ANNUAL 2018 REPORT





Our Mission: "To protect the public's health from vectorborne disease and nuisance, through a comprehensive mosquito and vector control program focused on innovation, experience and efficiency."

FOREWORD

Residents of the Shasta Mosquito and Vector Control District,

On behalf of the Board of Trustees and staff of the District, we are pleased to present the 2018 Annual Report for the Shasta Mosquito and Vector Control District. This year's theme is a look at the "tools of the trade". Our Integrated Vector Management approach to mosquito and vector control requires that we have a wide selection of tools at the ready to deal with whatever the control or surveillance situation might require. As we started planning our report, we were struck by a regular comment we get when people tour our facilities; "I had no idea your guys did all this stuff!" So, throughout the report we will highlight some tools that assist our District staff in their mission of protecting the public's health from vector-borne disease and nuisance.

This year brought a slightly at or below average for us regarding adult mosquito abundance and disease incidences. Although we continue to keep a lookout for any new or emerging mosquitoes and diseases, our focus was still on *Culex tarsalis* and *Culex pipiens* mosquitoes, which transmit West Nile virus (WNV). Despite a reduction in activity, we did see an increase in our WNV incidences, specifically in our adult mosquito samples. This suggests that although risk is lower than 2015 and 2016, taking personal steps to prevent mosquito bites is still extremely important. We will be living with WNV in Shasta County for the foreseeable future, so following the 4 D's hopefully becomes second nature for our residents. Statewide, we saw a similar reduction in overall human cases for WNV. Interestingly, we continue to see the same slow growth in St. Louis Encephalitis cases throughout California.

In 2018, we spent a period adapting to our new laboratory and insectary space. With the remodel project finishing early in the year, staff were able to "spread their wings" and really make the space their own. We're excited by the early impacts we are already noticing with the additional capacity and anticipate, not just continued expansion in our surveillance, but also heightened operational research. This allows our District to more efficiently and effectively serve the residents. This year also saw a doubling of our efforts to get our message out to the public. We produced radio PSAs, TV spots, joined Nextdoor, Instagram and Twitter and added several new events to our packed schedule. We plan to continue our varied and dynamic push into any medium that engages with the public...so if you see our informational items, let us know!

We continued our previous years efforts of pushing technology to the forefront of our priorities; working with our State Association to secure state funding to support a data program called CalSurv Gateway. This platform is designed to collect, store and make available mosquito surveillance, control and research data. This partnership between UC Davis and our industry will push our science to it's limits, providing the local District with timely, operationally relevant information to help make decisions about control, surveillance and public health protection. (https://maps.calsurv.org)

Finally, we would like to extend our sincerest appreciation and sympathy for all those impacted by the Carr Fire in 2018. Our response and coordination with local agencies and the community as a whole brought our District closer to the community and only solidified our belief that we serve a strong and compassionate group of residents. We are proud to be working for you!

Sincerely,

Peter Bonkrude District Manager

Mark J. Vlama

Michael MacNamara President



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Protecting public health since 1919

DISTRICT STAFF

Guangye Hu Kelly Cleland Mike Alexander Al Shabazian Corey Boyer Darrell Bible Haley Bastien Mark Mulcahy Pete Ledbetter (not pictured) Robert Ault





Administration Peter Bonkrude Darcy Buckalew Jenna Ingebretsen Missy Keeto





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DISTRICT HISTORY



INTEGRATED VECTOR

MANAGEMENT

Shasta Mosquito and Vector Control staff utilize Integrated Vector Management (IVM), a process that seeks to find the most effective and appropriate control strategy based on the information gathered by the District. Before more completely defining IVM, it is important to answer the question, "What is a Vector?" A vector is a living organism that can transmit disease between humans, or from other animals to humans. Many of these vectors are blood sucking insects and

arthropods like mosquitoes, ticks, fleas, sandflies and triatomine bugs.

IVM is defined as a "science-based decision-making process that seeks to improve efficacy, fiscal responsibility and ecological soundness." Put another way, an auto mechanic would not start tearing out a transmission based on a report of car troubles. They would collect data and find the likely culprit for the trouble based on their diagnostic investigation. This "diagnostic" process in mosquito control is our surveillance, and it serves as the basis for all our control strategies.

