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## What's Going on with the WEST NILE VIRUS

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- Ilkal M.A., V. Dhanda, B.U. Rao, S. George, A.C. Mishra, Y. Prasanna, S. Gopalkrishna and K.M. Pavri. 1988. **Absence of Viraemia in Cattle after Experimental Infection with Japanese Encephalitis Virus.** *Transactions. Royal Society of Tropical Medicine and Hygiene* 82(4):628-31.

*Abstract:* Cow calves were infected with Japanese encephalitis virus (JEV) by parenteral inoculation. One batch was reinfected with JEV, followed by West Nile virus (WNV), while another batch was reinfected directly with WNV. No viraemia due to either JEV or WNV was demonstrated in any of the calves. *Culex tritaeniorhynchus* mosquitoes fed on 4 of the calves infected with JEV during the first 10 d had no detectable virus, nor did they transmit the virus by bite to susceptible baby chickens. In another experiment, calves did not develop viraemia after infected *C. tritaeniorhynchus* mosquitoes were allowed to feed on them. Neutralizing and/or haemagglutination-inhibiting antibodies against JEV were demonstrated in 6 of the 11 calves, which explains the high proportion of JE seropositives among cattle in India. All the 5 calves that were infected with WNV subsequent to JEV developed neutralizing and haemagglutination-inhibiting antibodies against WNV also. The study indicates that cattle do not play a role in the maintenance of JEV in nature. Authors are with the National Institute of Virology, Puna, India.

- **International Conference on Emerging Infectious Diseases.** July 16-19, 2000. Center for Disease Control. Atlanta, Georgia.

*Summary:* Over 2000 public health professionals in many areas of specialty met in Atlanta in mid-July for the International Conference on Emerging Infectious Diseases. The program included plenary sessions and symposia with invited speakers, presentations on emerging infections, and oral poster presentations. Major topics included current work on surveillance, epidemiology, research, communication and training, bioterrorism, and prevention and control of emerging infectious diseases, both in the United States and abroad. The [Proceedings of the ICEID Conference](#) will be published (electronically and in print) in a special issue of the [Emerging Infectious Diseases Journal](#). Selected sessions are now available online via the conference homepage, <http://www.cdc.gov/ICEID>.

- James, Maurice T. and Robert F. Harwood. 1969. **Herm's Medical Entomology** The Macmillan Company: London. 484 pages.
- Jensen, T., R. Lampman, M. C. Slamecka and R. J. Novak. 2000. **Field Efficacy of Commercial Antimosquito Products in Illinois.** *Journal of the American Mosquito Control Association* 16(2):148-152.

*Abstract:* We evaluated the efficacy of commercial antimosquito products in field trials in Illinois in June 1998 by comparing mosquito landing rates. Products tested were a sonic mosquito repeller, an insect killing grid using

ultraviolet light and 1-octen-3-ol as lures, mosquito smoke coils containing a pyrethroid, citronella candles, the mosquito plant *Pelargonium citrosum*, and a N,N-diethyl-3-methylbenzamide (deet)-impregnated wrist band. Tl sonic mosquito repeller, insect killing grid, and mosquito smoke coils were evaluated in 16 trials over 5 days; tl citronella candles and mosquito plants in 11 trials over 4 days; and the wrist bands in 4 trials on 1 day. In all 3 studies, we compared landing rates with the antimosquito products to both positive (topical application of a de formulation) and negative (no treatment) controls. The deet topical repellent had a consistently lower landing rate than all the nontopically applied products tested. However, the mosquito coils and the deet-impregnated wrist bands did significantly reduce mosquito landing rates relative to untreated controls.

- Jensen, Truls, Sharon R. Lawler, and Deborah A. Dritz. 1999. **Effects of Ultra-Low Volume Pyrethrin, Malathion, and Permethrin on Nontarget Invertebrates, Sentinel Mosquitoes, and Mosquitofish in Seasonally Impounded Wetlands.** *Journal of the American Mosquito Control Association* 15(3):330-338.

*Abstract:* Wildlife managers are concerned that insecticides ad to control mosquitoes could suppress invertebrates on which wildlife feed. We assessed whether ultra-low volume (ULV) applications of pyrethrin, permethrin, malathion for control of adult mosquitoes reduced macroinvertebrate abundance and biomass or killed mosquitofish in seasonal wetlands in California. Pyrethrin was applied over 3 seasonal wetlands on Sutt National Wildlife Refuge (NWR), and malathion or permethrin were each applied over 2 seasonal wetlands on the Colusa NWR. Three control wet were used per site. We measured aquatic macroinvertebrate abundance a biomass before and after insecticide application and compared the survival of mosquito larvae held in sentinel cages. At Colusa, we also used mosquitofish as sentinels, caged adult mosquitoes over the wetlands to test pesticide efficacy and drift, and sampled night-flying insects using ultraviolet light traps. Results showed no detectable reductions in the abundance or biomass of aquatic macroinvertebrates in treated wetlands. Larval mosquitoes showed high survival in all areas. All adult mosquitoes died when caged over wetlands treated wii malathion or permethrin, but all survived in controls. All mosquitofish survived. Flying insect abundance decreased after insecticide application in both treated and control wetlands but rebounded in 48 h. Results indicated that ULV applications of these insecticides to control adult mosquitoes are unlikely to have substanti effects on the aquatic insects or fish in seasonal wetlands.

- Jensen, Truls, and Robert K. Washino. 1994. **Comparison of Recapture Patterns of Marked and Released *Aedes vexans* and *Ae. melanimon* (Diptera: Culicidae) in the Sacramento Valley of California.** *Journal of Medical Entomology* 31(4): 607-610.

*Abstract:* Recapture patterns of *Aedes vexans* (Meigen) and *Aedes melanimon* Dyar were compared in a mark-release-recapture study conducted on the Colusa National Wildlife Refuge, Colusa County, California, from 15 August to 2 September 1988. The 2.0% recapture rate for *Ae. vexans* females was significantly greater than the 0.9% rate for *Ae. melanimon* females. Daily survivorship of 0.70 for *Ae. vexans* females was significantly lower than the 0.84 estimate for *Ae. melanimon*. The two species had different patterns of dispersal. On day 1, when th majority of marked females of both species were recaptured, the mean dispersal distance for *Ae. vexans* females were significantly greater than that for *Ae. melanimon*. The cumulative dispersal distance for *Ae. vexans* females decreased during the study period. In contrast, *Ae. melanimon* dispersal increased gradually over time.

