

# *North Dakota Mosquito Surveillance 2005 Program*



**NORTH DAKOTA**  
DEPARTMENT *of* HEALTH



Division  
of  
Microbiology

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## **2005 North Dakota Mosquito Surveillance Program's Mission**

Through mosquito collection and speciation, the North Dakota Department of Health (NDDoH) monitors the risk of infection from arboviral encephalitides that are known to occur in this region. The North Dakota Mosquito Surveillance team focuses activities on *Culex tarsalis*, monitoring for increased numbers in the New Jersey mosquito trap network and viral identification using the CDC miniature light mosquito trap network. Should mosquito populations reach significant levels or arbovirus activity is detected, appropriate recommendations for mosquito population control will be issued by the NDDoH to the vector control districts.

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## **North Dakota Mosquito Surveillance Program Background**

Since 1975, the North Dakota Department of Health has monitored the mosquito populations throughout the state. The Mosquito Surveillance Program traditionally has been activated following arboviral outbreaks or flooding incidences in various locations throughout the state.

The program was first initiated in 1975 following an outbreak of western equine encephalitis (WEE) and St. Louis encephalitis (SLE) in the United States. In 1977, the program was officially formed under the title *North Dakota Arboviral Encephalitis Surveillance Program* and housed with the Division of Environmental Sanitation and Food Protection. This program was responsible for equine and human arbovirus surveillance until 1989.

The program was reinstated under the name *North Dakota Mosquito Surveillance Program* in 1994 in response to flooding of the Red River in 1993. This program was operated by the Division of Microbiology until 1997.

In 2000, the *North Dakota Mosquito Surveillance Program* was reinstated in response to the 1999 West Nile virus (WNV) outbreak in New York. In 2002, North Dakota had its first confirmed human cases of WNV, as well as detectable virus through laboratory testing in birds, horses and mosquitoes.

The 2003 program was expanded from 50 New Jersey mosquito traps to a network of 87 traps and 18 CDC miniature light mosquito traps. These enhancements provided network coverage statewide. The 2004 program further expanded the trap network to include 94 New Jersey mosquito traps and 33 CDC miniature light mosquito Traps. These enhancements ensured uniform surveillance activities statewide. A video was also produced to aid in trap-placement training.

The 2005 program further expanded to 103 New Jersey mosquito traps and 39 CDC miniature light mosquito traps.

## New Jersey Mosquito Trap Network

The New Jersey mosquito trap network monitors mosquito populations throughout the state. By identifying mosquito populations known to be competent encephalitis vectors, the information from the network is used to determine the threat of mosquito-borne encephalitis in various regions of the state.

*Thank you to the following New Jersey mosquito trap operators whose dedication and commitment to the North Dakota Department of Health Mosquito Surveillance Program made the 2005 program a success!*

### 2005 New Jersey Mosquito Trap Operators

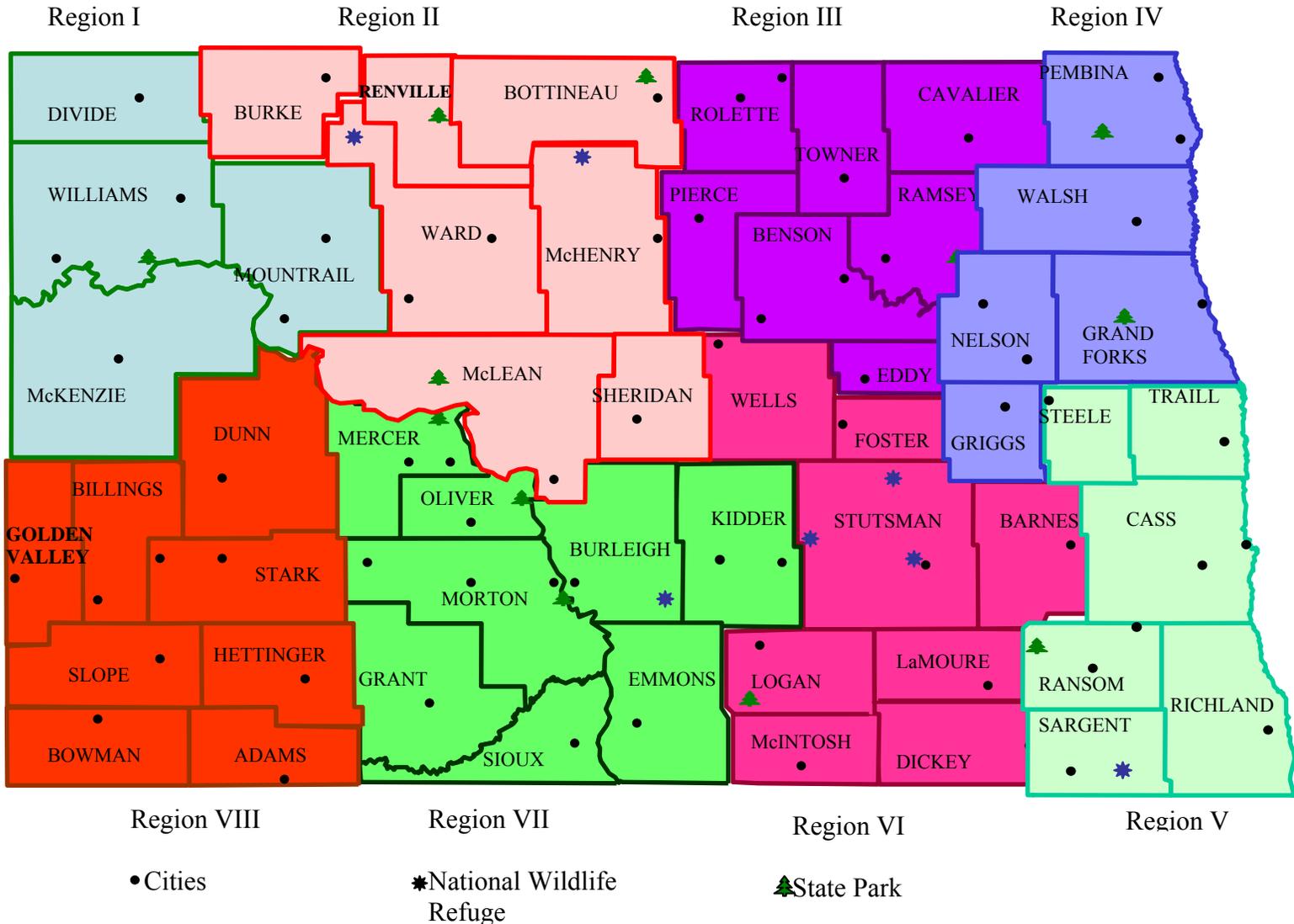
\*Indicates State Parks    \*\* Indicates National Wildlife Refuge

<b>Location</b>	<b>Trapper</b>	<b>Location</b>	<b>Trapper</b>	<b>Location</b>	<b>Trapper</b>
Almont	Idar Handegard	Chase Lake Prairie Project NWR**	David Bolin	Dickinson	Skip Rapp, Denny Smith
Amidon	Teresa Baumann	Cooperstown	Julie Ferry, Lyle Sherrard	Drayton	Tim Midboe
Arrowwood NWR**	Paulette Scherr	Crosby	Dennis Lampert	Edmore	Roger Nygard
Ashley	Marcus Lynn	Cross Ranch*	Dennis Clark	Elgin	Norman Schock
Beach	Alvin & Betty Tescher	Devils Lake	Myron Asleson, Leroy Axdahl	Enderlin	Rick Gillund, Glen Fuhrman
Beaver Lake*	Steve Wipperling	Finely	Diane Jacobson	Fargo	Reed Weisenberger
Belcourt	Jen Malaterre	Formen	Colleen Sundquist	Hillsboro	Jim Anderson
Belfield	Susan Heck	Fort Ransom*	John Kwapinski	Icelandic*	Henry Duray
Beulah	Keith Johnson	Fort Stevenson*	Richard Messerly	Indian Hills Rec Area*	Byron & Tolly Holtan
Bismarck	Mel Fischer	Fort Totten	Hilda Garcia	J. Clark Saylor NWR**	Gary Erickson
Bottineau	Sue Brandvold	Fort Yates	Bill Sherwood	Jamestown	Steve Reidburn
Bowbells	Petter Willyard	Ft. Abraham Lincoln*	Dan Scheleske	Lake Isabel	Carl Anderson
Bowman	Brenda Rettinger	Grafton	Mike Huska	Lake Sakakawea*	John Tunge, Dave Leite
Cando	Terry Harland	Grahams Island*	Dick Horner, Trevor Retterath	Lamoure	Tony Hanson, Leslie Hanson
Carrington	Bobbi Indergaard	Grand Forks	Todd Hanson	Langdon	Rob Gilseth
Carson	Norman Schock	Harvey	Karen Volk, Loren Stolz	Lewis & Clark*	Alan Larson
Casselton	Reed Weisenberger	Hazen	Keith Johnson	Linton	Bev Voller
Cavalier	Terri Gustafson	Hebron	Chad Stern, Lance Elmer	Lisbon	Randy Seelig
Center	Keith Johnson	Hettinger	Jesse Handegard	Long Lake NWR**	Gregory Knutson
Maddock	Jean Mosser	Napoleon	Julie Kramlich	Tewaukon NWR**	Kristine Askerooth
Mandan	Dick Bechtel	New Rockford	George Ritzke	Tioga	Don Zacharias, Kirk Odegard