IVM includes: the use of vector control methods based on the scientific knowledge of local vector ecology, surveillance data, and pathogen transmission risk; assessment of methods and applied research through collaboration among federal, state and local public health agencies, vector control agencies, and the research community; and engagement with local communities and stakeholders, and development of partnerships to educate, gain support, and change cultural practices.



CARR FIRE RESPONSE

The immediate impact of the restricted our surveillance fire and control activities, but once the fire was contained, we knew the environment would be left changed and new mosquito sources would be created that could cause additional public health risks for the foreseeable future. Most of our efforts are focused on manmade structures that will now go unmaintained for a long period of time; things like swimming pools, ornamental ponds, exposed septic systems, anything that can collect and hold water. Our initial inspections show that we added over 200 new mosquito breeding habitats, not including any new "natural" sources that will become apparent with winter precipitation. As a part of this community, we will continue to stay engaged in the recovery process to ensure that any additional vector public health risk from this tragedy will be mitigated.

Post-Carr Fire Mosquito Source Map



After the fire, Missy Keeto and staff visited with families at Turtle Bay. Big thanks to Turtle Bay Park for hosting FREE days and bringing joy to our community. #ShastaMosquito



The District provided flyers to advise about fire-affected pools and long-term maintenance needs.



Thank you first responders.

SERVICE REQUESTS

The connection we make with our district residents through service requests often serves as the best opportunity we have to hear the concerns of the constituents and share our knowledge and experience regarding mosquito and vector control. We strive to be responsive to requests for service and value the interaction. These requests cover a wide range of mosquito and vector related questions and issues including: mosquitofish requests, mosquito complaints, neglected swimming pool reports, and general

Service Requests by Community



questions about insects and our services. We rely on these requests, not to direct control treatments, but to help guide District surveillance. This allows staff to focus on areas where potential mosquito problems are occurring.

Types of Service **Requests Received** control activities. REQUEST 24/7 SERVICE 5.23% Neglected Pool 9.11% Mosquitofish & SR 40.13% Mosquitofish Only 43.68% Service Request Only www.ShastaMosquito.org Number of Service **Requests by Zip Code** 1 172

Tools of the Trade

The public can issue a service request anytime of the day 24/7. Using our website, they can sign up for service, gain about current conditions and even find out where we are performing our adult mosquito

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IMMATURE MOSQUITO CONTROL



Mosquito larvae and pupae.

Mosquitofish were planted in 900 mosquito sources



59,000 baby mosquitofish were raised in 2018



Our technicians spend much of their time inspecting the more than 16,000 potential mosquito breeding habitats throughout our District. Controlling mosquitoes in the water, while they are in their immature (larvae and pupae) form, is the most efficient and effective form of control. In the water they are contained, concentrated and relatively easy to treat before they become biting adults. Once found, we have several ways to control for the emergence of these immature mosquitões: physical control, biological control and chemical control. Each of these different strategies have positives and negatives depending on the time of year, species of mosquito, and habitat being treated. This year our staff made almost 20,000 inspections to these sources for mosquitoes.

Biological Control

Biological control is the use of other organisms that prey on, parasitize, compete with, or otherwise reduce mosquito populations. Our district uses the mosquitofish, *Gambusia affinis*, which effectively preys on mosquito larvae and pupae when released into mosquito breeding water bodies.

This year, the District released mosquitofish to 900 confined water bodies. Mosquitofish can survive in various water qualities and reproduce quickly within short periods of time.

Our indoor fish rearing facility provides mosquitofish for field releases (all year round), especially during the spring and the early summer. **Inspections by Habitat**



Residents can contact the District to request mosquitofish. Our technicians will bring fish to the site and release them in water sources, such as ponds, neglected swimming pools, and animal troughs. A total of 308 service requests from the public were received for mosquitofish. The mosquitofish are free of charge.





IMMATURE Mosquito control

Chemical Control

Chemical control of immature mosquitoes includes the use of products, named larvicides, that help to reduce mosquito populations before they become adults. These larvicides are often control-specific to mosquitoes and are categorized

in the following broad categories: microbial products, growth regulators, surface oils, and toxins derived from bacteria. In 2018, staff made over 5,000 treatments to water containing immature mosquitoes, and used over 30 different products and formulations. Treatments can be for sources of less than a few ounces of water or up to multiple acres of water. Sources treated with chemical control products often need to be re-inspected regularly to ensure the product is still producing the level of control sufficient to prevent emerging adults.