- Jia, Xi-Yu, Thomas Briese, Ingo Jordan, Andrew Rambaut, Han Chang Chi, John S. Mackenzie, Roy A. Hall, Jacqui Scherret and W. Ian Lipkin. December 4, 1999. **Genetic Analysis of West Nile New York 1999 Encephalitis Virus.** *The Lancet*, London. 354 (9194): 1971-1972. <http://www.thelancet.com/>.

*Abstract:* Analysis of the genome of the flavivirus responsible for the 1999 New York City encephalitis epidemic cloned from human brain by reverse-transcription polymerase chain reaction indicates its identity as a lineage West Nile virus closely related to WNVs previously isolated in the Middle East.

- Jordan, Ingo, Thomas Briese, Nicole Fischer, Johnson Yiu-Nam Lau, and W. Ian Lipkin. 2000. **Ribavirin Inhibi West Nile Virus Replication and Cytopathic Effect in Neural Cells.** *The Journal of Infectious Diseases* 182:1214-1217.

*Abstract:* West Nile virus (WNV) is an emerging mosquito-borne pathogen that was reported for the first time i the Western hemisphere in August 1999, when an encephalitis outbreak in New York City resulted in 62 clinica cases and 7 deaths. WNV, for which no antiviral therapy has been described, was recently recovered from a po of mosquitoes collected in New York City. In anticipation of the recurrence of WNV during the summer of 2000 an analysis was made of the efficacy of the nucleoside analogue ribavirin, a broad-spectrum antiviral compoun with activity against several RNA viruses, for treatment of WNV infection. High doses of ribavirin were found inhibit WNV replication and cytopathogenicity in human neural cells in vitro.

- Katz Y., Shlomo Lustig, Izhar Ben-Shlomo, David Kobiler, David Ben-Nathan. 2002. **Inhalation anesthetic-induced neuroinvasion by an attenuated strain of West Nile virus in mice.** *Journal of Medical Virology*. 66(4): 576-580. <http://www3.interscience.wiley.com/cgi-bin/fulltext?ID=90510691&PLACEBO=1E.pdf>

*Abstract:* There are contradictory reports regarding the effects of inhalation anesthetics on the immune system. Measurable immune responses have been studied in vitro, but little is known about the in vivo effects in the intact organism. We used an attenuated, non-neuroinvasive, nonlethal strain of the encephalitic West Nile virus termed WN-25, which can become lethal in combination with environmental stressors, to study possible modulatory immune effects of inhalation anesthetics in mice. Both single short-term exposure and repeated exposure to halothane and nitrous oxide were studied. Exposure to 30% CO<sub>2</sub> served as a positive control. Mortality, brain invasion, spleen weight, and antiviral antibodies served as the experimental endpoints. Halothane and nitrous oxide led to viral brain invasion, increased mortality, and suppressed immune response in a concentration- and time-dependent manner. Repeated exposures had a cumulative effect. Assessment of the stability of the viral attenuation did not demonstrate any alteration in the character of the virus, suggesting an increased access to the brain by inhalation anesthetics that led to the fatal encephalitis. These findings may be of special concern to populations at risk, such as operating room staff and patients undergoing general anesthesia in endemic areas of encephalitic virus species, in which subclinical infection may develop into an overt disease

- Kent, Robert. 1994. **The Development of the New Jersey Biological Control (Mosquito Fish) Program.** *Proceedings of the 40th Annual Meeting of the Northeastern Mosquito Control Association, December 1994.* . <http://www.nmca.org/nmca94-16.htm>.

*Excerpt:* As a continuing effort to control mosquitoes by way of the most efficient, economical and environmentally sound methods, mosquito larvae-eating fish have played an important role in New Jersey. Both saltmarsh and freshwater marsh native fish species have been encouraged to inhabit sites of mosquito production. The introduction of the mosquitofish, *Gambusia affinis*, has been an integral part of this effort for decades and decades. The pitfalls associated with using this species have varied. State and federal regulations regarding their use have been unclear. Stocking permits for this activity have been restrictive, difficult to understand and to obtain. The biology of the fish, its habitat, larvivorous efficiency and its colonization have often times eluded even experienced field biologists. Finally, the cost associated with the commercial procurement of *Gambusia* has made its full introduction into many programs a luxury. The approximate cost of the fish obtained from commercial hatcheries at this time was approximately fifty cents each. In 1990, as a result of a working relationship with the NJ Division of Fish, Game and Wildlife, an opportunity arose which inspired the concept of directly involving that Division's Bureau of Freshwater Fisheries in the colonization, stocking and surveillance of *Gambusia affinis*.

- Kilpatrick, Adams. 1996. **Proceedings and Papers of the 35th Annual Conference of the California Mosquito Control Association and the 23rd Annual Meeting of the American Mosquito Control Association**, Feb 5-8, 1967, San Francisco, CA, p53.

*Summary:* Details the efforts and efficacy of an aerial spraying program to control an urban epidemic of St. Louis encephalitis in Dallas in 1966. See also Hopkins et al. 1975. The following are excerpts from a Nov11'00 posting to ProMED-mail from F. Blaine Hollinger, MD (blaine@bcm.tmc.edu) about this epidemic and the efficacy of aerial spraying, in which the Kilpatrick and Hopkins papers are referenced:

"The presumed effectiveness of aerial spraying can be found in studies conducted in the 1960s. As a member of the Virology Division, Bureau of Laboratories, at the Centers for Disease Control (CDC), I [FBH] was part of a cooperative program between the CDC, the Texas State Health Department and the Dallas Health Department investigate and control an urban epidemic of St. Louis encephalitis in Dallas in 1966. During this epidemic, ultra low volume (ULV) malathion was used for the first time to control such an outbreak by aerial spraying. The mosquito vector control program consisted of ULV application of 95% malathion at the rate of approximately 225 ml per hectare by low-flying US Air Force C-123 Globemaster aircraft. A total of approximately 1927 km<sup>2</sup> of Dallas city and county were sprayed over 7 days in the early morning hours. I recall witnessing a "bugless" city during that interval. As described in the publications listed below, the program was highly effective in killing adult mosquitoes, but did not generally reduce the existing larval mosquito population.