**New Jersey Mosquito Trap Operators, Continued:**

Location	Trapper	Location	Trapper	Location	Trapper
Manning	Kevin Pavlish	New Town	Kerry Hartman	Towner	Nikki Medalen
McClusky	Dallas and Mariam Bold	Northern Prairie Wildlife Research **	Bob Woodward	Turtle River*	Steve Crandall, James Loken
McVile	Julie Ferry, Rick Haabeck	Oakes	Robert Schaefer	Upper Souris NWR**	Thomas Pabian
Medicine Lake NWR**	Beth Madden	Pembina	Kathy Johnson	Valley City	Jeff Diferding
Medora	Bruce Kaye	Ramsey	Allen McKay	Wahpeton	Shawn Kessel
Minot	Jim Heckman	Rolla	Mark Miller	Washburn	Sandy Birst
Mott	Kim Kibbel	Rugby	Jeanette Myglund	Watford City	Robert Nelson
Mouse River	Jim Heckman	Ryder	Jody Reinsch	Williston	Gene Gafkjen, Mike Melius
Lake Metigoshe*	Larry Hagen	Steele	Diane Jacobson	Waubay NWR**	Laura Hubers

**2005 New Jersey Mosquito Trap Surveillance Sites & Regions**



## New Jersey Mosquito Trap Network Information

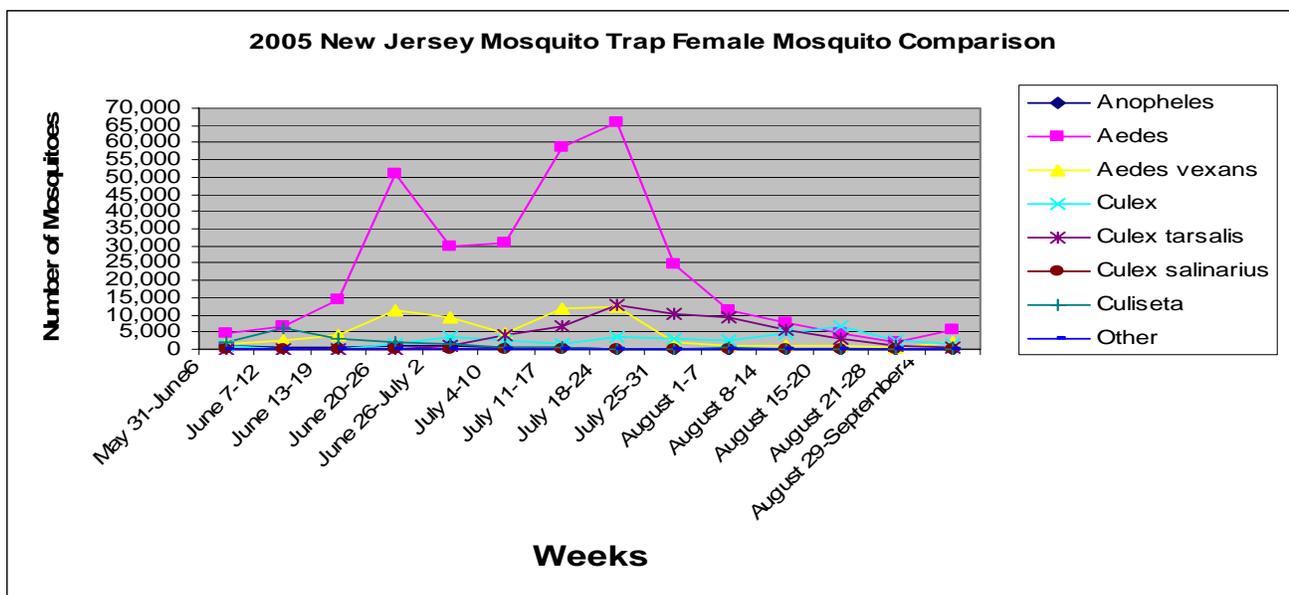
In 2005 the New Jersey mosquito trap network had a total of 103 traps across North Dakota. There were 12 in state parks and eight in national wildlife refuges. Two New Jersey mosquito traps were located in each urban area with a population greater than 7,000 citizens.

Each May, the New Jersey mosquito trap operator installs a trap in a suitable location at the beginning of mosquito season. Using a programmable timer, the trap is set to operate between the hours of 8:30 p.m. and 7 a.m. seven nights a week. At the end of the seven-day period, the trap contents are collected and sent to the North Dakota Department of Health, Division of Microbiology in Bismarck for counting and speciation. This process is repeated weekly until the end of mosquito season in September.

At the Division of Microbiology, the mosquito surveillance personnel sort the mosquitoes into sex and genera. Since male mosquitoes do not bite, they are of little health concern. However, their numbers are monitored because male mosquitoes hatch first, and increased numbers may indicate a future female mosquito population boom. The female mosquitoes are separated into four genera: *Anopheles*, *Aedes*, *Culex* and *Culiseta*. These genera are then enumerated.

The North Dakota Department of Health monitors for four genera:

- *Anopheles* is associated with malaria and West Nile virus.
- *Aedes* is associated with illnesses such as canine heartworm, LaCrosse encephalitis (LCE), eastern equine encephalitis (EEE), western equine encephalitis (WEE), California encephalitis (CAE), and West Nile virus (WNV). Although *Aedes vexans* has been shown to be capable of laboratory transmission of WNV, its mammalian feeding preferences decrease its potential as an enzootic vector for WNV.
- *Culex* is the mosquito of greatest public health concern in North Dakota, since all species are competent vectors of SLE, WEE and WNV. The species most commonly associated with encephalitis in North Dakota is *Culex tarsalis*, a principal arbovirus vector in rural agricultural ecosystems.
- *Culisetas* are monitored due to its association with Eastern Equine Encephalitis.



**2005 New Jersey Mosquito Trap Count Totals for Each Week - Counties**

Week of	Male	Female								Total female	Total mosquitoes	Sites counted
		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culex salinarius	Culiseta	Other			
May 31-June 6	3,778	714	4,331	1,416	922	6	44	1,360	0	8,793	12,571	50
June 7-12	5,315	370	6,171	2,278	57	0	0	5,139	6	14,021	19,288	56
June 13-19	11,914	506	12,084	3,300	72	0	0	2,232	72	18,266	30,180	53
June 20-26	23,951	578	40,315	9,418	1,226	36	0	1,319	20	52,912	76,863	52
June 26-July 2	9,335	615	26,661	8,847	3,067	967	40	1,332	23	41,552	50,887	58
July 4-10	11,067	689	28,935	4,727	2,226	3,803	32	470	0	40,882	51,949	50
July 11-17	17,264	351	52,474	10,523	1,208	5,730	20	467	0	70,773	88,037	58
July 18-24	8,882	194	35,581	4,476	1,675	7,575	69	248	0	49,818	58,700	59
July 25-31	7,785	109	23,233	1,999	2,758	9,713	67	90	0	37,969	45,754	55
August 1-7	11,248	158	10,217	950	2,156	8,424	14	428	4	20,351	33,599	55
August 8-14	5,893	70	7,325	7,325	4,277	5,604	40	117	0	18,315	24,208	59
August 15-20	3,458	148	3,657	772	4,983	2,436	70	214	0	12,280	15,738	55
August 21-28	2,433	72	2,144	455	2,541	785	3	32	0	6,032	8,465	44
August 29-September 4-	3,164	46	5,368	2,192	1,570	581	20	0	0	9,777	12,941	39
<b>2005 Totals</b>	<b>125,487</b>	<b>4,620</b>	<b>258,496</b>	<b>52,235</b>	<b>28,738</b>	<b>45,660</b>	<b>419</b>	<b>13,448</b>	<b>125</b>	<b>403,741</b>	<b>529,180</b>	

**2005 New Jersey Mosquito Trap Count Totals for Each Week - State Parks**

Week of	Male	Female								Total female	Total mosquitoes	Sites counted
		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culex salinarius	Culiseta	Other			
May 31-June 6	28	56	205	4	104	0	0	218	0	587	615	6
June 7-12	559	11	295	160	16	0	0	229	0	711	1,270	7
June 13-19	1,305	178	1,676	576	80	0	0	510	0	3,020	4,325	8
June 20-26	5,330	210	4,522	860	78	10	0	306	0	5,986	11,316	8
June 26-July 2	853	168	2,940	424	441	44	0	47	0	4,064	4,917	8
July 4-10	337	46	851	83	98	50	0	20	0	1,148	1,485	4
July 11-17	970	10	2,646	716	130	320	0	10	0	3,832	4,802	6
July 18-24	382	11	1,360	287	60	188	0	0	0	1,906	2,288	5
July 25-31	694	4	423	51	90	171	0	3	0	742	1,436	5
August 1-7	1,074	10	568	94	184	708	0	10	0	1,574	2,648	6
August 8-14	75	0	103	81	88	116	0	4	0	392	467	5
August 15-20	632	52	376	62	590	168	0	0	0	1,248	1,880	7
August 21-28	84	2	22	4	34	34	0	0	0	96	180	3
August 29-September 4-	134	0	74	0	77	41	0	0	0	192	326	5
<b>2005 Totals</b>	<b>12,457</b>	<b>758</b>	<b>16,471</b>	<b>3,402</b>	<b>2,070</b>	<b>1,850</b>	<b>0</b>	<b>1,357</b>	<b>0</b>	<b>25,498</b>	<b>37,955</b>	