Physical Control

Physical control, being an essential component of IVM, has been a fundamental part of the District's program for many years. Physical control does not directly control the mosquito population; rather, it manipulates the physical environment of mosquitoes, thereby reducing mosquito populations. The manipulation of the mosquito's physical environment can be done through sourcereduction (i.e. the mitigation

or elimination of a source), hand brushing in and around sources to enhance access to mosquito breeding sites and efficacy of larvicides, modifying sources to augment the impact of natural mosquito predators, herbiciding. the physical removal or burning of brush, and working with land owners to encourage prudent land and water use practices. Although most of the physical control is performed during the mosquito off-season, the District remains engaged in these activities throughout the year.



Backhoe



Dumptruck

Chainsaw



Tools of the Trade

Argo



ATV



Larvicide Truck



Maruyama



Handcan





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IMMATURE Mosquito control

Swimming Pools

Unmaintained or neglected swimming pools usually breed *Culex* mosquitoes that transmit West Nile virus. One unmaintained pool can produce more than a million mosquitoes during the season, capable of infecting the neighborhood and putting the entire community at risk.

In the Spring of 2018, staff inspected 112 neglected swimming pools as follow-ups to fish releases and pesticide treatment. Of the 112 pools inspected, 62% were found with fish still in the pool, only 9% were maintained pools, and 20% were treated with mosquitofish and larviciding products.

In the summer of 2018, the District conducted a flyover by a contracted service and identified 355 pools for inspection. Of the 355 pools, 12% had mosquitofish, 30% were maintained pools, and 12% were treated with products.

The Carr Fire generated more than 200 new swimming pools. Staff inspected and treated them as appropriate following the fire and will continue to monitor those pools in the 2019 season.



A tarped pool with standing water and leaves,

Winter & Summer Pool Resolutions





Inspections Treatments

Catch Basins

Catch basins (storm drains) can cause serious mosquito-breeding problems in the urban and suburban areas. They collect and retain water from rain and excessive irrigation of lawns and vegetation gardens and breed *Culex* mosquitoes that play an important role in West Nile Virus (WNV) transmission.

In 2018, staff inspected nearly 8,000 catch basins, of which 696 (8.7%) were found wet and treated with larvicides.

To prevent flooding adjacent catch basins, residents should check their sprinkler systems to ensure they do not excessively saturate landscaping.



Staff checking a catch basin.





500

FEBRUARY

ADULT Mosquito Control

Adult Mosquito Control

Adult mosquito control, referred to as adulticiding, is the practice of controlling adult mosquitoes by applying chemical products. Adulticides are an integral component of a comprehensive IVM program because they can immediately reduce the number of adult mosquitoes in an area. This becomes important when adult mosquitoes reach high enough numbers to spread diseases or

Map of Treatments



This year, District staff completed 400 adulticiding routes and treated over 120,000 acres. Residents can visit our website, www.shastamosquito.org, to review where and when our adult mosquito applications will be conducted, or to subscribe to our spray notification list.

Adult Mosquito Control Applications by Month



Map of ULV Fogging Routes







Truck mounted ULV Fogging equipment

reduce the well-being of our

residents. Adult mosquito control

is a means to rapidly knockdown

biting adult mosquitoes. Adult

mosquito control does have its

limitations. This requires the District to use this intervention along

with several other tools; namely,

a robust larval control program

and increasing our community

engagement regarding personal

bite prevention. Because of the low

application rates, typically less than

3 ounces per acre, no additional

precautions are required for our

residents during these applications.

Additionally, the size of the droplet, the time of the application (dusk/

dawn), and the knowledge of critical

habitats mitigate any non-target

impacts. Our applications are made

in dynamic response to our adult

mosquito surveillance, meaning we are responding that night, or the

next day to trap data. This level





RESEARCH & DEVELOPMENT



Staff aspirating mosquitoes for overwintering surveillance.

