

Naval Base Ventura County

Mosquito Ecology and NBVC Point Mugu Mosquito Control Program

The Mugu estuary is the largest saltwater marsh in southern California. This estuary is situated within Navy Base Ventura County (NBVC) Point Mugu and makes up 48% of the total base area. The estuary ecosystem supports a wide variety of wildlife, which also includes mosquitoes. Mosquitoes can be a nuisance and some species are a potential health threat to humans. The native mosquitoes are a part of the natural ecosystem here and will always be present at some level. NBVC is dedicated to managing the mosquito population in order to protect base personnel and residents from excessive mosquito interactions, especially those species that carry disease.

With about 22 species of mosquitoes potentially active at NBVC, some flying by day, some by night, you will have an annoying encounter with mosquitoes during the warmer months of the year. There are 2 main mosquitoes: (1) *Aedes taeniorhynchus* (Salt Marsh Mosquito), appearing early in the season (May-Oct), and breeds in salt water. These “nuisance mosquitoes” aggressively bite during the day but are less likely to carry disease; and (2) *Culex spp.* (multiple species) appearing in mid/late-season (Jul-Oct), breed in fresh water, and bite at dusk/dawn and night. These are called “vector mosquitoes” because they could transmit diseases such as West Nile Virus.

There is always the potential for new, non-native mosquitoes to show up. In recent years 2 new non-native invasive mosquitoes have arrived in the United States: Asian Tiger Mosquito, *Aedes albopictus*, and the Yellow Fever Mosquito, *Aedes aegypti* (collectively referred to as invasive *Aedes* in this paper). Both are in the same genus, *Aedes*, as our native non-vector mosquito, however these mosquitoes can carry serious diseases like Zika, Dengue, Yellow Fever, and Chikungunya. The invasive *Aedes* mosquitoes are also day biters like the native Salt Marsh Mosquito but are different in that they breed in fresh water and are usually found in or near homes and work places. They occur in over 30 states throughout the United States and several counties in California, but have not been detected in Ventura County at this time. No matter what species, mosquitoes have 2 things in common: their need for water in which to breed and grow and the need to feed on blood.

Mosquito Life Cycle

Before laying their eggs, mosquitoes seek a blood meal from a warm-blooded host: a bird, a dog, possibly even you. In search of a meal, mosquitoes are drawn to carbon dioxide given off by your breath, your body heat, and your own moisture. They track you down by your breath, and then zero in on your skin temperature and your sweat. The main attraction is the carbon dioxide you exhale.

When feeding, mosquitoes inject saliva into the skin to help extract the blood. It is the saliva that causes the itching you feel after being bitten. This is also when they transmit disease. Only females require blood and will bite, though some will feed on flower nectar as well. Males solely depend on flower nectar.

Adult fresh water mosquitoes lay their eggs on moist surfaces near water, or directly onto still water. Any containers that hold standing water are ideal breeding sites: old tires, toys, ponds, pools, uncovered boats, birdbaths, even dishes under flowerpots. In industrial areas, equipment that is covered by tarps or

waterproof plastic may harbor these pests in puddles on the plastic. The equipment itself may even be configured in such a way that water is allowed to pool on it, making an ideal habitat for mosquitoes. Some, like the new invasive *Aedes* mosquitoes, can breed in small amounts of water indoors (like potted plant saucers or pet dishes).

Adult salt marsh mosquitoes lay their eggs in the moist soil just above the average high tide line. During the summer months there are typically higher than normal tides and warm weather, the 2 key elements for mosquitoes to breed successfully. The higher tides flood the soils with mosquito eggs and form pools allowing the larvae to grow and convert to adults.

The entire life cycle (from egg to adult) for a mosquito can be as little as 4 days or as long as 1 month. Most commonly for the mosquitoes found here the life cycle is 7 days. This is important to remember so you can regularly change water in pet bowls, bird baths, or children's pools in less time to prevent adults from emerging.

