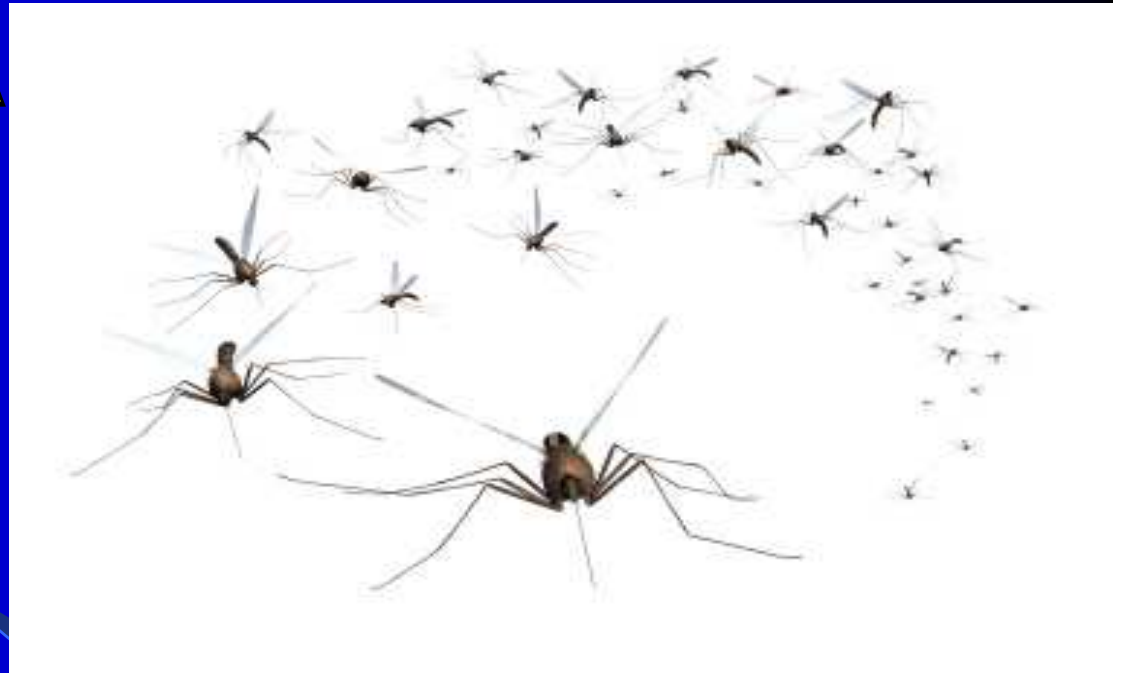
If you think the MD is not aware of the value of **Identification** on the previous slide, ask him if he is willing to suffer the legal consequences of prescribing medications to a patient without a confirmed diagnosis (ID of problem).

Identification of problem species in mosquito control is as important to our programs as it is in medical situations.

- ID of problem species provides confidence that guides your control actions.
- ID of problem species puts you on firm ground when addressing the media and the public. You know what you are talking about.
- Overall, ID helps prevent the over use of personnel, time, pesticides, and equipment, while providing focus for control success.

WE HAVE A PROBLEM!

(How to describe and name all the species.)



TOO MANY MOSQUITO SPECIES!

- In 1959 the first world catalog contained 2,401 species.
- Currently, 50 years later we have 3,520 species.
- Harbach (2007) estimated the 3,520 may only be 1/3 to 1/5 of actual living species.
- 1,119 species described in last 50 years at rate of only 22.4 species per year. (Too slow!)

Currently in the USA there are 180 species or only 5% of the 3,520, but we still have 4 undescribed species.

In the rest of the world the numbers boggle the mind.