Larvicide Efficacy

ADVERTISED ON

ORGANIC WATER

THE LABEL

PRODUCT IN

PRODUCT IN

CLEAN WATER

In 2018, staff tested a larvicide for its residual effect on mosquito larvae. The slow release product is an insect juvenile hormone analogue of mosquitoes that prevents the emergence of adult mosquitoes. Results from the testing can help staff schedule reinspection and treatment of the sources based on the residual effect in varying water quality and source types.

30

DAYS

Overwintering Mosquitoes

Since 2015, District staff have surveyed overwintering mosquitoes between November and February. Staff capture hundreds of mosquitoes which are submitted for encephalitis virus testing. This data has shed light on the species and abundance of mosquitoes which overwinter as adults, as well as the type of refuge they use. -800



Cache Valley Virus

40 Days

In 2013, the District received a report of an occurrence of mosquito borne Cache Valley Virus in the Oak Run area. Last year, the District conducted surveillance for the virus utilizing EVS traps, resting units, and aspiration of adults seeking shelter in protected structures in the Oak run, Millville, and Palo Cedro areas. This spring, a total of 32 mosquito samples were tested

Mosquito

larva

for the presence of Cache Valley Virus; there were no positives. Surveillance for Cache Valley Virus has continued during the fall and winter of 2018, with plans to send the adult samples in for testing in the following spring.



Staff aspirating mosquitoes for Cache Valley Virus testing.

Tools of the Trade

Hatching container



BioAssay Bottles

47

DAYS



Aspirator



12

BG Trap Counter

This year, the District obtained a BG counter which is an accessory device that counts mosquitoes as they pass through the unit. The device also transmits this data back to the lab so that staff can see mosquito collections in the field. This remarkable unit has great potential to affect surveillance and control operations. Staff plan to deploy the BG counter to strategic locations for surveillance in 2019.



BG trap, counter, and solar power unit.

Laboratory & Insectary

The District's upgrade of the lab two new insectaries includes for rearing mosquitoes within a controlled environment. To conduct standardized studies of mosquito control products, it is important to be able to have mosquitoes on hand that represent local species but have known levels of susceptibility to the products' we use. In 2018, the District began maintaining a colony of Culex quinquefasciatus strain CQ1, which is analogous to the District's local Culex pipiens mosquitoes but is completely susceptible to all mosquito control products used by the District.



Larval trays in the new insectary.

BG Trap Counts per 15 Minutes



Bottle BioAssay Testing

The District uses bottle bioassays to monitor for any increase in tolerance to adult mosquito control products in local mosquito populations. Local mosquitoes are placed in bottles with small amounts of pesticides alongside lab-reared pesticidesusceptible mosquitoes. The time that it takes to kill the mosquitoes is recorded and compared.



Staff testing mosquitoes.

Bottle BioAssay Mosquito Mortality Rates

Bottle Bioassays, Salinas Ranch, 9/26 - 9/27, Cx pipiens, Etofenprox



VECTOR SURVEILLANCE

Tick Surveillance

From November 2017 through March 2018, District staff collected ticks at 17 locations throughout the District to monitor tick populations and disease risk. Ticks are collected by sweeping a 1-meter square cloth along trails where ticks "quest" on the tips of vegetation seeking to attach to passing host animals. Collected ticks are identified and counted in the laboratory. Ixodes pacificus ticks are grouped in samples of 3 to 5 ticks and submitted to another laboratory to be tested for presence of tickborne diseases.

During the 2017-2018 tick season, 439 samples totaling 2080 lxodes pacificus ticks were submitted for testing, looking for the presence of Borrelia burgdorferi (Lyme Disease) and Borrelia miyamotoi, a bacterium that can cause a relapsing fever in humans. Tick populations from November 2017 through March 2018 were higher than previous years and higher than the seasonal average.



Percent Distribution of Ticks By Genus

(2017 - 2018 at 17 Sites in Shasta MVCD)



November 2017 - March 2018

Tools of the Trade



Tick surveillance requires very little in the way of equipment beyond a pair of keen eyes and a "tick flag". A tick flag is a 1-meter square piece of light fabric attached to a handle. The ticks stick to the fabric and are easily removed and counted. We calculate abundance by the ticks collected per hour.





