Floodwater mosquito management in the western USA

Larval control solutions in flood plains & irrigation habitats

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Lewis & Clark on the Missouri:

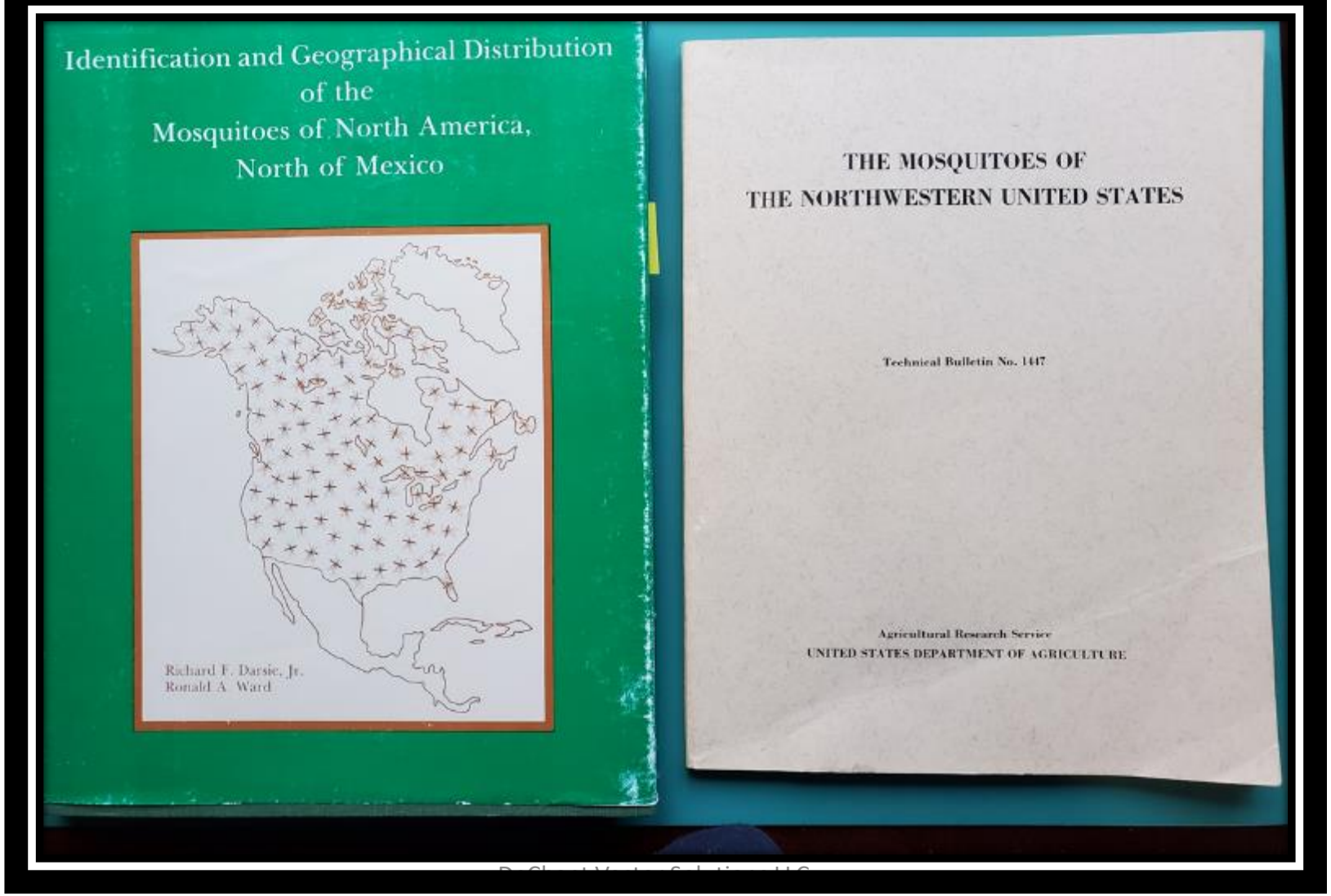
At the Falls of the Missouri in June-July of 1805, the men spent every moment for a full month under the constant threat of ambush by either grizzlies or mosquitoes or, more likely, both at the same time.