Mosquito Vectors and Disease

Mosquitoes that breed in fresh water are the biggest threat to human health. They can be a vector for disease. To transmit a disease the vector mosquito will bite an animal or person that has the disease in their blood, then bite another animal or person passing the disease along through its saliva. The more common mosquito-borne diseases in the United States include Western Equine Encephalitis, St. Louis Encephalitis, and West Nile Virus. The diseases carried by the invasive *Aedes* mosquitoes include Zika, Dengue, Yellow Fever, and Chikungunya which can only be transmitted if the disease is in the human population and the invasive *Aedes* are present and biting. Mosquito transmitted diseases are discussed in more detail in the "Mosquito Diseases" white paper.

Mosquito Control Program at NBVC

Nobody wants to be bitten by mosquitoes. No matter how extensive the mosquito control program, there will always be mosquitoes flying around. The best protection for yourself and family is to dress appropriately or use mosquito repellent to prevent mosquitoes from being able to bite your skin. In order to help reduce the threat of mosquito bites, NBVC has an extensive mosquito control program that includes surveillance and treatment around the 2100 acre salt marsh and large fresh water puddles that are detected.

The goal of the program is to keep mosquito larvae, especially fresh water mosquitoes, from converting into adults. The good news is that there is little naturally occurring fresh water on base which would breed the vector types of mosquitoes. The major sources for fresh water are water pipe leaks, rain/sprinkler puddles or personnel or residents water use around homes or work areas. Quickly identifying these fresh water sources and eliminating them reduces the chance that vector mosquitoes will be able to breed. No matter how extensive the control program, it will not eliminate all mosquitoes.

IPM

NBVC follows guidelines set forth in the Integrated Pest Management Plan (IPMP) on when and how to control various pests. Integrated Pest Management (IPM) is a method of setting priorities and goals for controlling pests while minimizing harm to people and the environment. IPM starts with the least toxic, something as simple as keeping food properly stored to avoid attracting ants, and progresses to most toxic like using pesticides or herbicides if the less toxic methods did not meet the goals. IPM also sets thresholds for tolerance of pest species recognizing that no one can eliminate all pests all the time. The best method to keep pests away is to avoid creating a situation that attracts them. The way to do that for disease carrying mosquitoes is to eliminate their breeding grounds, fresh water!

As directed in NBVC's IPMP, we strive to reduce or minimize the amount of pesticides used on base. Our goal at NBVC is to detect mosquito breeding grounds by using historical data, habitat factors, tide levels, and other available information and then implement appropriate treatment to keep populations under satisfactory control. Controlling our behaviors and environment are the best ways to reduce the threat of disease spread from mosquitoes. We also have to consider the many regulations restricting the use of pesticides that might inadvertently drift into nearby natural bodies of water. Imagine how complicated it is to release air borne pesticides while trying to keep them from drifting and contaminating the lagoon system!

Mosquito Control Season

Here at NBVC, the mosquito control program generally runs from May through October, though treatment of water bodies could start earlier and run later depending on the weather and the detection of larvae. The Navy works with Ventura County and California State Vector Control Agencies, and other Federal and State agencies, to communicate about mosquito presence, disease, and control strategies. We comply with all local, State, and Federal Environmental agencies mandates for mosquito control.

Larval Mosquito Control

The goal of the program is to prevent mosquito larvae from transforming into adults. This is accomplished by applying larvicide to kill mosquito larvae and/or a growth inhibitor to prevent the larvae from turning into adults. Pest management crews begin by sampling water throughout the base looking for "wigglers", larval mosquitoes that have hatched from eggs. When larvae are found, treatment is immediately applied. The tolerance level, or threshold, for numbers of mosquito larvae detected before a control method is implemented is 1 larva. The reason for the low threshold is that it is known that there will be more/others that are not detected so applying control makes sense.

The larvicide used is a naturally occurring bacterium known as *Bacillus thuringiensis var. israelensis* (Bti). This type of treatment is the least toxic to humans and to non-target organisms. When wigglers are detected, Bti briquettes or liquids are placed in the water. Some Bti products may be applied in advance in areas known to breed mosquitoes even if larvae aren't detected at the time. There are many areas on the base that historically produce mosquito larvae. Treating in advance of detection allows us to catch the larvae early and at the right stage when they will be feeding.

Adult Mosquito Control

For adult mosquitoes, there are several different types of traps set up around the base that attracts flying adults. Some of the traps are specific to attracting the invasive Aedes mosquitoes if they should be in the

area. This allows us an opportunity for early detection and rapid treatment. Some of the mosquito traps remove small amounts of adults from the air, helping to reduce the potential incidence of bites.