Rodent Surveillance

The District occasionally assists California Department of the Public Health to perform rodent surveillance for diseases such as plague and Hantavirus. Rodent surveillance is usually focused in areas such as campgrounds where humans may be exposed to rodents, their excreta and the ectoparasites they carry. These events are excellent training opportunities for SMVCD staff. Additionally, staff may provide advice to the public on rodent control and exclusion tactics around the home.

Mosquito Surveillance

Mosquitoes are attracted to many physical and chemical cues such as light and carbon dioxide. Vector control professionals capitalize on this characteristic by using the same kinds of cues to draw mosquitoes into mosquito surveillance traps. There are many kinds of traps, each with their own specificity and nuance. The District uses a variety of traps to understand the full scope of the adult mosquito population.

By sampling and assessing the adult mosquito population, Ditrict staff gather information about the potential hazards in the district. Some species, though voracious biters, are simply a nuisance. Other species, however, spread disease and their presence warrants greater action.

Adult mosquito surveillance also guides immature mosquito control. Different species have vastly





Staff identifying mosquito species using a dichotomous key.



different behaviors and needs, especially as larvae. The composition of the adult mosquito population can inform staff of which types of water sources support mosquito larvae nearby.

For example, the larvae of the western treehole mosquito are generally found in the cavities of oak trees which retain water. The discovery of many western treehole mosquitoes often means there is a tree cavity nearby which is harboring mosquito larvae.

Mosquito Surveillance - EVS Trap Counts (Weekly)





A staff member putting on safety equipment to prepare for rodent surveillance.

Tools of the Trade





CDC AGO



BG Sentinel Trap



DISTRICT-WIDE

DISEASE SURVEILLANCE

The District relies on several indicators to survey local virus transmission and disease. Mosquito samples, sentinel chicken blood samples, and dead bird saliva samples are all collected by District staff to monitor disease transmission in these key species. The District also receives limited on human and equine data WNV illness. The detection of a positive sample from any of these surveillance tools prompts swift response by the District.

fools of the Trade

The lifecycle of a mosquito sample



WNV

Data is entered into CalSurv for <u>data</u>

freezer.





Overall, the District experienced a slight uptick in the number of West Nile virus (WNV) positive samples in 2018 compared to 2017. Despite this minor increase, WNV detection continues to be at low to average levels.

MOSQUITO SAMPLES

Mosquito samples are first collected in traps, which provides population data, which then drives control decisions. After processing, some mosquito species are tested for the presence of viruses. A positive result provides information on when and where virus transmission may occur.

HUMAN & HORSE CASES

Human and horse cases are reported to the District by public health or veterinary professionals.



DEAD BIRD REPORTS

Dead birds are another indicator of virus transmission within an area. Corvids, such as crows and magpies, are reported by the public, collected by District staff, sampled and tested for virus infection.

SENTINEL CHICKENS

Sentinel chicken flocks provide information on virus transmission occurring between a mosquito and one of the sentinel chickens. Indicators like mosquito samples and dead birds only provide a rough idea of where virus transmission may occur, since these animals are highly mobile. Where the animal is infected and where they are found may be two different locations. On the other hand, sentinel chickens do not disperse from their coops, so they provide a better understanding of where virus transmission has occurred.

District-wide Positive WNV Indicators 2015-2018

	2015	2016	2017	2018
Human Cases	2	1	1	1
Horses	2	1	0	1
Dead Birds	15	3	2	5
Mosquito Samples	48	12	0	8
Sentinel Chickens	18	3	4	4
Total	68	16	7	19

Trap Counts & WNV Mosquito Pools (Weekly)



STATE-WIDE DISEASE SURVEILLANCE

Shasta

Butte

Sutter 110

Yolo

Tehama

Glenn

Colusa

Napa

Lake

Sonoma

Siskiyou

Trinity

Mendocino

Del

Humboldt

Norte

Modoc

Lassen

Plumas

. Sierra

Nevada

Placer

El Dorado

West Nile Virus Statewide, fewer WNV positive mosquito samples and sentinel chickens were found in 2018

compared to 2017. Likewise, 2018 saw only 215 human cases of WNV. less than half the number diagnosed in 2017. 2018 was one of the least active years in recent history.