**2005 New Jersey Trap Count Totals for Each Week - Wild Life Refuges**

Female												
Week of	Male	Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culex salinarius	Culiseta	Other	Total female	Total mosquitoes	Sites counted
May 31-June 6	691	64	155	266	8	0	0	319	0	812	1,503	4
June 7-12	454	76	422	116	0	0	0	714	0	1,328	1,782	6
June 13-19	606	20	792	184	10	0	0	184	0	1,190	1,796	4
June 20-26	3,204	250	6,180	1,100	0	0	0	184	0	7,714	10,918	6
June 26-July 2	84	20	258	64	12	0	0	1	20	375	459	2
July 4-10	87	10	916	79	33	31	1	4	0	1,074	1,161	4
July 11-17	610	0	3,420	440	50	420	0	0	0	4,330	4,940	2
July 18-24	3,564	40	28,740	7,768	1,636	5,020	0	0	0	43,204	46,768	4
July 25-31	314	10	850	136	178	288	0	0	0	1,462	1,776	4
August 1-7	876	72	444	26	112	346	0	0	0	1,000	1,876	3
August 8-14	780	20	440	30	100	160	0	20	0	770	1,550	6
August 15-20	508	4	576	4	920	428	0	0	0	1,932	2,440	5
August 21-28	260	10	50	0	40	60	0	0	0	160	420	3
August 29-September 4-	28	0	9	8	39	8	0	0	0	64	92	5
<b>2005 Totals</b>	12,066	596	43,252	10,221	3,138	6,761	1	1,426	20	65,415	77,481	

**CDC Miniature Light Mosquito Trap Network**

The CDC miniature light mosquito trap network monitors mosquito populations known to be competent encephalitis vectors. The information from the network can be used to determine the threat of mosquito-borne encephalitis in various regions of the state. In 2005, the CDC miniature light trap network included 21 locations within the state and two locations out of state (Montana and South Dakota).

*Thank you to the following CDC miniature light mosquito trap operators!*

**2005 CDC Miniature Light Mosquito Trap Operators**

\* Indicates State Parks \*\* Indicates National Wildlife Refuge

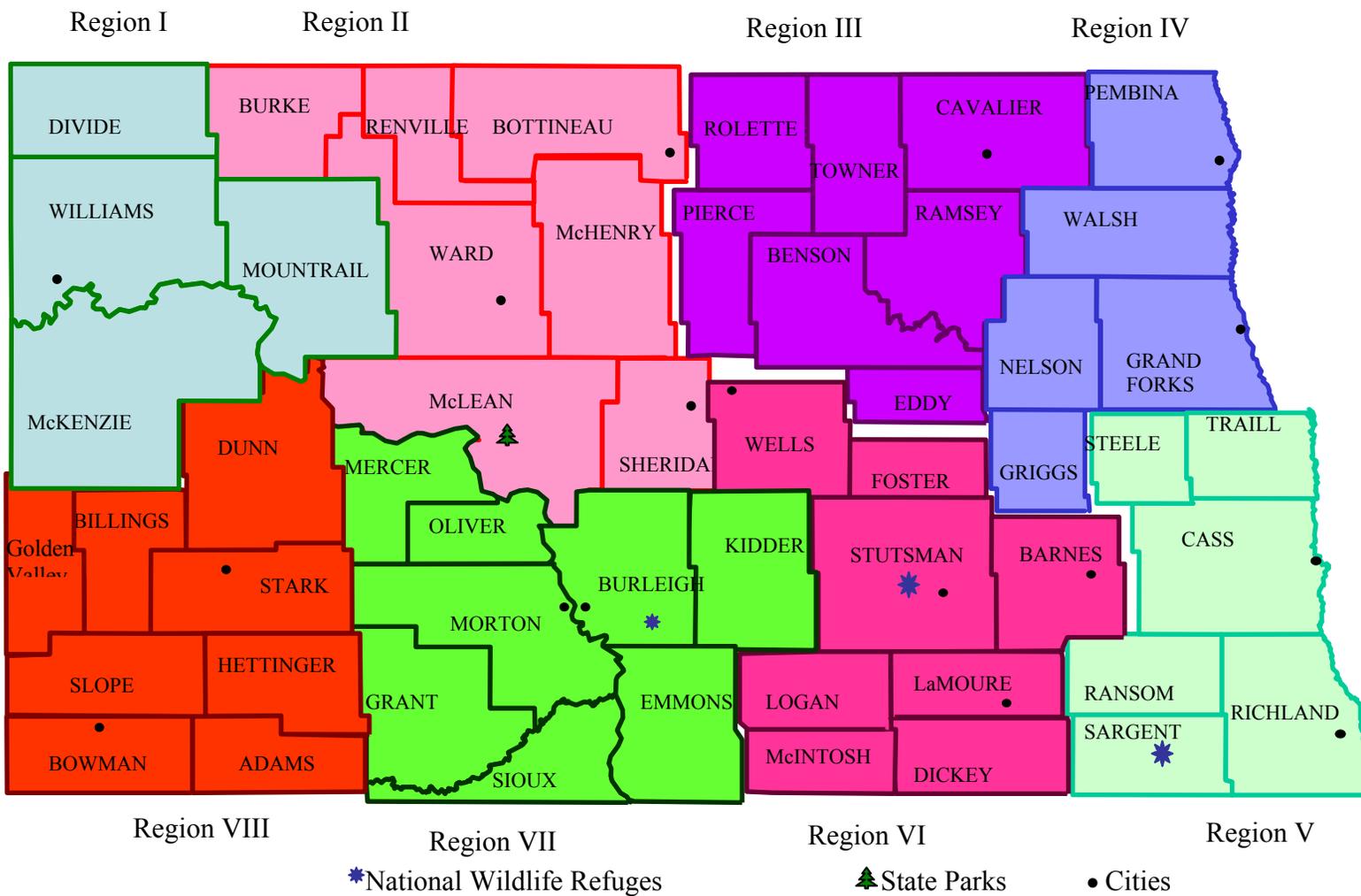
Location	Trapper	Location	Trapper	Location	Trapper
Bismarck	PHL Mosquito Surveillance Personnel	Grand Forks	Todd Hanson	Medora	Bruce Kaye
Bottineau	Sue Brandvold	Harvey	Loren Stolz	Minot	Mark Syverson
Bowman	Brenda Rettinger	Jamestown	Jim Michael	Towner	Nikki Medalen
Chase Lake NWR**	David Bolin	Lake Sakakawea*	John Tunge, Dave Leite	Valley City	Jeff Differding
Devils Lake	Allen McKay	LaMoure	Tony Hanson, Leslie Hanson	Wahpeton	Shawn Kessel
Dickinson	Kevin Pavlish	Langdon	Rob Gilseth	Waubay NWR**	Laura Huber
Drayton	Tim Midboe	Mandan	PHL Mosquito Surveillance Personnel	Williston	Dave Benth
Fargo	Don Russiff, Elisha Kabanuk	Medicine Lake NWR**	Beth Madden		

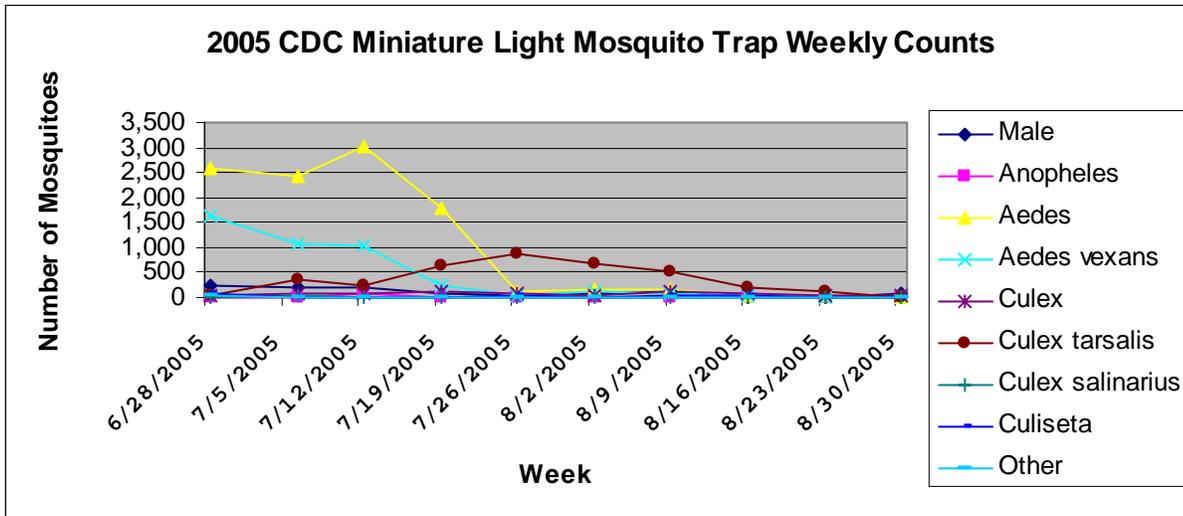
## CDC Miniature Light Mosquito Trap Network Information

The CDC miniature light mosquito trap is a battery-operated carbon-dioxide-baited trap that allows collection of mosquito specimens for laboratory testing. The traps are set up in suitable mosquito trapping locations in the evening, baited with carbon dioxide and collected the next morning. The samples are then placed in shipping coolers with icepacks to preserve any virus present and sent to the Division of Microbiology for speciation. At the laboratory, the collection is speciated and counted. The *Culex tarsalis* is separated from the collection and placed in pools of up to 50 mosquitoes. The pools are then tested using a nucleic acid amplification procedure to detect the presence of West Nile virus. Testing of 2005 mosquito pools resulted in no detection of WNV.