Once adult mosquitoes are active, there is very little that can be done to lower their numbers. When adult mosquitoes are present it is important for everyone to take responsibility to find the mosquito protection that best works for you and your family. Cover your exposed skin with long sleeves or pants that are baggy, not tight. Also, find a mosquito repellent that works best for you and your body chemistry.

There are some areas where spraying adult mosquitoes may be effective. This is typically around door alcoves or in dense vegetation. A backpack sprayer is used to spray vegetation, lawns, entryway alcoves where adult mosquitoes will be resting. Insecticides that target adults (adulticides) have pyrethrin (a plant-derived poison) in some form as their active ingredient. These are broad-spectrum insecticides that kill all insects that come into contact. The benefit for spraying specifically where mosquitoes are resting is that there is a better opportunity to kill more of the target species and less of potentially beneficial insects like honeybees.

The least effective method is known as ultra-low volume truck mounted fogging. A tank is mounted to the back of a truck and a spray is emitted as the truck drives slowly along roadways. Only the mosquitoes that fly through the fog at the time of fogging will be killed. So will any other insect. The fog droplets are relatively heavy and fall to the ground within hours and therefore will no longer be in a position to come into contact with adult mosquitoes. The numbers of adult mosquitoes killed represents a very low percentage of the flying mosquitoes in the area. In addition, there is a limited time frame in which the trucks can spray. Care is taken to avoid time when people are most active so this usually means pre-dawn hours. Vector mosquitoes are more active during this time, but the nuisance mosquitoes that come out during the day would not be affected.

There are restrictions in the use of fogging under the Clean Water Act to ensure that no fog chemical drifts into water bodies. Nearly half of the total area of NBVC Point Mugu consists of water bodies that flow into the ocean and there is a relatively constant breeze, so the application window allowed for fogging is extremely limited. If the fogging chemicals reach the open water, it would be a violation to the Clean Water Act. Because fogging is not effective at reducing the numbers of adult mosquitoes, kills all insects including beneficial ones like honey bees, and has a potential to contaminate open water it is not considered appropriate for this base. Most other Vector Control agencies around the country find this to be true and also do not employ fogging as a control strategy. Fogging is only used in cases of a severe mosquito borne disease outbreak.

Impacts of Mosquito Control Methods

Mosquitoes, member of the Dipteran (fly) family, have both aquatic (egg, larvae, pupa) and terrestrial life stages. The impacts of reducing mosquitoes in aquatic and/or terrestrial ecosystems have not been well studied. Mosquitoes do play an important role in passing food energy along to other organisms in the food chain. Some of the pesticides we use to control adult mosquitoes also kill or harm other organisms that are not the target. For example, there is evidence that the use of broad spectrum pesticides have negatively affected populations of the European Honey Bee, a major pollinator for food crops.

The use of Bti for larvae is the least toxic to non-target organisms. Like other varieties of this natural soil bacterium, Bti is a stomach poison that must be ingested by the larval form of the insect in order to work. The toxicity of Bti to an insect is directly related to whether the insect has the proper receptor sites in their stomach. Without the proper receptor sites, the Bti will simply pass harmlessly through the insects gut. Bti is not known to be toxic to other insects (non-fly family) or other organisms.

All pesticides used to kill adult mosquitoes are broad-spectrum insecticides. Virtually every pesticide used to manage adult mosquitoes has the potential to adversely impact non-target species (organisms that aren't mosquitoes). The only selective aspect of these pesticides is the manner and timing in which they are applied: directly applied to the target mosquito and timed for when the target mosquito is out flying.

Non-target deaths from adulticides may occur in either terrestrial or aquatic habitats as a result of deposition, runoff, inhalation, or ingestion. There are very few studies that have examined the non-target effects of mosquito adulticides. Beetles and the wasp/ant/bee family have shown the greatest susceptibility to ultra-low volume (ULV) fogging. Adulticides have also been identified as a likely contributing factor in the decline of several rare butterfly species in the Florida Keys, for example. NBVC has species in all of these insect groups some of which are either protected sensitive species, or pollinate rare plants. This is why fogging is not recommended for use here at NBVC.