The prime thrust during an epidemic such as this is to eliminate the infected adult mosquitoes as quickly as possible. Spraying is generally carried out with supplemental ground control with fogging. The efficacy of such

a program on human cases is difficult to accurately evaluate. However, after the aerial spraying, there was a marked fall in the number of mosquito vectors and in their infection rate, which was felt to have effectively reduced vector transmission. While virus activity was reduced significantly, it was not entirely eliminated. However, immediately after spraying, the resting site counts dropped to near zero for about a week. It could be assumed that both infected and non-infected vector mosquitoes were reduced enough to temporarily reduce transmission to an ineffectual level. The hypothesis is that by the time surviving mosquitoes reemerge, viremia in infected birds will have either disappeared or declined to the point that the infection cycle might be broken."

- Kitron, Uriel, Donald W. Webb and Robert Novak. 1989. **Oviposition Behavior of *Aedes triseriatus* (Diptera: Culicidae): Prevalence, Intensity, and Aggregation of Eggs in Oviposition Traps.** *Journal of Medical Entomology* 26(5): 462-467.
- Kline, Daniel L. 1998. **Olfactory Responses and Field Attraction of Mosquitoes to Volatiles from Limburger Cheese and Human Foot Odor.** *Journal of Vector Ecology* 23 (2 Dec):186-94.

*Abstract:* Olfactory responses of female *Aedes aegypti* (Linnaeus) to various odor stimuli were studied in a dual-port olfactometer. Responses (*i.e.*, the percent of ca. 75 available female mosquitoes in flight chamber entering each olfactometer port) were studied toward clean conditioned air (control), human foot skin emanations (collected on socks by wearing them for three days), human hand, and Limburger cheese. Mean percent response was greatest to the human hand (80.1%), followed by the human worn sock (66.1%), Limburger cheese (6.4%), and control (less than 0.1%). In field studies the worn sock alone attracted very few mosquitoes but a synergistic response occurred to the sock + carbon dioxide baited traps for most species of mosquitoes in six genera (*Aedes*, *Anopheles*, *Coquillettidia*, *Culex*, *Culiseta*, and *Psorophora*). This synergistic effect persisted even when the socks were exposed to environmental conditions for eight consecutive days. Limburger cheese alone did not attract mosquitoes to traps compared to unbaited traps, and there appeared to be a slight repellent effect for most mosquito species when used in combination with carbon dioxide.  
Author is with the USDA, ARS, Gainesville, FL 32604, USA.

- Kline, Daniel L, Gene F. Lemire. 1998. **Evaluation of Attractant-Baited Traps for Mosquito Management on Key Island, Florida, USA.** *Journal of Vector Ecology* 23(2 Dec): 171-185.

*Abstract:* A three-year research project was conducted on Key Island, Collier County, Florida, USA, to evaluate an innovative attractant-based mosquito management technique. In the first year, species composition, relative abundance, and spatial distribution were determined. Although 16 species were collected, the dominant species was the black salt march mosquito, *Aedes taeniorhynchus*, which was the primary pest species. Efficacy of a single line barrier, consisting of 52 carbon dioxide (200 cc/min) + octenol (ca. 4 mg/h) baited traps (1994) or insecticide (lambda-cyhalothrin) impregnated shade cloth targets (1995), spaced ca. 16.5 m apart, to reduce mosquito abundance in a resort area, was evaluated on the northern end of the island. Success was evaluated by means of baited surveillance traps located on both sides of the barrier. Traps and targets performed equally well. Though not statistically significant ( $p > 0.05$ ), there was a reduction in mosquito abundance in the resort area when the barrier was functional. These data indicate that with refinement this mosquito management technique may be practical in certain situations.

- Kline, Daniel L. 1999. **Comparison of two American Biophysics Mosquito Traps: The Professional and a new Counterflow Geometry Trap** *Journal of the American Mosquito Control Association, Inc.* 15(3): 276-282.

*Abstract:* Large cage and field studies were conducted to compare the efficacy of 2 American Biophysics Corporation mosquito traps, the standard professional (PRO) trap and a new counterflow geometry (CFG) trap. The PRO trap utilizes conventional downdraft technology and the CFG trap uses a patent-pending technology. In large cage studies, similarly baited CFG traps captured approximately 1.7 times as many laboratory-reared *Aedes taeniorhynchus* as the PRO trap. The CFG trap baited with CO<sub>2</sub> + octenol resulted in significantly reduced landing counts compared to all other treatments; mean landing count was reduced from 233.8 (12.99/min), when no trap was present, to 24.7 (1.37/min). In field studies against natural populations of woodland species, the CFG trap captured 7.8 times more mosquitoes than the PRO trap overall, and approximately 11 times more *Anopheles crucians*, *Anopheles quadrimaculatus*, and *Culex erraticus*.  
Author is with the USDA, ARS, Gainesville, FL 32604, USA.

- Kline, Daniel L. 2002. **Evaluation of various models of propane-powered mosquito traps.** *Journal of Vector Ecology* 27(1): 1-7.

*Abstract:* Large cage and field studies were conducted to determine the efficacy of various models of propane-

powered mosquito traps. These traps utilized counterflow technology in conjunction with catalytic combustion to produce attractants (carbon dioxide, water vapor, and heat) and a thermoelectric generator that converted excess heat into electricity for stand-alone operation. The cage studies showed that large numbers of *Aedes aegypti* and *Ochlerotatus taeniorhynchus* were captured and that each progressive model resulted in increased trapping efficiency. In several field studies against natural populations of mosquitoes two different propane traps were compared against two other trap systems, the professional (PRO) and counterflow geometry (CFG) traps. In these studies the propane traps consistently caught more mosquitoes than the PRO trap and significantly fewer mosquitoes than the CFG traps. The difference in collection size between the CFG and propane traps was due mostly to *Anopheles crucians*. In spring 1997 the CFG trap captured 3.6X more *An. crucians* than the Portable Propane (PP) model in spring 1998 it captured 6.3X more *An. crucians* than the Mosquito Magnet Beta-1 (MMB-1) trap. Both the PP and MMB-1 captured slightly more *Culex* spp. than the CFG trap. Author is with the USDA, ARS, Gainesville, FL 32604, USA.