In 2005, the CDC miniature light mosquito trap network expanded to include 39 CDC miniature light mosquito traps in 23 locations across North Dakota, South Dakota and Montana. The CDC trap network began its first week of operation the last Tuesday night in June. The network then operated once a week, usually Tuesday night, until the first Tuesday night in September.

### 2005 North Dakota CDC Miniature Light Mosquito Trap Network Sites





### Arbovirus Information

More than 2,500 different species of mosquitoes are found worldwide, with about 200 species in the United States. The most common vector in the spread of arboviruses is the mosquito; however, not all mosquitoes are vectors in the transmission of arboviruses.

Male mosquitoes feed almost exclusively on nectar and therefore do not bite. Female mosquitoes lay mosquito eggs that require a blood meal and bite animals, warm or cold-blooded, and birds. Stimuli that influence biting include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Humans are seldom the first or second choice for a blood meal. Horses, cattle, smaller mammals and birds are preferred. Although acquiring a blood meal is essential for egg production, both male and female mosquitoes are mainly nectar feeders.

Mosquito-borne diseases cause more than one million human deaths every year. Some of these diseases include protozoan infections, such as malaria; filarial pathogens, such as canine heartworm; and viruses that cause dengue, yellow fever and encephalitis.

Arthropod-borne viruses (arboviruses) are the most diverse and serious diseases transmitted to susceptible vertebrate hosts by mosquitoes. All arboviral encephalitides are zoonotic involving a nonhuman primary vertebrate and a primary arthropod vector. Humans and domestic animals can develop clinical illness but usually are “dead-end” hosts because they do not contribute to the transmission cycle.

**West Nile virus (WNV)** is the most recently emerged arbovirus in North America. West Nile virus is named after the West Nile region of Uganda where it was first discovered in 1937. *Culex* species of mosquitoes are the primary vectors. Common in many parts of the world, WNV had not been seen in the United States until late summer 1999, when it made its debut in New York. WNV then proceeded to travel westward across the continent the following year. West Nile fever can be characterized by fever, headache and rash to more serious symptoms. Although only a small percentage of people infected with WNV display symptoms, WNV can cause encephalitis (an inflammation of the brain) and meningitis (inflammation of the brain and spinal cord) in humans and animals.

**Western equine encephalitis (WEE)** is mostly found in states west of the Mississippi River. The primary vector is *Culex tarsalis*. Birds are the most important host. Since 1964, there have been fewer than 1,000 cases reported. Human mortality rates are about 5 percent, with horse mortality rates considerably higher.

**Eastern equine encephalitis (EEE)** is spread to horses and humans by infected mosquitoes. Annually, there are a small number of cases nationwide. EEE is the most serious of the arboviruses that can affect the central nervous system (CNS), resulting in severe complications and even death. Symptoms may range from none at all to flu-like to more serious infections with sudden fever and severe headache followed by seizures and coma. About half of patients die, and of those who survive, many suffer permanent CNS damage.

**St. Louis encephalitis (SLE)** is transmitted from birds to mammals by an infected mosquito. SLE was discovered in 1933 in St. Louis, Mo. Since then, SLE has been reported in 46 states. Most infections of SLE do not result in illness, with mild cases exhibiting aseptic meningitis or fever. The elderly and very young children are more susceptible, with fatality rates from 2 percent to 20 percent, and neurologic dysfunction occurring in about 1 percent of survivors.

**The California serogroup** is a group of several related viruses that included California encephalitis, La Crosse encephalitis, and Jamestown Canyon virus. Each year, about 75 cases are reported in the United States, with the majority of the illnesses resulting from La Crosse encephalitis. The California serogroup viruses primarily affect male children younger than 16. Infections are mild, with a mortality rate of about four deaths per 1,000 infections.

**North Dakota Mosquito Surveillance  
Risk Assessment Chart  
For Arbovirus Activity**

<b>Risk Category</b>	<b>Probability of Human Outbreak</b>	<b>Definition of Conditions</b>	<b>Recommended Response by Mosquito Surveillance Team and North Dakota Vector Control Personnel</b>
1a	Remote	Mid-season; first week of July; no observed epizootic activity; low population counts of vector species from New Jersey trap network	Begin preliminary, low-intensity CDC live-trapping network and testing in all areas of the state; test for targeted virus presence.
1b		Late-season; third week of July through September; no observed epizootic activity; high population counts from New Jersey trap network	Deploy mid-intensity CDC live-trapping network and viral testing in areas with high population counts of targeted vector species; continue low intensity trapping and testing in other areas.
2	Low	Sporadic epizootic activity in birds or mosquitoes	Deploy high intensity CDC live-trapping network and viral testing in epizootic areas, and consider preliminary control measures such as source reduction and larval control; continue surveillance in other areas.
3	Moderate	Initial confirmation of virus in horse or human; moderate activity in birds or mosquitoes	Continue as in Category 2; consider adult mosquito-control as indicated by surveillance activity.
4	High	Measures suggesting high risk of human infection (for example, high dead bird densities, high mosquito infection rates, multiple positive mosquito species, horse or mammal cases indicating escalating epizootic transmission, or a human case)	Response as in Category 3; initiate adult mosquito control program in areas of potential human risk.
5	Outbreak in progress	Multiple confirmed human cases; conditions as listed in Category 4	Implement emergency adult mosquito-control program; if widespread, consider aerial spraying.

## Appendix A

### New Jersey Mosquito Trap Data Analysis

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The mosquito's life cycle has four separate and distinct stages: egg, larva, pupa and adult. A female mosquito breeds in the presence of water and lays fertile eggs after obtaining a blood meal. The location in which a female mosquito deposits her eggs in the environment depends upon larval habitat preference. The 36 mosquito species indigenous to North Dakota can be grouped into four categories that reflect their larval habitat preference. These categories include the permanent pool group, the transient water group, the floodwater group, and the artificial container and tree-hole group.

Mosquitoes within the **permanent pool group**, *Anopheles* and *Culex* species, lay eggs either singly or side by side on the water surface of permanent ponds and lakes. Permanent pool mosquitoes can develop continuously in warm water and hatch daily into adults. **Transient water mosquitoes** such as *Culex tarsalis* prefer to lay their eggs in pools of a temporary nature. Common habitats of the transient water group are roadside ditches, canals, ground pools and irrigated lands. Transient water mosquito eggs in ditches and small depressions must wait until rainfall to begin the hatching process. **Floodwater mosquitoes**, the *Aedes* species, lay eggs singly on damp soil or along vegetated shorelines; the eggs remain dormant until these areas are flooded. Once flooded, the eggs hatch if conditions are favorable. Large numbers of larvae emerge, and adults can appear as early as six days after flooding. A major rainstorm, a series of showers, or irrigation sufficient enough to produce standing water promotes hatching in the floodwater species of mosquitoes. The **artificial container and tree-hole group of mosquitoes** place their eggs inside the wall of a container or depression inside a tree, at or above the water line, and the eggs hatch when the water levels rise. A heavy rain resulting in standing water in old tires, tin cans and flowerpots will begin the hatching process for artificial container mosquitoes.

Once hatched, larvae of all species emerge and live in water. After four stages, or instars, the larva molts into a pupa. The pupa stage is a resting, non-feeding stage where the pupa is encased until the adult matures and emerges from the skin after one-and-a-half to four days. Adult male mosquitoes hatch first and live from six to seven days. Female mosquitoes can live for about two weeks but have been found to survive for up to five months with ample food. Peak adult mosquito populations usually appear within two weeks after a number of eggs hatch.

Along with increased rainfall, warmer water temperatures speed up hatching and larval development. If outdoor temperatures are 50 degrees Fahrenheit or more, productive breeding sites readily produce mosquito larvae. With increasing water temperatures, large mosquito populations can emerge within one week. Research in laboratory settings has shown that if the water temperature exceeds 100 degrees Fahrenheit, it takes only three to four days for larval metamorphosis; if the temperature is 90 degrees Fahrenheit, it takes five days; and a lower water temperature of 70 degrees Fahrenheit decreases rate of growth to 10 days. Floodwater species of *Aedes* larvae generally metamorphose within five to seven days after hatching. The species *Culex tarsalis* completes its life cycle in 14 days at 70 degrees Fahrenheit and in only 10 days at 80 degrees Fahrenheit. On the other hand, some species have naturally adapted to go through their entire life cycle in as little as four days or as long as one month.