There will always be mosquitoes, some good years and some bad years in spite of our efforts. NBVC works diligently to keep the mosquito population at the lowest levels possible. It takes a village to manage mosquitoes! We appreciate your help and patience.

Mosquito Control Tips

Don't let your yard or home become a mosquito breeding ground!

- Empty anything that holds standing water - old tires, buckets, plastic covers, toys, wheelbarrows, tools, flower pots, etc. Drill large holes in the tires to allow water to drain. Turn buckets upside down and even tilted to prevent water from pooling on the bottom.
- Every week, change water in birdbaths, fountains, wading pools and animal troughs.
- Check inside the house for sources like potted plant saucer, desk fountains, water pans in water dispensers or refrigerators, pet water bowls, drains, or any other small standing water source.
- Recycle or cover unused containers - bottles, cans and buckets may collect water if left outdoors.
- Make sure roof gutters drain properly, clean clogged gutters in the spring and fall.
- Fix leaky outside faucets and sprinkler systems. Make sure your sprinklers don't over run and create puddles. An empty house in the neighborhood might have a water leak in the yard; have the housing authority check empty homes for leaks.
- Make sure windows and door screens are bug-tight. Replace or repair as needed.
- Keep lawns and shrubbery trimmed so that light can penetrate, mosquitoes like dense/dark foliage to hide in.
- If you see any suspicious puddles around the base (especially a puddle that seems to be in the same place even when it hasn't rained), please report it through a Maximo Request (work order).
- Place a Maximo Request or contact housing to report large swarms of mosquitoes. Be specific in the location of the swarm and the approximate numbers ("I see several flying around" is a small

“swarm”, not something you would report. Hundreds (and probably thousands) would be a large swarm. A swarm as large as a laptop = small; a swarm as large as a desk chair = large).

Protect Your Skin

Don't let yourself be on the menu. During the mosquito season it is important that you take preventative measures to ensure you and your family don't receive excessive bites. Reduce or eliminate any standing fresh water, no matter how little it might be, in and around your house or work station. There are many mosquito repellents on the market that might work well with your body chemistry. Dress appropriately by wearing long sleeves or pants that are baggy. Here are some ideas for you and your family to protect yourselves from mosquito bites.

- Stay indoors at dawn and dusk, if possible, when vector mosquitoes are most active.
- Wear long-sleeved, loose-fitting shirt or blouse, loose-fitting long pants, and a hat when going into mosquito areas.
- Moving air is the best, non-toxic way to keep adult mosquitoes away. Use fans outside when sitting at a picnic table or place fans near doorways facing out to keep mosquitoes from flying in.
- Repellents with DEET are very effective, and are widely used to reduce the risk of bites. Take special care when applying repellents on your children and follow label directions. Other more natural repellents that contain eucalyptus and lemon oils have been noted by Consumer Reports as effective. Try a variety of repellents, you never know what works best for you.
- Do not scratch mosquito bites. Make sure bites are kept sanitized especially with young children.

Contacts

Lincoln Housing manager: Kari Reeger, Lincoln Housing (805-986-0928, kreeger@lpsi.com)

Maximo request: Call 805-989-8888 to receive a Maximo Request Form

Natural Resource Manager: Valerie Vartanian, NBVC IPM Coordinator (805-989-4740, valerie.vartanian@navy.mil)

NBVC Public Works PAR: Richard Berumen, (805-989-9425, richard.berumen@navy.mil)

Resources

American Mosquito Control Association: <http://www.mosquito.org/faq>

California Department of Health, Mosquitoes and Mosquito-Borne Diseases:

<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MosquitoesandMosquitoBorneDiseases.aspx>

California Department of Health Services: <http://www.westnile.ca.gov/>

Center for the Disease Control and Prevention, West Nile Virus: www.cdc.gov/ncidod/dvbid/westnile

Center for the Disease Control and Prevention, Zika: <http://www.cdc.gov/zika/>

National Pesticide Information Center, Choosing and Using Insect Repellents:

<http://npic.orst.edu/ingred/ptype/repel.html>

United States Environmental Protection Agency, Mosquito Control:

<http://www2.epa.gov/mosquitocontrol>

Ventura County Vector Control: <http://vcrma.org/envhealth/technical-services/vector/index.html>