- Kline, Daniel L. **Large Cage and Field Comparison Tests of Mega Catch and Mosquito Magnet Traps** *USDA Field Research Results* <http://www.megacatch.com/klineUSDA.html>

*Abstract:* The relative efficacy of various configurations of the Mega Catch<sup>a</sup> and Mosquito Magnet<sup>a</sup> mosquito traps were evaluated at three study sites: a large outdoor screen cage, a suburban residential backyard and a wildlife refuge. Laboratory reared *Aedes aegypti*, *Culex quinquefasciatus* and *Ochlerotatus taeniorhynchus* were used in the large cage studies. In these studies CO<sub>2</sub>-baited Mega Catch<sup>a</sup> traps caught nearly 2 times as many *Ae. aegypti* and nearly equal numbers of the other two species as the Mosquito Magnet<sup>a</sup> Pro trap. The Mega Catch<sup>a</sup> trap without CO<sub>2</sub> caught several hundred less *Ae. aegypti* and only about 0.25 times as many *Oc. taeniorhynchus* as the CO<sub>2</sub>-baited configuration. Studies conducted in a suburban residential backyard indicated that the Mega Catch<sup>a</sup> trap, whether baited with CO<sub>2</sub> or not, caught a larger variety of mosquitoes than the Mosquito Magnet<sup>a</sup> Pro: without CO<sub>2</sub> it caught about the same quantity of mosquitoes as the Pro, with CO<sub>2</sub> it caught ca. 3 times as many mosquitoes as the Pro. In the wildlife refuge several configurations of the Mega Catch trap were compared to the Mosquito Magnet<sup>a</sup> Pro and Residential models. The CO<sub>2</sub> baited configurations of the Mega Catch<sup>a</sup> traps (dry and wet collection methods) caught many more mosquitoes than either the Pro or Residential traps. Mixed results were obtained in comparative trials with the no CO<sub>2</sub> configurations. The Residential unit was the least effective in trapping mosquitoes in these trials. With the exception of the wet CO<sub>2</sub> baited configuration, the Pro and Residential units caught more *Culicoides* spp biting midges. Author is with the USDA, ARS, Gainesville, FL 32604, USA.

- Klingberg, M.A. W. Jasinska-Klingberg and N. Goldblum. 1958. **Certain Aspects of the Epidemiology and Distribution of Immunity of West Nile Virus in Israel.** *Proceedings of the 6th International Congress of Tropical Medicine and Malaria* 6:132-140.

*Summary:* At the time of this publication, Israel was the only country where epidemic West Nile fever had been recognized. Epidemics of varying intensity occurred in the human population in 6 of the 8 years beginning with first detection in 1950 (severe in 1950, 1953, 1957 with several hundred ill; lesser intensity with fewer affected in 1951, 1952 and 1954). Within a month after the first outbreak was detected in mid-July, 1950, it was at epidemic proportions: 636 cases of "overt disease" were recorded in a population of about 1000. Outbreaks consistently started suddenly in July, peaked in August-September and declined abruptly at end of September or early October. In some years there were two peaks. Total duration 8 weeks, with epidemic peaks 2-3 weeks. Epidemics were consistently located only in two places along the Mediterranean coast: 40 miles to the north of Tel Aviv and 15 miles to the SE.

"The immunity of the population living in the vicinity of the epidemic areas was studied by means of the CF reaction which indicates recent infection." 73% positive were found in endemic areas as compared with 7-12% in non-endemic areas. Among recent immigrants, CF antibodies were found in 5% of immigrants from Morocco as compared with 54% of immigrants from Egypt. It was noted that overnight visitors to epidemic areas became ill while day laborers did not (indicating that night-feeding mosquitoes were vectors) and that incidence was higher among those living in tents than in screened enclosures. Two species of culicine mosquitoes were most frequently caught: *Culex molestus* and *C. univittatus*.

- Klun, Jerome A., Da Ma, and Raj Gupta. 2000. **Optically Active Arthropod Repellents for Use Against Disease Vectors.** *Journal of Medical Entomology* 37(1): 182-187. <http://www.entsoc.org/pubs/jme/jmetocs/PDFs/me010000182o.pdf>

*Abstract:* Optically inactive 1-[3-cyclohexen-1-ylcarbonyl] piperidine and 1-[3-cyclohexen-1-ylcarbonyl]-2-methylpiperidine are repellents against blood-feeding arthropods. Pure stereoisomers of these compounds were

synthesized and characterized for use in bioassays. Initial laboratory tests with the malaria vector *Anopheles stephensi* Liston showed that this species was repelled differentially by the stereoisomers of 1-[3-cyclohexen-1-ylcarbonyl]-2-methylpiperidine. Two stereoisomers were twice as repellent as the other stereoisomers. These results indicate that stereoisomerism influences repellent efficacy in this class of compounds.

- Komar, N., R. Lanciotti, R. Bowen, S. Langevin and M. Bunning. **Detection of West Nile virus in oral and cloacal swabs collected from bird carcasses.** *Emerg Infect Dis* July 2002 [cited 2002 May 30];8. Hard copy pp741-742. <http://www.cdc.gov/ncidod/EID/vol8no7/02-0157.htm>.

*Abstract:* We evaluated if postmortem cloacal and oral swabs could replace brain tissue as a specimen for West Nile virus (WNV) detection. WNV was detected in all three specimen types from 20 dead crows and jays with an average of  $>10^5$  WNV PFU in each. These findings suggest that testing cloacal or oral swabs might be a low-resource approach to detect WNV in dead birds.