➤ **913 *Aedes* and *Ochlerotatus***

➤ **763 *Culex***

➤ **476 *Anopheles***

➤ **265 *Uranotaenia***

➤ **140 *Wyeomyia***

➤ **88 *Toxorhynchites***

➤ **57 *Coquillettidia***

➤ **48 *Psorophora***

➤ **38 *Orthopodomyia***

➤ **37 *Culiseta***

There are big ID problems on a world basis, but identifying mosquitoes in the USA is fairly easy

- we have good keys and literature base
- we have numerous personnel that identify mosquitoes
- we have good equipment and working conditions
- we have identification expertise at three levels

Three levels of ID expertise to help you select the best ID method for your program/research

- I. Identifiers.** Backbone of mosquito surveillance and control. Identify numerous specimens and species routinely. Front line in detecting invasive species and abundance changes.
- II. Morphological Taxonomists.** Investigate species differences, describe new species, and evaluate natural groupings. Provide training, keys, guidelines, and literature.
- III. Molecular Geneticists.** Investigate species genomes, detect genetic sequences of species that serve as ID primers, and develop new techniques of value for mosquito ID.

“Pros” and “Cons” of 3 levels of
mosquito ID expertise
(hereafter Identifier, Taxonomist, and Geneticist)

I. Equipment/Technical Support

A. Identifier – moderately cheap and durable
even in field

B. Taxonomist – more expensive and
extensive, but durable even
in field

C. Geneticist – Very sensitive and expensive,
best used in laboratory due to
contamination problems.

II. TRAINING REQUIRED

- A. Identifier – easily acquired with adequate background info., short ID courses, and OJT
- B. Taxonomist – usually Ph.D. education and training in entomology, morphology, biological sciences, and museum and field experience
- C. Geneticist – Ph.D. training in classical and molecular genetics, biology, biochemistry, and statistics, but usually limited training in entomology and taxonomy

III. EXPERTISE

A. Identifier – Can sort and ID local mosquitoes easily and accurately on routine basis.

B. Taxonomist – Accurately identifies genera and species over large geographical areas. Studies, identifies, and describes new species following rules of International Code of Zoological Nomenclature (ICZN).

C. Geneticist – Can detect, isolate, and use genetic primers to ID species. Uses genetic data in studies to determine phylogenetic relationships. Can target genes (alleles) that affect biological and ecological attributes of mosquitoes

IV. IDENTIFICATION ACCURACY

A. Identifier – levels vary based on training and experience, but usually more than 90%.

B. Taxonomist – with literature and reference specimens, trained to ID at 98-100% level.

C. Geneticist – without contamination, ID level is 100%. However, usually needs a preliminary morphological ID in order to select or prepare the correct primers.

V. THROUGHPUT (speed of productivity)

- A. Identifier –IDs hundreds or thousands of local specimens with 90+% accuracy on daily basis.
- B. Taxonomist – Rapidly sorts and IDs hundreds or thousands of specimens of many species at 98-100% accuracy from different geographic areas. Often IDs without use of keys.
- C. Geneticist –Due to time intervals in tests, testing one specimen per well or vial, obtaining correct primers, and precautions to prevent contamination, identification throughput is slow. Routine ID of multiple species in large numbers is impractical and expensive.

VI. WRITTEN RESOURCES

- A. Identifier – requires keys and guidelines until very experienced. May prepare own local keys.
- B. Taxonomist – maintains personal library of keys and literature for different geographical areas. Searches for new characters and publishes results. Provides newly prepared keys to Identifiers.
- C. Geneticist – relies on recent publications in professional journals. Designs, develops, and tests new techniques that are then published.

VII. FIELD MOBILITY

- A. Identifier – can respond rapidly to identify species at targeted sites, disease outbreaks, and post-disaster mosquito assessments.
- B. Taxonomist – can direct rapid collecting and ID efforts. Responds rapidly to ID and assess mosquito populations during disease outbreaks and post-disaster situations in different geographical areas.
- C. Geneticist – mobility usually limited by sensitive equipment and contamination problems. Often collaborates with field people who collect and ID specimens and ship to geneticist for molecular testing.

VIII. PRESERVED MATERIAL

- A. Identifier – may or may not preserve specimens (dried or alcohol) for reference. Saves specimens for pooling efforts.
- B. Taxonomist – preserves specimens for reference during studies to detect new species or intra-species variations. Often uses specimens in ID courses, provides reference specimens to Identifiers, or pools specimens for virus tests.
- C. Geneticist –preserves species genomes and species specific genetic sequences at ultra-low temperatures and some deposited in GenBank.

IX. TEACHING AND SUPPORT

- A. Identifier – experienced personnel help train new employees, and also provide biological information important for identification.
- B. Taxonomist – provides ID training courses to students and Identifiers. Confirms ID for specimens submitted and provides requested literature.
- C. Geneticist – provides training to university students. Provides limited molecular IDs upon request. Collaborates with Identifiers and Taxonomists.