Source: True West Magazine
https://truewestmagazine.com/wp-content/uploads/2005/09/lewis-clark-great-falls.jpg

Western Floodwater Habitats and Species

Habitats	Aedes/Ochlerotatus Species	Successional Species
River/Stream Floodplains	*Aedes vexans, Aedes sticticus, Aedes spenceri idahoensis*	*Culex tarsalis, Culex pipiens, Anopheles punctipennis, Anopheles freborni*
Flooded Pastures	*Aedes nigromaculus, Aedes melanimon, Aedes dorsalis, Aedes vexans*	*Culex tarsalis, Culex pipiens*
Duck Clubs	*Aedes melanimon, Aedes dorsalis*	*Culex tarsalis, Culex pipiens*
Snowmelt/Rainwater Pools	*Aedes washinoi, Aedes increpitus, Aedes communis, Aedes hexodontis, Aedes fitchii*	*na*
Salt Marshes	*Aedes dorsalis, Aedes squamiger, Aedes taeniorhynchus*	*Culex tarsalis*

Know your Mosquitoes!



River Floodwaters

Lower Columbia River Floodwaters

Flooded Pastures

Flooded Pastures

Refuges and Duck Clubs

Refuges and Duck Clubs

Salt Marshes

- Pickleweed, bullrush, grass & sedge
- Depressions above normal high tide line
- Influenced by tide & wind
- Complex systems

Salt Marshes

Floodwater Mosquito Challenges

- Flight Range
- Aggressive biting behavior
- Habitat mapping
- Hydrology (prediction)
- Development speed
- Accessing habitats
- Treatment/coverage

The Columbia River Basin

- 2,000 km (1242 mi) long
- 820-meter (2690 ft) drop from headwaters to ocean.
- Fourth largest river in North America by volume.
- Watershed includes BC and seven US states
- Snow melt & rainfall contribute to flow
- 14 hydroelectric dams on its main stem alone.
- 20+ Mosquito control programs throughout the drainage.
- Programs affected by unintentional and intentional flooding.

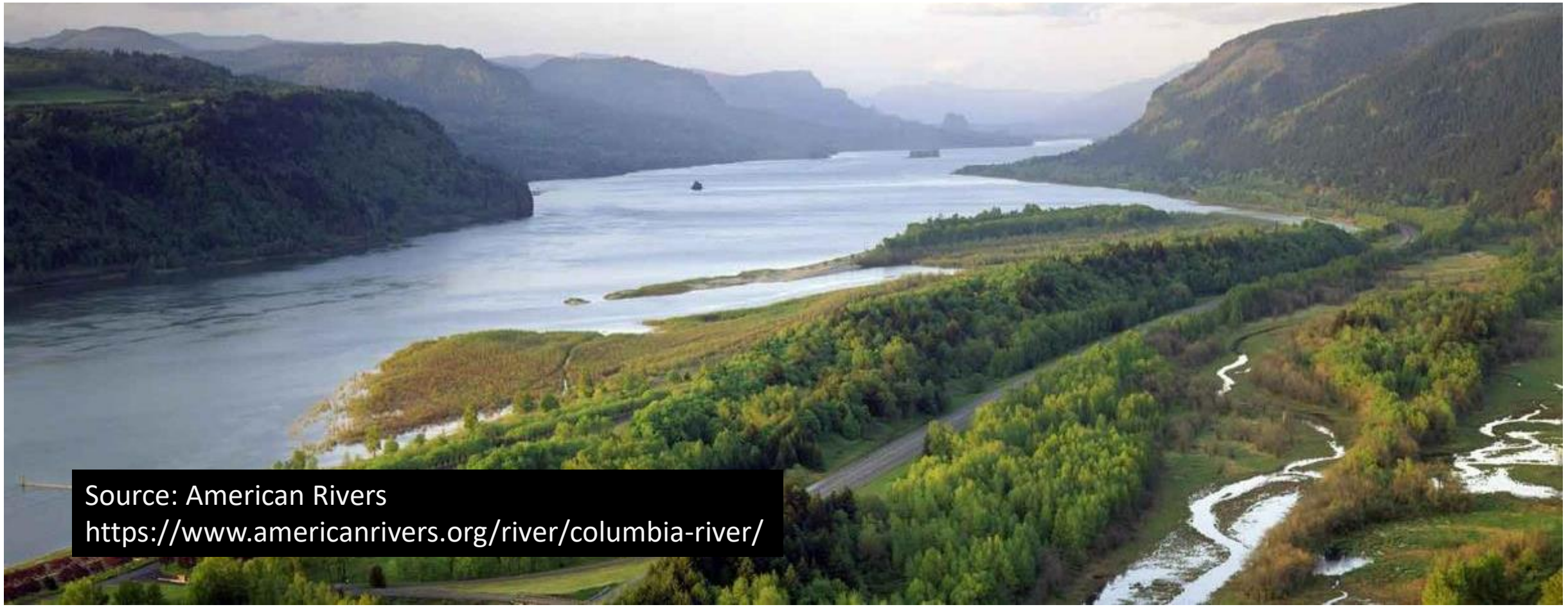
Yes, The Columbia Does Flood!