- Komar, Nicholas, Nicholas A. Panella, Joseph E. Burns, Stephen W. Duszka, Tina M. Mascarenhas, and Thomas O. Talbot. 2001. **Serologic Evidence for West Nile Virus Infection in Birds in the New York City Vicinity During an Outbreak in 1999.** *Emerging Infectious Diseases* 7(4): 621-625. <http://www.cdc.gov/ncidod/EID/vol7no4/komar2.htm>

*Abstract:* As part of an investigation of an encephalitis outbreak in New York City, we sampled 430 birds, representing 18 species in four orders during September 13-23, 1999, in Queens and surrounding counties. Overall, 33% were positive for West Nile virus-neutralizing antibodies, and 0.5% were positive for St. Louis encephalitis virus-neutralizing antibodies. By county, Queens had the most seropositive birds for WNV (50%); species with the greatest seropositivity for WNV (sample sizes were at least six) were Domestic Goose, Domestic Chicken, House Sparrow, Canada Goose, and Rock Dove. One sampled bird, a captive adult Domestic Goose, showed signs of illness; WNV infection was confirmed. Our results support the concept that chickens and House Sparrows are good arbovirus sentinels. This study also implicates the House Sparrow as an important vertebrate reservoir host.

- Lacey, L.A. 1990. **Persistence and Formulation of *Bacillus sphaericus*** pp. 284-294 in H. de Barjac and D.J. Sutherland, eds. *Bacterial Control of Mosquitoes and Blackflies: Biochemistry, Genetics and Applications of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus**. Rutgers University Press, Rutgers, NJ.
- Laird, Marshall, Lester Calder, Richard C. Thornton, Rachel Syme, Peter W. Holder and Motoyoshi Mogi. 1994. **Japanese *Aedes albopictus* among Four Mosquito Species Reaching New Zealand in Used Tires.** *Journal of the American Mosquito Control Association* 10(1):14-23.

*Abstract:* Since a 1988-89 survey of northern New Zealand revealed no additions to the known mosquito fauna, this country's used tire importations have much increased. Relevant entomological quarantine was thus monitored in a November 1992-January 1993 Auckland project, during which almost 1/3 of 8,549 casings from Japan proved wet on inspection. In this study and at two South Island ports afterwards, five vessels from Japan and one from Australia were found to have brought in mosquito-infested used tires. Live *Aedes albopictus* (all larval instars, pupae, and adults) and *Aedes japonicus*, and dead *Tripteroides bambusa* were discovered in shipments from Japan (3 interceptions each in the first 2 cases, and one in the 3rd). Live *Tripteroides tasmaniensis* were recorded from the Australian cargo. One of the *Ae. albopictus* arrivals was followed by an apprehended introduction at an Auckland importer's premises.

- Lake, R.W. and R. G. Weber. 1986. **Piperonyl-butoxide-Synergized Resmethrin as an Aerially Applied Mosquito Adulticide.** *Proceedings of the Annual Meeting of the N J Mosquito Control Association, Cape May* 73:50-5

*Abstract:* Field trials were conducted in Delaware during July and August 1983 to test the effectiveness of a commercial resmethrin formulation synergized with piperonyl butoxide against adult mosquitoes. The product was diluted in soybean oil and applied from the air as a ULV mist at 3.93 q a.i./ha in July, and in August at 1.96 q a.i./ha (swath width 76.2m; airspeed 241.4 km/h; nozzles flat fan Tee-jet No.8001 set facing 35 deg forwards; altitude 23 m). For caged field-collected females of *Aedes sollicitans*, the average mortality at 4 hours posttreatment was 95.4 and 95% at the 3.93-q and 1.96-q application rates, respectively. At 24 hours posttreatment, the 3.93-q rate produced 98.3% mortality. The 1.96-q rate produced 98.7% mortality 17.5 hours after treatment. Light-trap catches at the trial site taken 24 hours before and after the July treatment showed that the field population of mosquitoes was reduced by 96.7%.

- Lampman, Richard, Ute Eckenbach, David Seigler, and Robert Novak. 2000. **Laboratory Evaluations of Methylated Soy Oil and Monoterpenes as Mosquito Larvicides.** *Journal of the American Mosquito Control Association.* 16(2):153-157.

*Abstract:* The larvicidal toxicities of methylated soy oil (MSO) and surfactant combinations were compared to 2 commercially available oil larvicides (Golden Bear Oil 1111<sup>®</sup> and Bonide<sup>®</sup>) in standard laboratory bioassays of 4th-stage larvae of *Culex pipiens* Linn. The dose lethal to 50% of the test organisms (LD<sub>50</sub>) and the dose lethal to 95% of the test organisms (LD<sub>95</sub>) values are presented as microliters per beaker (treatment surface area of 54 cm<sup>2</sup>). The surfactant-MSO mixtures differed significantly in their toxicity to *Cx. pipiens* larvae; 2% Pyroter CPI-40<sup>®</sup> in MSO was more toxic than 2% Pluronic L121<sup>®</sup> in MSO (LD<sub>50</sub> = 3.8 microliters per 54 cm<sup>2</sup> and 11.3 microliters per 54 cm<sup>2</sup>, respectively). The 2 most active larvicides were Golden Bear Oil (LD<sub>50</sub> = 3.6 microliters per 54 cm<sup>2</sup>) and the 2% Pyroter-MSO mixture. These 2 were not significantly different from each other. Bonide (LD<sub>50</sub> = 6.2 microliters per 54 cm<sup>2</sup>) and the Pluronic L121-MSO mixture (LD<sub>50</sub> = 11.3 microliters per 54 cm<sup>2</sup>) were less toxic than Golden Bear Oil and the MSO-Pyroter mixture and they were significantly different from each other. Bioassays with 4th-stage larvae of *Anophele stephensi* Liston showed toxicity of the Pyroter-MSO formulations increased about 2-fold from 18°C to 24°C (LD<sub>50</sub> = 20.5 microliters per 54 cm<sup>2</sup> and 11.8 microliters per 54 cm<sup>2</sup>, respectively). The laboratory bioassays suggest that MSO mixed with surfactants are potential mosquito larvicides. We also evaluated the influence of the 2 surfactants on the toxicity of 3 monoterpenes. The larvicidal activity of citral and limonene increased with the addition of surfactants, but neither surfactant enhanced the toxicity of cineole. All 3 monoterpenes, with and without surfactants, were considered poor candidates as surface larvicides because of their high volatilities.