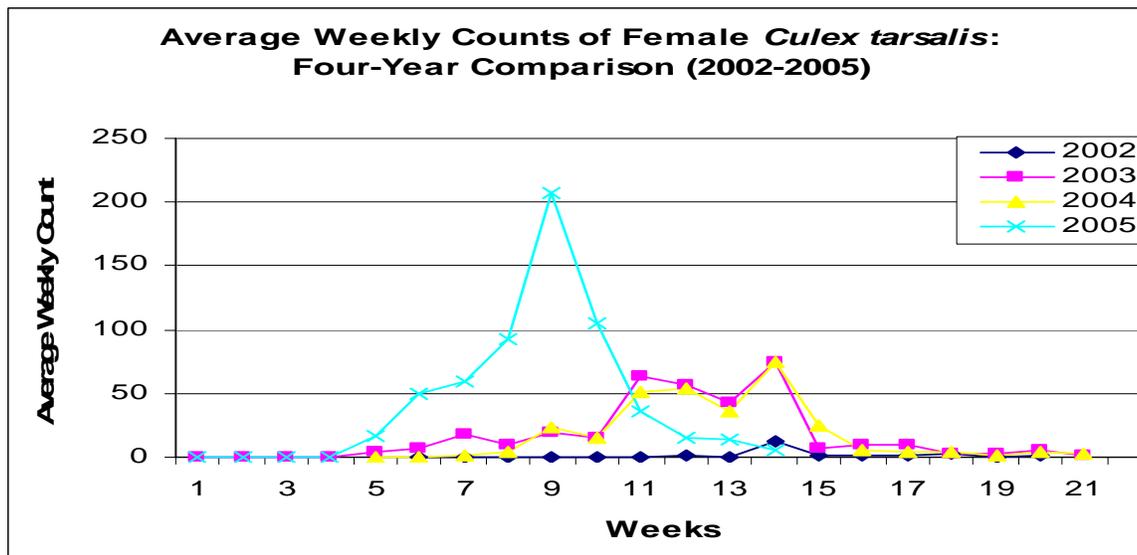
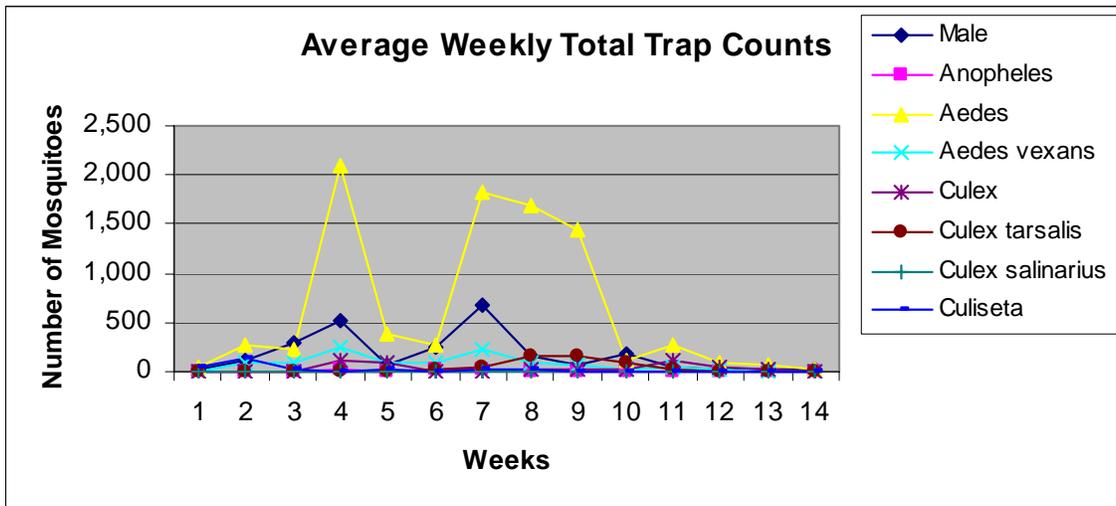
When a mosquito becomes an adult, the weather elements affect its peak activity. Most mosquitoes are active from dusk until dawn when wind speeds are less than eight miles per hour, the air temperature is between 65 degrees Fahrenheit and 80 degrees Fahrenheit, and the weather is moderate.

Heavy rains, gusting winds, and cool or high daytime temperatures all limit a mosquito's feeding activity. At temperatures lower than 50 degrees Fahrenheit, mosquitoes become sluggish, reducing their host-seeking behavior. At higher temperatures, usually during daytime hours, adult mosquitoes seek cover in vegetated or humid areas with shade.

# Region I

## North Dakota Mosquito Surveillance

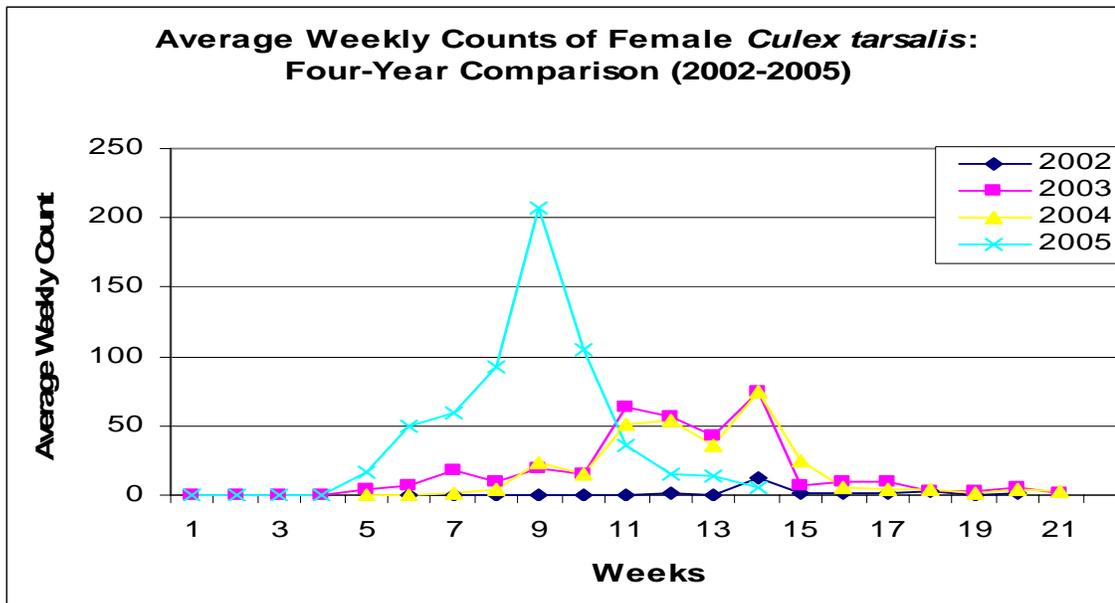
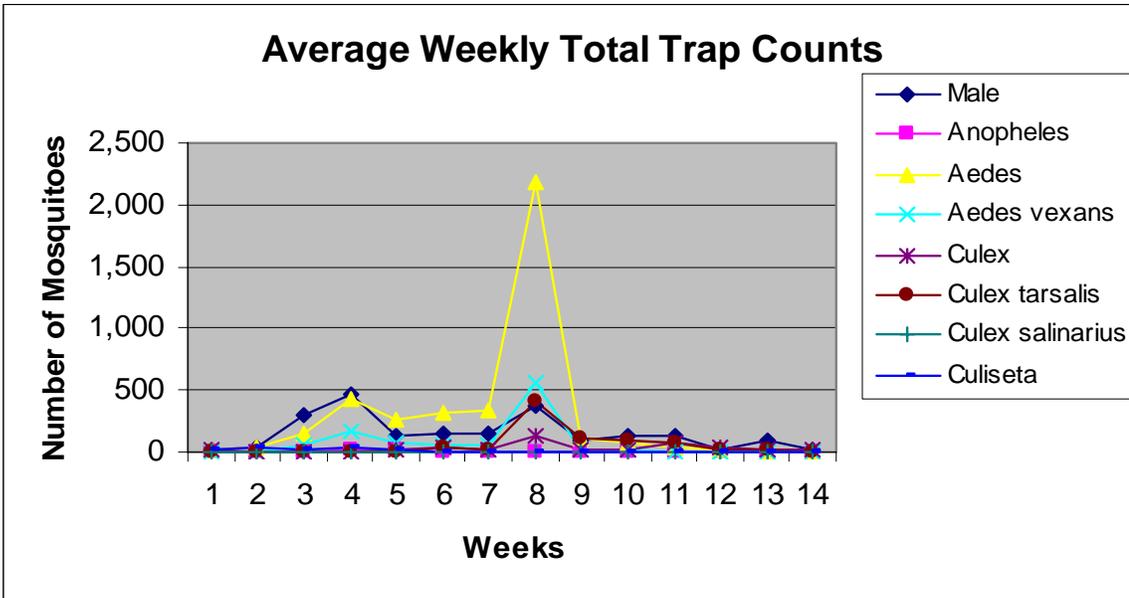
### New Jersey Mosquito Trap Data Analysis



