Slightly Less Simple Mosquito Modeling

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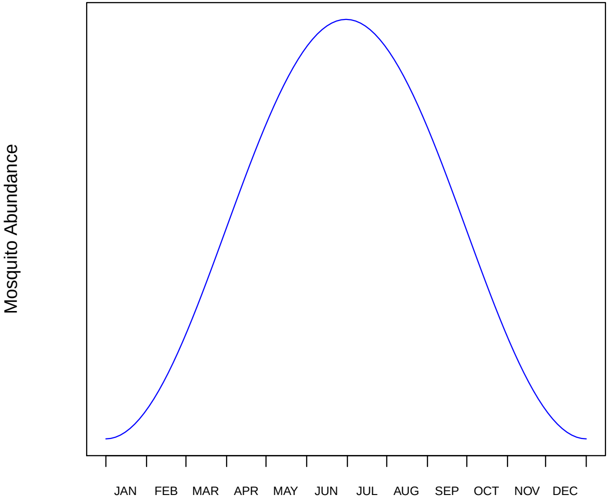
What's this talk really about?

- expression with models,
- simple analytical approaches,
- a little dimensional analysis,
- how to connect those with experiments, and
- a little about work habits and tools



Mosquito Abundance
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

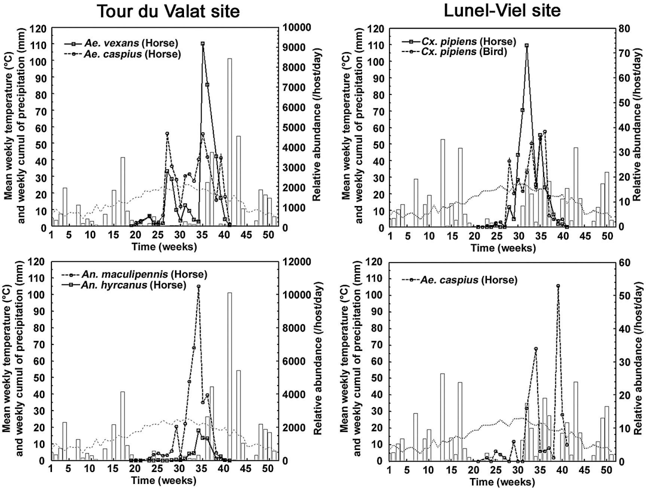


Figure: Bicout et al. "Horse-, Bird-, and Human-Seeking Behavior and Seasonal Abundance of Mosquitos in a West Nile Virus Focus of Southern France". J. Med. Entomol. 43(5): 936-946 (2006)

So, a Disconnect.

Specifically, it is impossible to match features like peak population, total population over a year, and turnover rate with a functional form

$$M(t) = C \sin(\omega t + \theta)$$

. . . and these features can be critical to predicting transmission dynamics, and thus planning interventions.

Do Better, But Keep It Simple

What's appealling about this trigonometric representation?
Simplicity:

- two parameters
- no spatial features
- "easy" analytical form

Possible to identify alternatives that *can* match salient features, but still retain these features?

What are those salient features?

- every year,
- over a relatively short duration,
- the mosquito population rapidly increases,
- sits at a high level of activity,
- then rapidly declines,
- apparently connected with resource availability & environmental suitability

What's present in the trigonometric formulation?

- every year, **CHECK!** . . . *but not the rest of:*
- over a relatively short duration,
- the mosquito population rapidly increases,
- sits at a high level of activity,
- then rapidly declines,
- apparently connected with resource availability & environmental suitability

1. useful to write models in terms of measurable parameters,
2. measurable parameters are not scale-free,
3. mathematics is more useful when scale free, therefore
4. dimensional analysis is awesome

“New” Habits and Tools

The general arrow of scientific work has been towards increased specialization and collaboration.

This presents a few challenges to getting work done:

- lashing together methods from different fields,
- getting genuine peer-review, and
- the purely mechanical handling of different people simultaneously working on the same “thing”

How can we address these issues?

“New” Habits and Tools

Fortunately, there’s a whole industry that’s continuously tackling this exact problem: software development, and more specifically open-source software projects.

What tools and habits can we adopt from this field? What risks are associated with that? What’s still missing?

The Good

- version control systems,
- collaborative tools on top of those,
- preference for code documentation leading to
  - bite-sized parts,
  - modularity,
  - re-usability, and
  - verifiability (a/k/a unit testing)
- open availability of all source,
- combines with version control to provide complete history of work product

The Bad

- openness can make for opportunity to be “scooped”,
- can focus more on process than product,
- learning curve for most scientists

The Ugly

- university contracts' intellectual property clauses,
- academic institutions don't "get" these tools,
- community adoption?

Why bring this up?

It's a little bit advocacy, and I built this presentation using this work model.