Photo: Kevin Wingert, Bonneville Power Administration

The Columbia Below Bonneville Dam

- *The annual spring floods of the Columbia River usually inundate thousands of acres of open and wooded lowlands along its borders below Bonneville Dam for a distance of about 60 miles or more up and down the river from Vancouver, Wash., and Portland, Oreg. The Willamette River floods smaller areas for about 15 miles above the point where it joins the Columbia, and considerable backing up of water occurs near the mouths of smaller tributaries in this region. The area that flooded above the site of the Bonneville Dam before it was built is now permanently covered with water (Stage, 1943).*

  - *Studies on Aedes Vexans (Meig.) and Aedes Sticticus (Meig.), Flood-Water Mosquitoes, in the Lower Columbia River Valley*
  - *C. M. Gjullin, W. W. Yates, H. H. Stage*
  - *Annals of the Entomological Society of America, Volume 43, Issue 2, 1 June 1950, Pages 262–275, https://doi.org/10.1093/aesa/43.2.262*
  - *Published: 01 June 1950*



The Columbia Gorge Below Bonneville Dam

Floodplains Near Portland, OR and Vancouver, WA

- Areas between 8 and 24 feet above mean sea level.
- Clark, Columbia, Cowlitz, Multnomah & Skamania Counties affected.
- Well mapped and characterized in GIS systems.
- Flood predictions based on river gages and flow data from Bonneville Dam
- Cooperative aerial *Bti* granule applications.