# Region II

## North Dakota Mosquito Surveillance

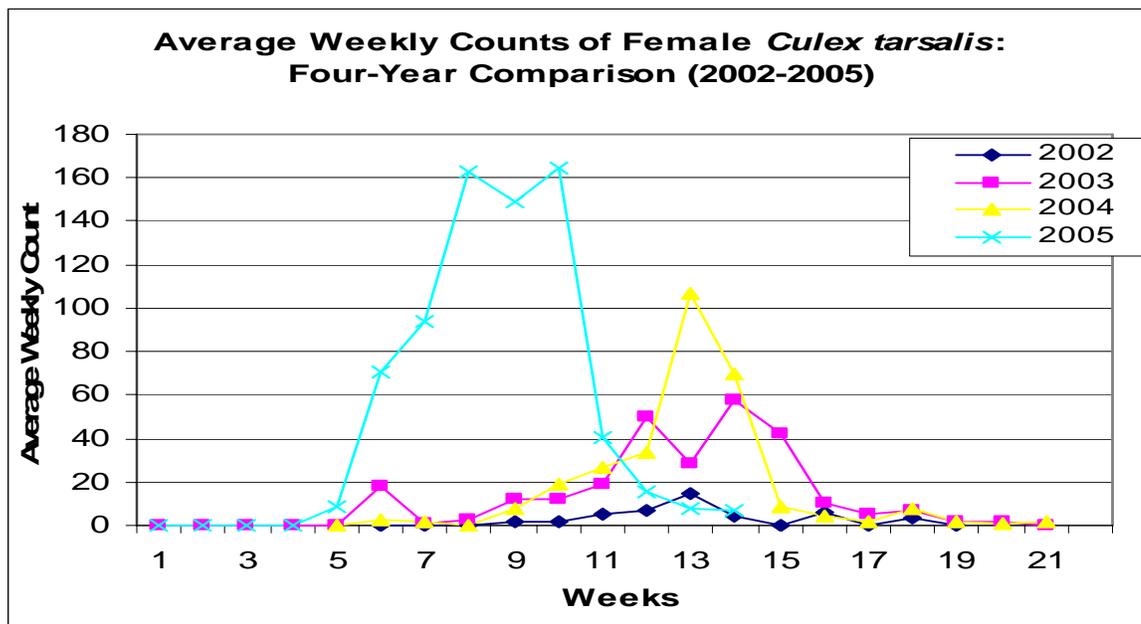
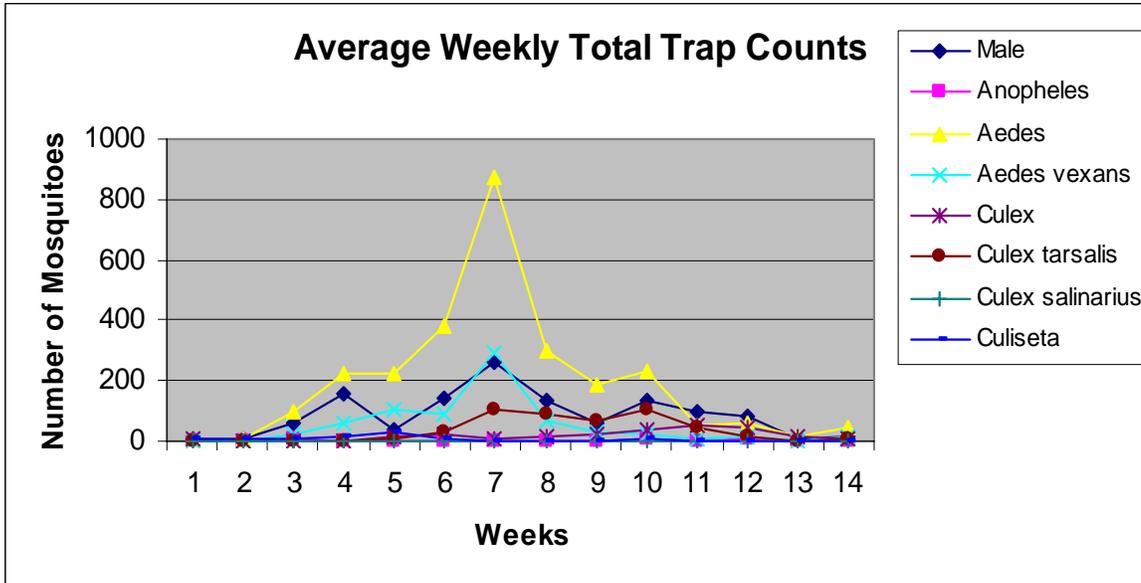
### New Jersey Mosquito Trap Data Analysis



# Region III

## North Dakota Mosquito Surveillance

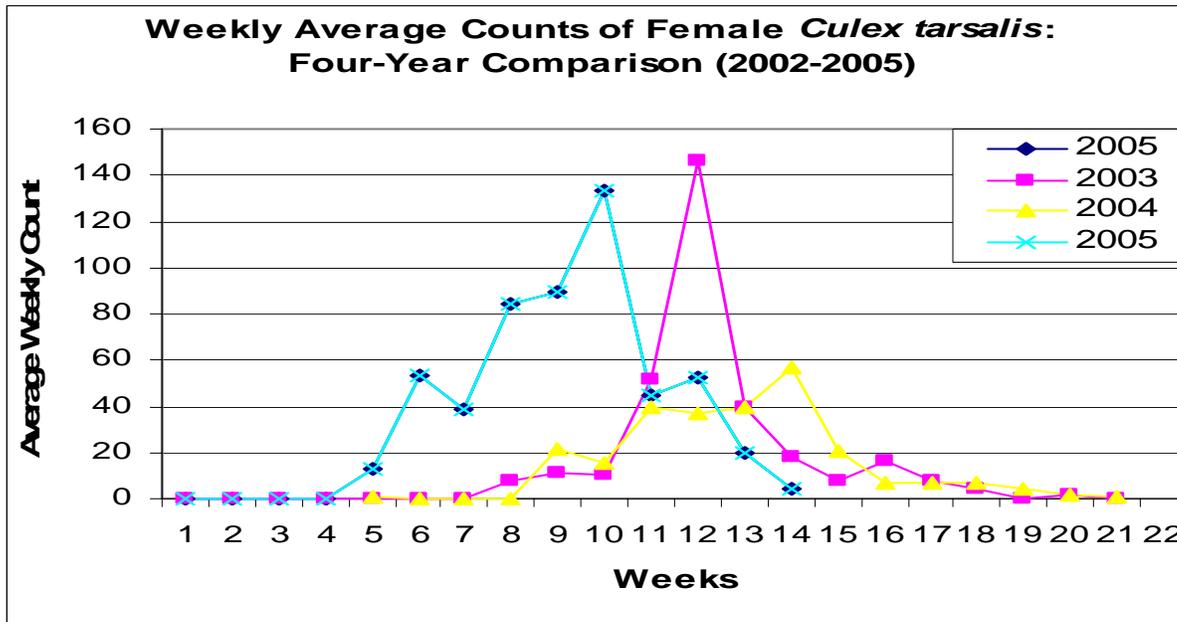
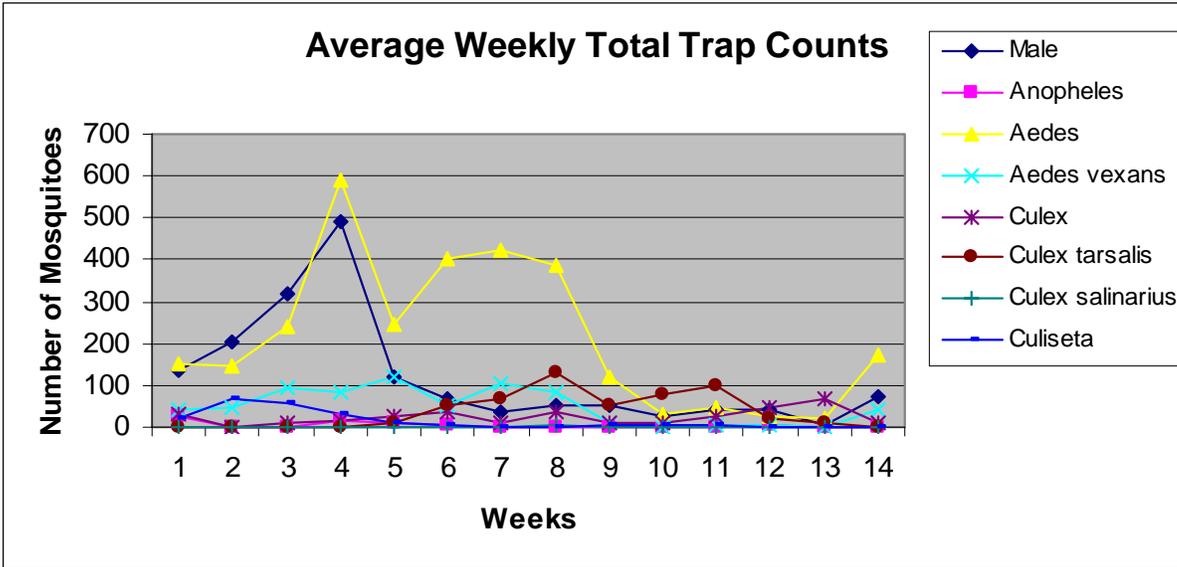
### New Jersey Mosquito Trap Data Analysis