- Lampman, Richard, Scott Hanson and Robert Novak. 1997. **Seasonal Abundance and Distribution of Mosquitoes at a Rural Waste Tire Site in Illinois.** *Journal of the American Mosquito Control Association* 13(2):193-200.

*Abstract:* The species composition, abundance, and distribution of mosquito larvae in tires were determined on dates at a relatively large rural tire dump (about 300,000 tires) in southeastern IL (Jasper County). Several observations at the site differed from those in previous reports about mosquitoes in tire yards, including 1) a relatively high percentage of tires positive for *Aedes triseriatus* larvae in an open-field area, 2) a greater abundance of *Culex pipiens* than *Cx. restuans* in late season collections, 3) a seasonal change in the distribution of *Aedes atropalpus* larvae in tires from open field and edge of woods areas, and 4) the presence of *Ae. albopictus* as major late-season species. *Ae. albopictus* adults were captured in sod-baited gravid traps along the edge of a wooded riparian area 200 m from the tire pile.

- Lanciotti, R.S. et al. 1999. **Origin of the West Nile Virus Responsible for an Outbreak of Encephalitis in the Northeastern United States.** *Science* 286 (17 December): 2333-2337.

*Abstract:* In late summer 1999, an outbreak of human encephalitis occurred in the northeastern United States that was concurrent with extensive mortality in crows (*Corvus* species) as well as the deaths of several exotic birds at a zoological park in the same area. Complete genome sequencing of a flavivirus isolated from the brain of a dead Chilean flamingo (*Phoenicopterus chilensis*), together with partial sequence analysis of envelope glycoprotein (E-glycoprotein) genes amplified from several other species including mosquitoes and two fatal human cases, revealed that West Nile (WN) virus circulated in natural transmission cycles and was responsible for the human disease. Antigenic mapping with E-glycoprotein-specific monoclonal antibodies and E-glycoprotein phylogenetic analysis confirmed these viruses as WN. This North American WN was most closely related to a WN virus isolated from a dead goose in Israel in 1998.

- Lanciotti, R.S. et al. 2002. **Complete Genome Sequences and Phylogenetic Analysis of West Nile Virus Strain Isolated from the United States, Europe, and the Middle East.** *Virology* 298: 96-105.

*Abstract:* The complete nucleotide sequences of eight West Nile (WN) virus strains (Egypt 1951, Romania 1996-MQ, Italy 1998-equine, New York 1999-equine, MD 2000-crow265, NJ 2000MQ5488, NY 2000-crow3356) were determined. Phylogenetic trees were constructed from the aligned nucleotide sequences of these eight viruses along with all other previously published complete WN virus genome sequences. The phylogenetic trees revealed the presence of two genetic lineages of WN viruses. Lineage 1 WN viruses have been isolated from the northeastern United States, Europe, Israel, Africa, India, Russia, and Australia. Lineage 2 WN viruses have been

isolated only in sub-Saharan Africa and Madagascar. Lineage 1 viruses can be further subdivided into three monophyletic clades.

- Lawler, Sharon P., Truls Jensen, Deborah A. Dritz, and George Wichterman,. 1999. **Field Efficacy and Nontarget Effects of the Mosquito Larvicides Temephos, Methoprene, and *Bacillus Thuringiensis* Var. *Israelensis* in Florida Mangrove Swamps.** *Journal of the American Mosquito Control Association*.15(4):446-452. 1999.

*Abstract:* We compared the efficacy and nontarget effects of temephos, *Bacillus thuringiensis* var. *israelensis* (*B.t.i*) and methoprene applied by helicopter to control mosquito larvae in mangrove swamps on Sanibel Island, FL, i May 1997. Three sites per treatment and 3 untreated sites were used. Temephos (Abate □) was applied at 37 ml/ha (43% active ingredient [AI], *B.t.i.* granules (Vectobac G□) were applied at 5.606 kg/ha (200 International Toxic Units/mg), and methoprene (Altosid□ ALL) was applied at 213 ml/ha (5% AI). Efficacy was quantified i monitoring the survival of caged and uncaged larval *Aedes taeniorhynchus* . We quantified mortality of sentinel nontarget amphipods (Talitridae) at all sites, monitored the effect of temephos on flying arthropods using light traps, and collected dead insects in tarps suspended under mangroves in areas treated with either temephos or methoprene. Each pesticide showed good overall efficacy but occasional failures occurred. No detectable mortality of amphipods or flying insects attributable to pesticides was found. The inconsistent field efficacies o the pesticides indicate a need for reinspection of treated sites in this habitat.

- Layton, M.C. 1996. **Malaria in New York City.** *Bulletin of the New York Academy of Medicine* 73(2):456-458. <http://www.nyam.org/nyam/>.
- Layton, M.C., M.E. Parise, C.C. Campbell, et al. 1995. **Mosquito-transmitted Malaria in New York City, 1993.** *The Lancet* 346:729-731. <http://www.thelancet.com/>.
- Lederberg, Joshua. 1998. **Emerging Infections: An Evolutionary Perspective.** *Emerging Infectious Diseases* 4 (3):336-371.

*Abstract:* Our relationship to infectious pathogens is part of an evolutionary drama (1). Here we are; here are th bugs. They are looking for food; we are their meat. How do we compete? They reproduce so quickly, and there are so many of them. They tolerate vast fluctuations of population size as part of their natural history; a fluctuation of 1% in our population size is a major catastrophe. Microbes have enormous potential mechanisms of genetic diversity. We are different from them in every respect. Their numbers, rapid fluctuations, and amenability to genetic change give them tools for adaptation that far outpace what we can generate on any short-term basis.

So why are we still here? With very rare exceptions, our microbial adversaries have a shared interest in our survival. With very few exceptions (none among the viruses, a few among the bacteria, perhaps the clostridial spore-forming toxin producers), almost any pathogen reaches a dead end when its host is dead. Truly severe host-pathogen interactions historically have resulted in elimination of both species. We are the contingent survivors of such encounters because of this shared interest.