Source: City of Portland Environmental Services

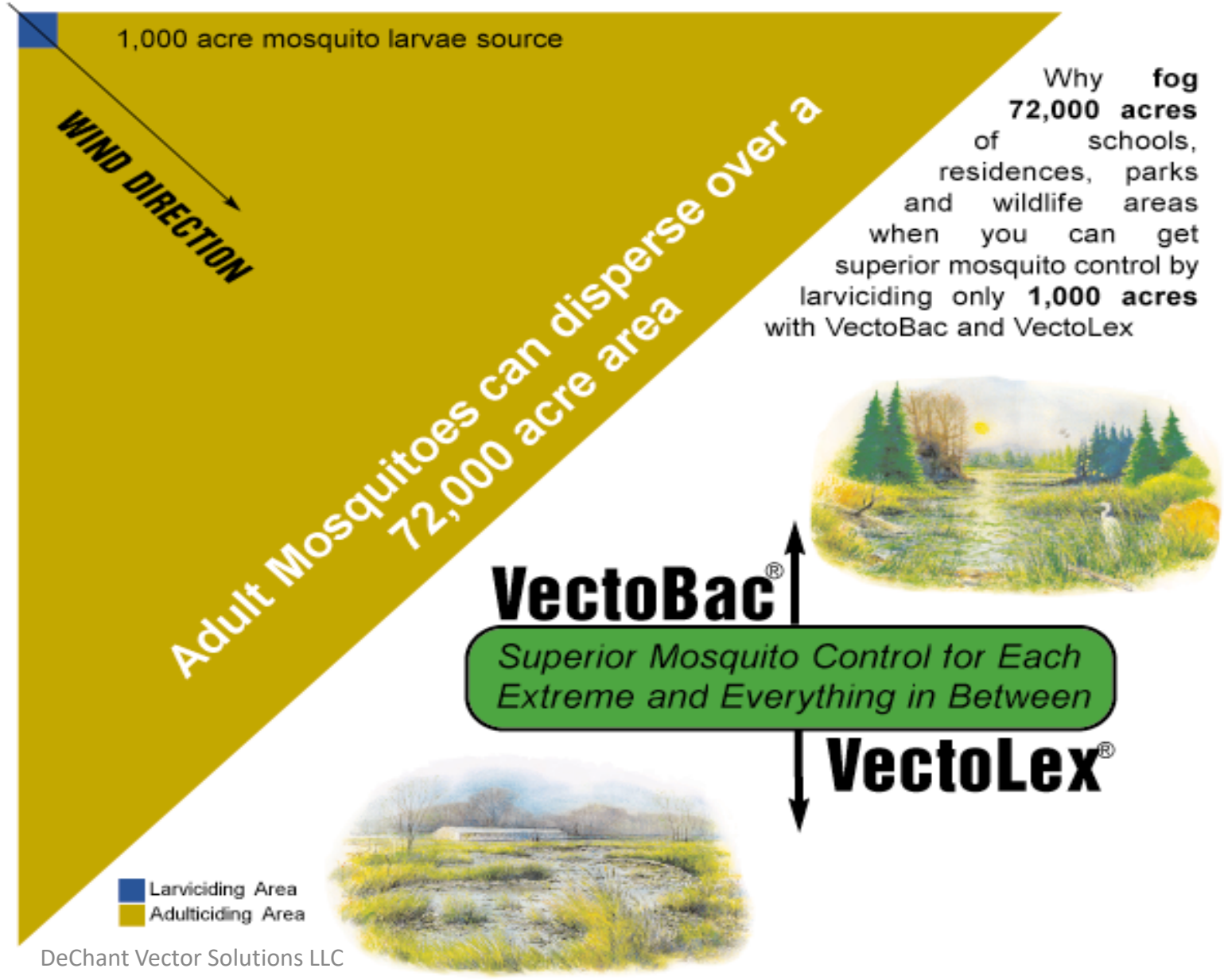
Focus on Larval Control

Larviciding Logic

An example of the advantages of larviciding compared to adulticiding

- Estimating The Numbers
- 1000 acres
- 10 per dip
- 5 billion mosquitoes

- 15 mile flight range
- 90 degree dispersion
- 72,000 acres



Don’t want this to happen!