# Region IV

## North Dakota Mosquito Surveillance

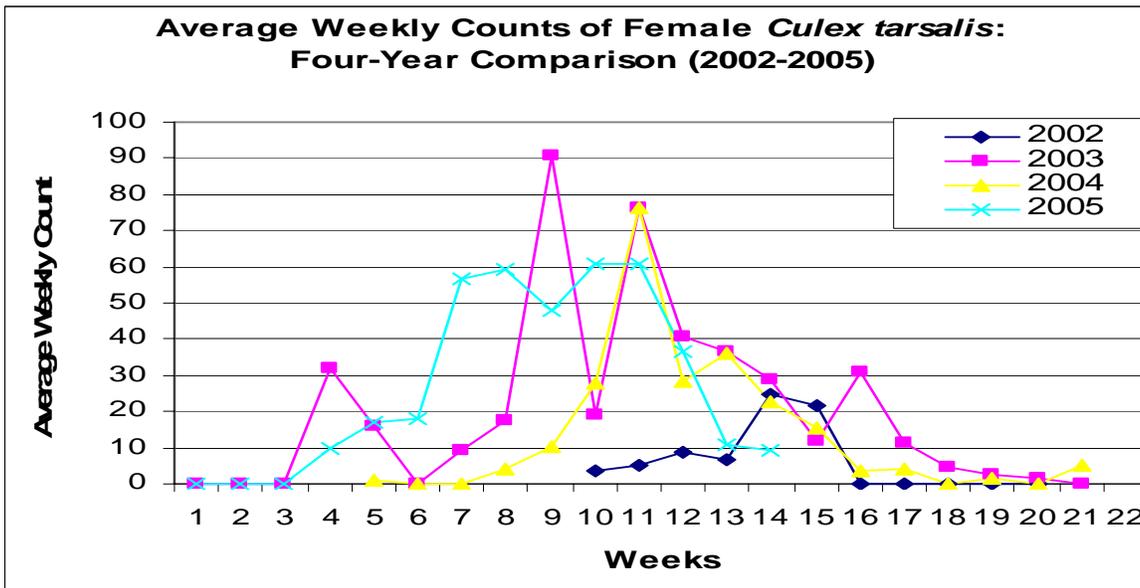
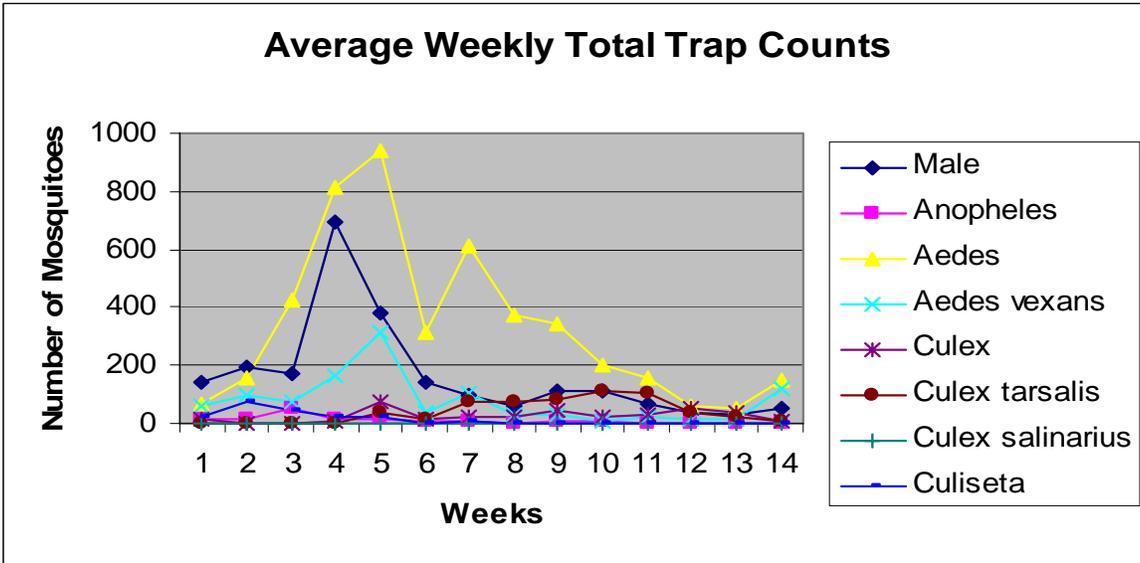
### New Jersey Mosquito Trap Analysis



# Region V

## North Dakota Mosquito Surveillance

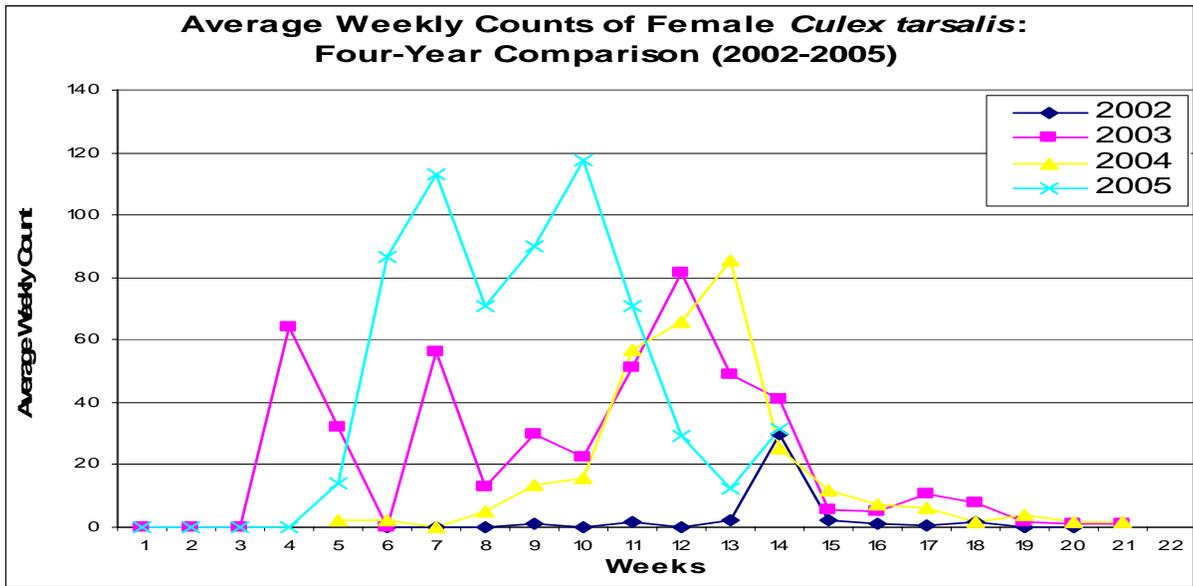
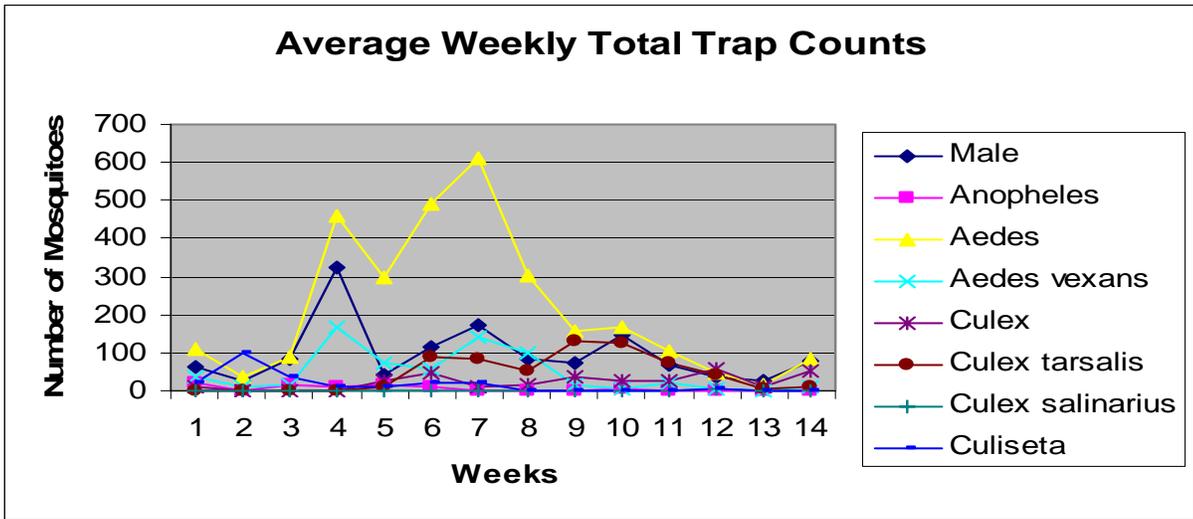
### New Jersey Mosquito Trap Data Analysis



# Region VI

## North Dakota Mosquito Surveillance

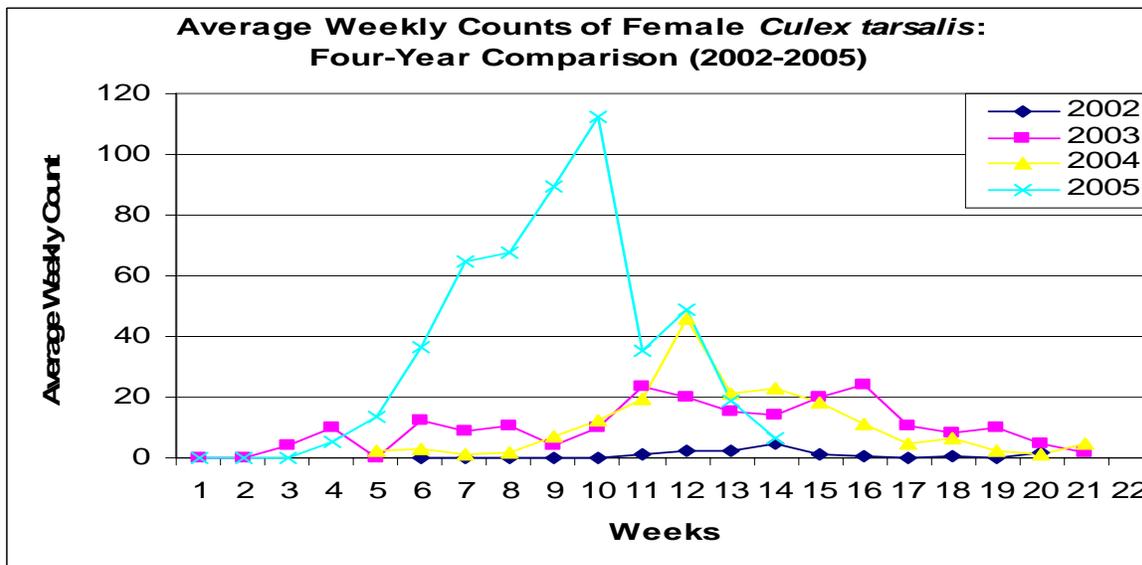
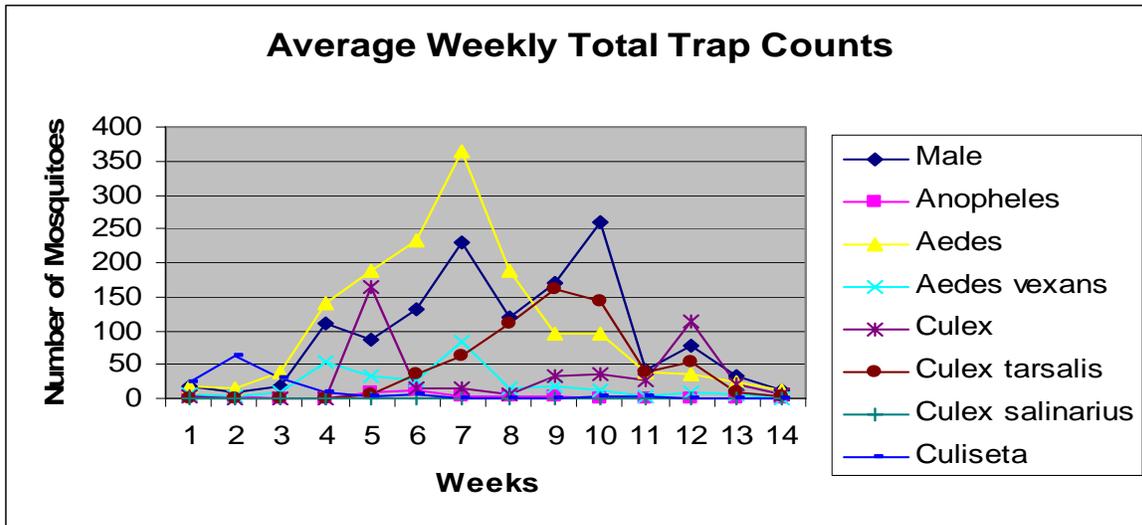
### New Jersey Mosquito Trap Data Analysis