- Le Duc, J. W., W. Suyemoto, B. F. Eldridge and E. S. Saugstad. 1972 . **Ecology of Arboviruses in a Maryland Freshwater Swamp. II. Blood feeding Patterns of Potential Mosquito Vectors.** *American Journal of Epidemiolog* 96:123-28.
- Le Guenno B., A. Bougermouh, T. Azzam and R. Bouakaz. 1996. **West Nile: A Deadly Virus?** *Lancet*, London. 348:1315. <http://www.thelancet.com/>.
- Lee, Sung-Eun. 2000. **Mosquito Larvicidal Activity of Piperonaline.** *Journal of the American Mosquito Control Association*. 16(3):245-247.

*Abstract:* A methanol extract of *Piper longum* fruit was found to be active against mosquito larvae of *Culex pipiei pallens* at 10 µg/ml after 24 h. A piperidine alkaloid, piperonaline, was found to be responsible for this activity with the 24-h median lethal dose (LD<sub>50</sub>) value for this compound being 0.21 mg/liter. The LD<sub>50</sub> value of piperonaline was not much higher than those for the 3 organophosphorous insecticides malathion, chlorpyrifos-methyl, and pirimiphos-methyl, used for comparative purpose in this study. Structural elucidatio of piperonaline was by means of mass spectrometry (<sup>1</sup>H and <sup>13</sup>C nuclear magnetic resonance imaging).

- Lenormand, Thomas, Denis Bourguet, Thomas Guillemaud and Michel Raymond. 1999. **Tracking the Evolutio of Insecticide Resistance in the Mosquito *Culex pipiens*.** *Nature* 400: 861-864.

**OR INSECTICIDE RESISTANCE IN THE MOSQUITO *Culex pipiens*. *Nature* 400: 861-864.**

**Abstract:** The evolution of pesticide resistance provides some of the most striking examples of darwinian evolution occurring over a human life span. Identification of resistance alleles opens an outstanding framework in which to study the evolution of adaptive mutations from the beginning of pesticide application, the evolution of interactions between alleles (dominance) or between loci (epistasis). Here we show that resistance alleles can also be used as markers to dissect population processes at a microevolutionary scale. We have focused on the antagonistic roles of selection and migration involved in the dynamics of local adaptation with reference to allelic frequencies at two resistance loci in the mosquito *Culex pipiens*. We find that their frequencies follow an annual cycle of large amplitude (25%), and we precisely unravel the seasonal variation of migration and selection underlying this cycle. Our results provide a firm basis on which to devise an insecticide treatment strategy that will better control the evolution of resistance genes and the growth of mosquito populations.

- Levins, Richard, Tamara Auerbuch, Uwe Brinkmann, Irina Eckardt, Paul R. Epstein, Tim Ford, Najwa Makhoul, Christina dePossas, Charles Puccia, Andrew Spielman and Mary E. Wilson. 1994. **The Emergence of New Disease.** *American Scientist* 82(1): 52-60.
- Lindsay, L.R., J.D. Heal and G.A. Surgeoner. August 1996. **Comparative Evaluation of the Efficacy of Bite Blocker, OFF! Skintastic, and Avon Skin-So-Soft to Protect Against Aedes Species Mosquitoes in Ontario: Final Report.** Unpublished, 5 pp. Contact: L.R. Lindsay, G. A. Surgeoner and J. D. Heal, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada or Gary Sheppard, Chemfree Environment Inc., 16763 Hymus Blvd., Kirkland, Quebec Canada H9H 3L4.

**Introduction** The purpose of this study was to compare, under field conditions, the relative efficacy of Bite Blocker<sup>Reg.</sup> (Batch No. 199607023, active ingredients: 2.0% soybean oil), OFF!<sup>Reg.</sup> Skintastic spray (6.65% N, N diethyl-M-toluamide), and Avon<sup>Reg.</sup> Skin-So-Soft mosquito, flea and deer tick repellent (0.05% oil of citronella) to protect against *Aedes* mosquitoes in Ontario.

**Results** The number of bites received by subjects treated with Bite Blocker<sup>Reg.</sup> applied at 30, 90, and 120 minutes prior to exposure to mosquitoes did not differ significantly from the number of bites received by subjects treated with OFF!<sup>Reg.</sup> Skintastic applied at 30 and 90 minutes prior to exposure ( $P$  greater than 0.5). There was no significant difference between the number of mosquitoes biting subjects treated with Avon<sup>Reg.</sup> Skin-So-Soft when this product was applied at 30, 90 or 210 minutes prior to exposure to mosquitoes ( $P \sim 0.2$ ). When subjects were treated at 210 minutes prior to exposure to mosquitoes, the number of mosquitoes biting subjects treated with OFF!<sup>Reg.</sup> Skintastic was significantly higher than the biting count for subjects treated with Bite Blocker<sup>Reg.</sup> ( $P \sim 0.001$ ) and significantly less than the number biting subjects treated with Avon<sup>Reg.</sup> Skin-So-Soft ( $P$  less than 0.001). The percent repellency provided by three repellents varied among the different products. Avon<sup>Reg.</sup> Skin-So-Soft provided a 39.6-56.8% reduction in the number of bites compared with the non-treated subjects. Bite Blocker<sup>Reg.</sup> reduced mosquito biting by 97.0-99.2% whereas OFF!<sup>Reg.</sup> Skintastic provided from 85.8-100% repellency compared with non-treated subjects. During the biting count evaluations, ambient air T ranged from 16.4-22.8 degrees C, relative humidity ranged from 69.8-90.8% and wind was always less than 10 km per h and typically less than 5 km per h. None of the subjects noted any adverse effects after the products were applied [Results are accompanied by 3 tables.]

- Lindsay, L.R., G.A. Surgeoner and J.D. Heal. 1996. **Field Evaluation of the Efficacy of Three Druide<sup>Reg.</sup> Citronella-Based Repellents to Protect Against Aedes Species Mosquitoes in Ontario: Final Report.** Unpublished, 8 pp. Contact: L.R. Lindsay, G. A. Surgeoner and J. D. Heal, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada or Vincent LeCorne, Laboratoires Druide, 154, Prom. Oneida, Pointe-Claire, Quebec H9R 1A8.