X. NUMBERS AVAILABLE

- A. Identifier – most numerous identification resource on world wide basis. Huge increase in USA due to WNV invasion.
- B. Taxonomist – becoming an endangered resource due to very limited educational and fund support. Decline in numbers explains the slow rate of new species descriptions.
- C. Geneticist – Rapidly growing identification resource in developed countries. Should become more active in describing and naming new species.

OTHER IMPORTANT CONSIDERATIONS

- **Loss of Identifiers due to demise of programs**
- **Increasing diseases due to human population pressures caused by global warming**
- **75 new “provisional” *Anopheles* species need to be formally described and named.**
- **Increase the deposition of species genetic sequences (primers) in GenBank. Only 447 (12.8%) of 3,520 species now in GenBank.**
- **Condense descriptions of new species and include molecular genetic differences (Collaboration!).**

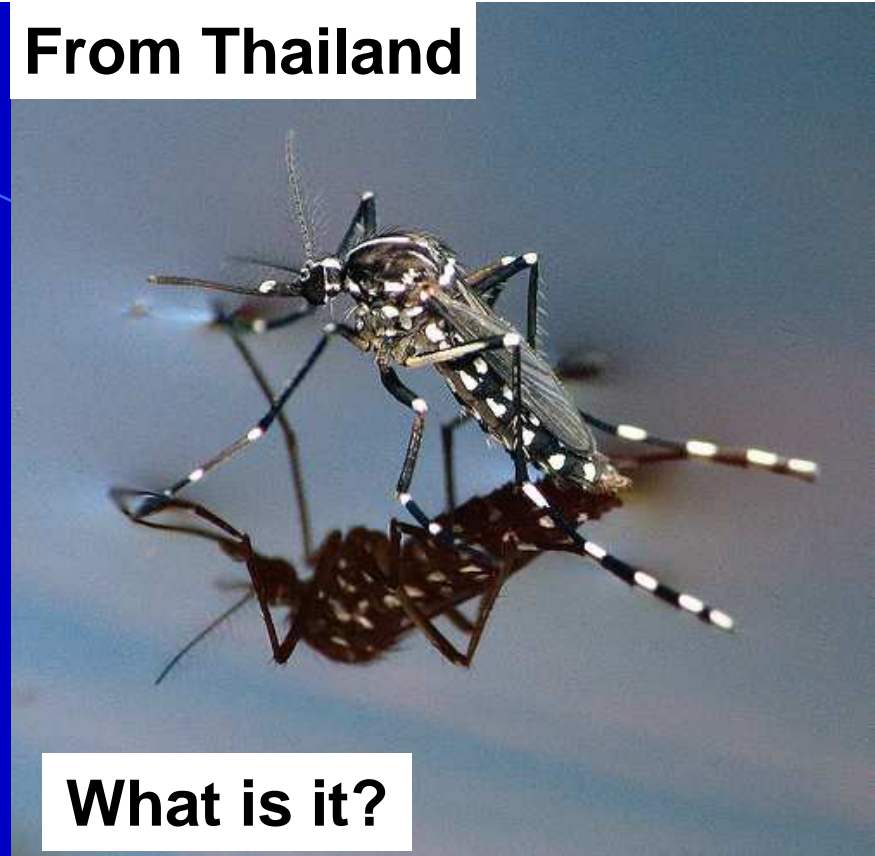
Morphology or Molecular?

Here are my opinions.

1. There is no “either/or” choice. BOTH ARE ESSENTIAL!
2. Applied mosquito surveillance/control programs will continue to rely primarily on morphological ID.
3. Public Health organizations concerned with pathogens of humans and domestic animals will need to use both methods.
4. Universities and basic research organizations will rely primarily on molecular techniques and use field collected or museum specimens.

From Thailand

Conclusions



What is it?

1. Taxonomists and Geneticists need to be cross-trained to deal with naming and describing new species.
2. Morphological ID will be needed as far as I can see in the future.
3. Molecular ID is the most accurate method, but not automatically the right method for all efforts.

ANY QUESTIONS?

THANKS!