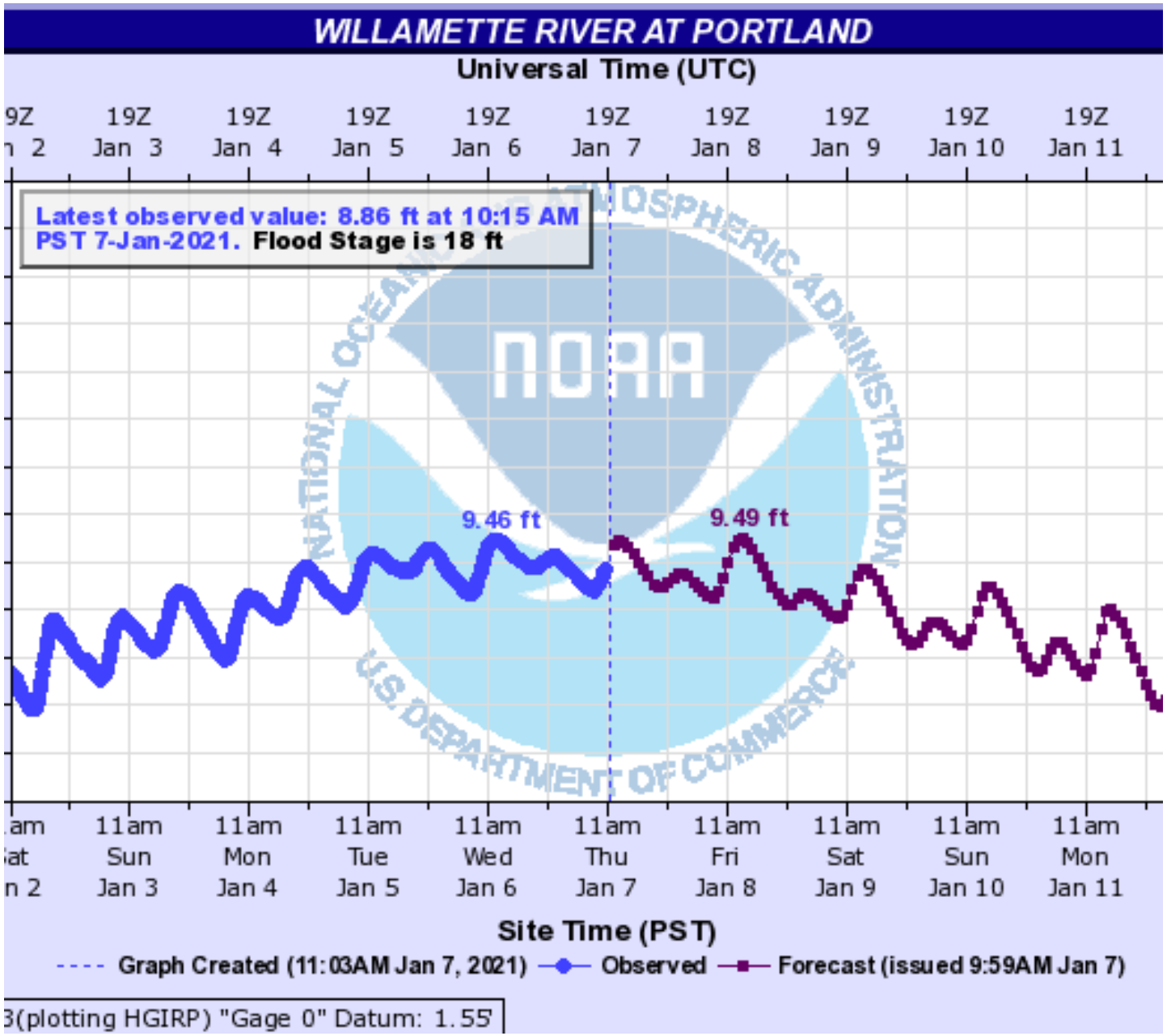
Surveillance & Predicting Broods

- **Need to react quickly and with maximum efficiency**
- **Efficient survey requires planning & local knowledge**
- **GIS/GPS systems are essential**
- **Important to understand river stages and tidal influence**

Photos by Motoya Nakamura

River Gage Data

- Readily available in real time
  - Willamette – Portland
  - Columbia – Vancouver
  - Columbia - Longview
- Correlates with flooding of larval sources
  - Source elevation data
  - GIS shape files of sources
  - Local algorithms using multiple gages, history, and experience
- Helps guide surveillance & control decisions
  - Where to survey
  - Treatment timing
  - Resource planning & logistics



Source: Columbia Drainage Vector Control

Flooding and Treatment Zones in Columbia County

Control Strategies & Tactics – Portland 1945

Dorthy McCullough Lee persuaded the colonel in charge at the 44th Army Air Force Base – Located at what is now Portland's International Airport – "to fly a Billy Mitchel B-25 bomber over the worst breeding areas" spraying 3000 acres with a 5% solution of DDT in SAE-40 and diesel oil.

From

A Brief History of Mosquito Control in the Pacific Northwest

By Gordon Patterson, Wingbeats Magazine, Winter 2019

Control Strategies & Tactics –2021

Monitoring mosquito populations helps us to identify changes in our community such as geographic spread of vector mosquitoes.

Preventing or controlling ideal breeding habitat. Different mosquitoes prefer different habitats. We work to identify what those habitats are and work with landowners and community members to eliminate mosquito breeding conditions when possible.

Controlling mosquitoes as larvae prevents mosquitoes from becoming flying and biting adult insects.

We prioritize immature mosquito control before they become flying, biting adults. Usually this means applying BTi (a soil bacteria found throughout our environment) into habitats with excess mosquito populations.

From

Multnomah County Vector Control Website

Photos: Columbia Drainage Vector Control and West Umatilla VCD

Cooperative Aerial Program

- Mostly aerial application of Bti (VectoBac®) granules
- Sling bucket application

Ground Applications with Backpack & ATV

Strategies & Control Materials

- **Single-brood real time response (post flood) for large areas**
  - 200 ITU Bti corn cob granules
    - 5-10 lbs/acre (standard is 8lbs/acre)
    - L1 to early L4
  - 400 ITU Bti + 0.1% S-methoprene corn cob granules
    - 2.5-5 lbs/acre (standard is 4 lbs/acre)
    - L1-L4
- **Pre-flood/re-flood treatment**
  - 4.25% S-methoprene pellets
    - Multiple brood pre-flood (flood/re-flood)
    - 2.5-5 lbs/acre
    - Extended pre-flood window
  - 400 ITU Bti + 0.1% S-methoprene corn cob granules
    - Single brood pre-flood
    - 10-20 lbs/acre
    - Short pre-flood window
- **Transitional habitats (Aedes to Culex)**
  - Bti + Bsph combination granules (50 Bs ITU)
    - 5-20 lbs/acre
  - 4.25% S-methoprene pellets
    - 4 lbs/acre

Photo: Columbia Drainage Vector Control

The Future?