**Summary:** The purpose of this study was to assess, under field conditions, the efficacy of three Druide<sup>Reg.</sup> citronella-based products (lotion, milk and sunblock formulations; active ingredients: 10% oil of citronella and 5% terpene of citronella) to protect against *Aedes* species mosquitoes. The complete protection time was calculated for each product, complete protection being 95% fewer bites than non-treated controls. The complete protection time provided by the three candidate repellents varied from 7 to 60+ minutes and the milk formulation had a significantly longer complete protection time than the other two candidate repellents. All of candidate repellents reduced the number of mosquitoes biting by 95% over the 1<sup>st</sup> and 2<sup>nd</sup> 30 minutes after application, although the lotion and milk formulations were more effective than the sunblock formulation during the 2<sup>nd</sup> 30 minutes following product application.

- Lindsay, L.R., G.A. Surgeoner and J.D. Heal. Undated. **Evaluation of Walkabout<sup>Reg.</sup> (2.8%) citronella) as a Repellent Against Summer *Aedes* spp. Mosquitoes.** Unpublished, 5pp. Contact: J. D. Heal, G. A. Surgeoner, and S. M. Butler, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

*Summary:* The purpose of this study was to assess, under field conditions, the efficacy of the 2.8% oil of citronella product, Walkabout<sup>Reg.</sup>, for protection against summer *Aedes* spp. mosquitoes. The Walkabout<sup>Reg.</sup> oil significantly reduced the number of mosquitoes biting treated subjects. The average percent repellency that this product provided over the one hour evaluation period was excellent (greater than 96.0%). Complete protection times were variable although on 5 to 8 instances, CPT was at least 30 minutes. As a result, consumers with a low tolerance to mosquito bites will likely have to reapply this product at 30 minute intervals to maintain 95-100% protection. Although this level of protection provided by Walkabout<sup>Reg.</sup> is less than would be anticipated with comparable DEET-based formulation, the "organic" nature of the active ingredients will likely appeal to some consumers.

- Lindsay, L.R., G.A. Surgeoner, J.D. Heal, and G.J. Gallivan. 1996. **Evaluation of the Efficacy of 3% Citronella Candles and 5% Citronella Incense for Protection Against Field Populations of *Aedes* Mosquitoes.** *Journal of the American Mosquito Control Association* 12 (2): 293-294.

*Abstract:* We assessed the efficacy of 3% citronella candles and 5% citronella incense in protecting subjects from bites of *Aedes* spp. under field conditions. The study was conducted in a deciduous woodlot in Guelph, Ontario, Canada from July 26 to August 10, 1995. Eight subjects, dressed identically, were assigned to one of 8 positions on a grid within the study area. Two citronella candles, 2 citronella incense, 2 plain unscented candles, or no candles (i.e. nontreated controls) were assigned to 2 positions on the grid each evening. Subjects conducted 5-min biting counts at each position and performed 16 biting counts per evening. On average, subjects received 6 +/- 0.4, 8.2 +/- 0.5, 8.2 +/- 0.4, and 10.8 +/- 0.5 bites/ 5 minutes at positions with citronella candles, citronellaincense, plain candles, and no candles, respectively. Although significantly fewer bites were received by subjects at positions with citronella candles and incense than at nontreated locations, the overall reduction in bites provided by the citronella candles and incense was only 42.3% and 24.2%, respectively.

- Lindsay, Steve, Juliet Ansell, Colin Selman, Val Cox, Katie Hamilton and Gijs Walraven. June 3, 2000. **Effect of Pregnancy on Exposure to Malaria Mosquitoes.** *The Lancet*. London. 355:1972. <http://www.thelancet.com/>.

*Abstract:* Pregnant women attracted twice the number of *Anopheles Gambiae* complex -- the predominant African malaria-carrying mosquito -- than did their non-pregnant counterparts. We postulate that physiological and behavioral changes that occur during pregnancy are responsible for increased attractiveness, which could be important in intervention strategies aimed at protecting this high-risk group against malaria.

- **LOBSTER-L:** Unmoderated open listserv for formal and informal discussions regarding health problems of northern lobsters--*Homarus americanus*, the die-off in Long Island Sound, lobster research, etc. Subscribe by sending an email to [Listserv@UConnvm.UConn.Edu](mailto:Listserv@UConnvm.UConn.Edu). Put SUBSCRIBE LOBSTER-L [YOUR FULL NAME] (not your email address) in the body of your message. LOBSTER-L is supported by the University of Connecticut and administered by Nancy Balcom ([balcom@unconnvm.uconn.edu](mailto:balcom@unconnvm.uconn.edu)), Connecticut Sea Grant, 1084 Shennecossett Road, Groton, CT 06340, USA, (860) 405-9109.

LOBSTER-L may be of relevance to those interested in West Nile Virus because the suggested link between pesticides used for West Nile Virus mosquito control and non-target impacts on lobsters may be discussed.

- Lord, R.D. and C.H. Calisher. 1970. **Further Evidence of Southward Transport of Arboviruses by Migratory Birds.** *American Journal of Epidemiology* 92:73-78.
- Lvov, D.K., A.M. Butenko, V.L. Gromashevsky, V.Ph. Larichev, S.Ya. Gaidamovich, O.I. Vyshemirsky, A.N. Zhukov, V.V. Lazorenko, V.N. Salko, A.I. Kovtunov, Kh.M. Galimzyanov, A.E. Platonov, T.N. Morozova, N.V. Khutoretskaya, E.O. Shishkina and T.M. Skvortsova. 2000. **Isolation of Two Strains of West Nile Virus during an Outbreak in Southern Russia, 1999.** *Emerging Infectious Diseases* 6(4 July-August 2000). <http://www.cdc.gov/ncidod/eid/vol6no4/lvov.htm>.

*Abstract:* From July to September 1999, a widespread outbreak of meningoencephalitis associated with West Nile virus (Flavivirus, Flaviviridae) occurred in southern Russia, with hundreds of cases and dozens of deaths. Two

strains of West Nile virus isolated from patient serum and brain-tissue samples reacted in hemagglutination-inhibition and neutralization tests with patients' convalescent-phase sera and immune ascites fluid from other strains of West Nile virus.

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