Statewide Positive WNV Indicators 2015-2018				
	2015	2016	2017	2018
Human cases	782	442	502	215
Dead birds	1349	1352	505	501
Mosquito sample	3329	3528	3371	1963
Sentinel Chicken	449	343	305	163

California WNV Positive Indicators by County

Counties with West Nile virus activity (no human cases)

Counties with West Nile virus activity (number of human cases)

St Louis **Encephalitis Virus**

St. Louis Encephalitis virus (SLEV) has a long history in California. Since 1937, SLEV was frequently detected and caused epidemics among horses and humans. SLEV abruptly disappeared for more than a decade during which the virus went undetected statewide despite an increase of mosquito surveillance. As quickly as it disappeared, SLEV unexpectedly reemerged in 2015 when both mosquito samples and sentinel chickens from multiple locations were found to harbor the virus.

Geographically, SLEV has been detected in the southern and regions of California. central During 2018, the number of SLEV positive mosquito samples doubled compared to 2016 & 2017. The number of human cases and infected sentinel chickens remained comparable to previous years.



OUTREACH & PUBLIC EDUCATION

Despite extensive mosquito control efforts, comprehensive mosquito surveillance, and very low levels of West Nile virus detection, there was still one human case of WNV confirmed within the District in 2018. This shows that there is no substitute for public awareness about mosquito-borne diseases and the importance of mosquito prevention and avoidance measures taken by the public. Therefore, the District works to constantly improve its efforts at public education and outreach as a key part of its comprehensive Integrated Vector Management program.

Although the District has existed since 1919, there are still residents who are not familiar with our mission. To improve awareness, the District has refreshed our outreach campaigns with consistent branding and innovative audio and visual PSA production. The District staff has also incorporated a multi-platform web and social media presence to

Website & Social Media **Highlights of 2018**



reach our community on a digital level.

And perhaps the most memorable addition to our outreach efforts in 2018 includes Missy Keeto, our mosquito mascot, and her Swat Team. You might see Missy buzzing around at community events or visiting a local classroom, to help District staff educate the public about how to avoid mosquito bites and prevent mosquitoes from growing nearby.

Events

Q



Missy Keeto

reading her

Book.

new Activity

District staff manning a booth for the trout release days, as part of the "Classroom Aquarium Education Program."



Missy Keeto admiring the many informational brochures the District provides at all of our outreach events.

stomosouito oro

Missy Keeto and staff visiting with a class during a field trip to the District.



Below: Missy Keeto and staff at the Shasta District Fair checking on our mosquitofish aquarium.





staff member in our new photo banner, as a mosquito larva, about to be eaten by a mosquitofish.



FINANCIAL REPORT BREAKDOWN

The Shasta Mosquito and Vector Control District depends on property tax revenues and benefit assessments to fund its operations. The District's objective is to be fiscally responsible in accordance with Generally Accepted Accounting Principles (GAAP), Governmental Accounting, Auditing and Financial Reporting (GAAFR) as well as State Controller reporting guidelines.

The District also completed one of the Capital Improvement projects that was prioritized 5 years ago: the lab expansion. This took longer than expected but was a successful experience and will support planning for the future growth of the district.

2017-2018	
Assets	
Cash and cash equivalents	\$2,916,415
Due from other governments	\$ 41,332
Inventories	\$ 82,852
Non-depreciable capital assets	\$ 51,273
Depreciable capital assets, net	\$ 1,113,165
TOTAL ASSETS	\$ 4,205,037
Liabilities	
Accounts payable	\$17,801
Net pension liability	\$ 2,326,066
Compensated Absences	\$ 165,876
TOTAL LIABILITIES	\$ 2,509,743

2017-2018 REVENUES				
Property Taxes	\$ 1,305,966	49.44%		
Assessments	\$ 1,280,057	48.46%		
Interest & Miscellaneous	\$ 55,650	2.11%		
TOTAL REVENUE	\$ 2,641,673	100%		
2017-2018 EXPENDITURES				
Salaries and Benefits	\$ 2,058,509	74.63%		
Service and Supplies	\$ 672,623	24.39%		
Utility Expense	\$ 27,040	0.98%		
TOTAL EXPENDITURES	\$ 2,758,172	100%		

Left: Missy Keeto during the filming of our Summer PSA: Mosquito Squatter.

Below: A district



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