# Region VII

## North Dakota Mosquito Surveillance

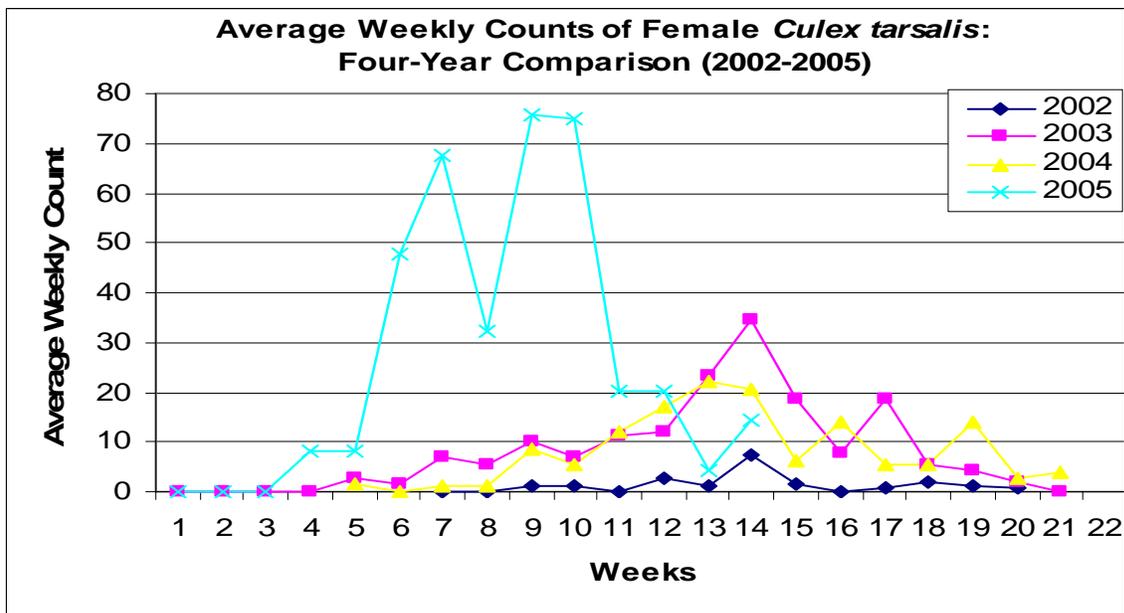
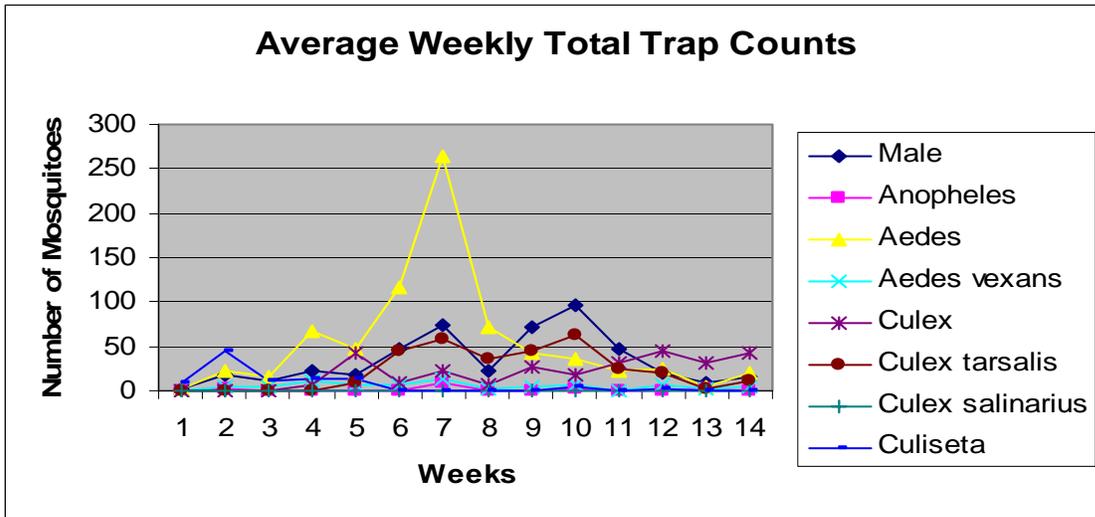
### New Jersey Mosquito Trap Data Analysis



# Region VIII

## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

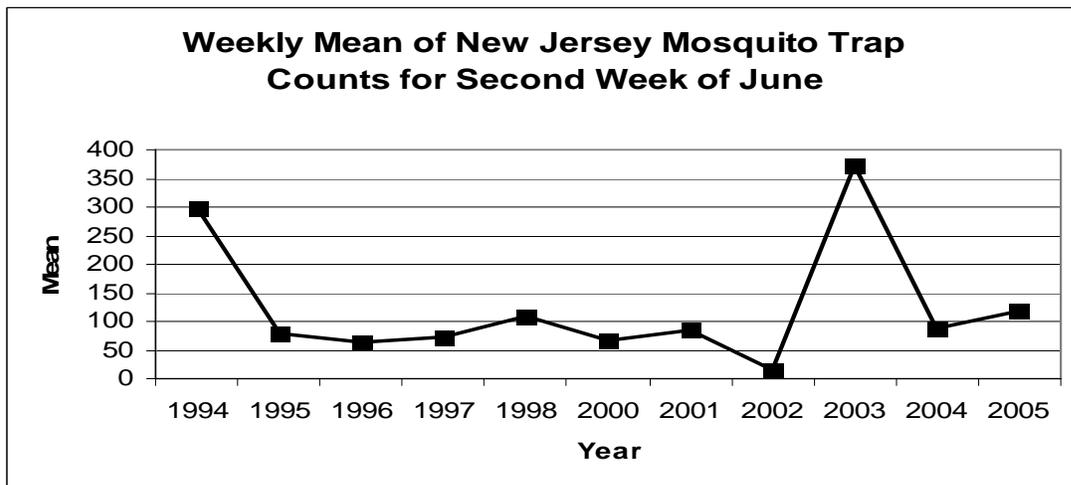
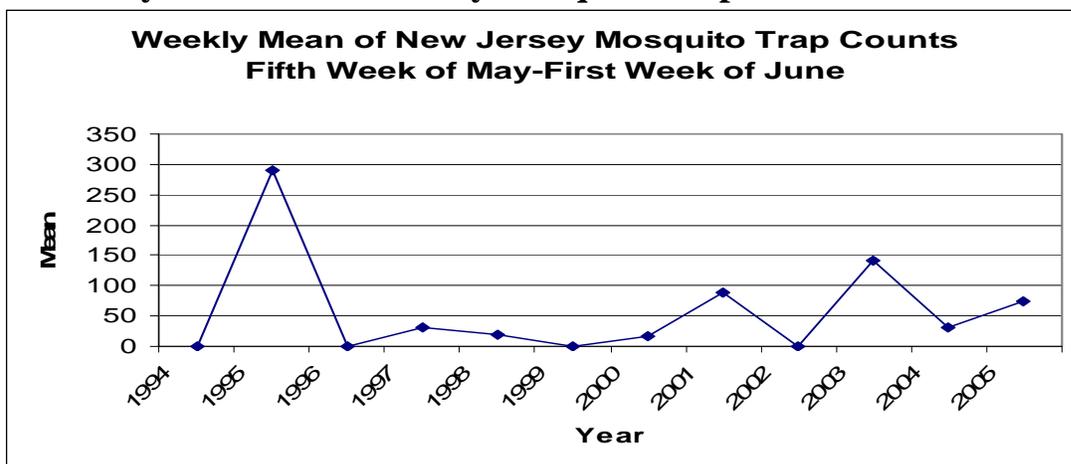


**Appendix B 1994-2004**  
**Weekly New Jersey Mosquito Trap Counts Comparison**

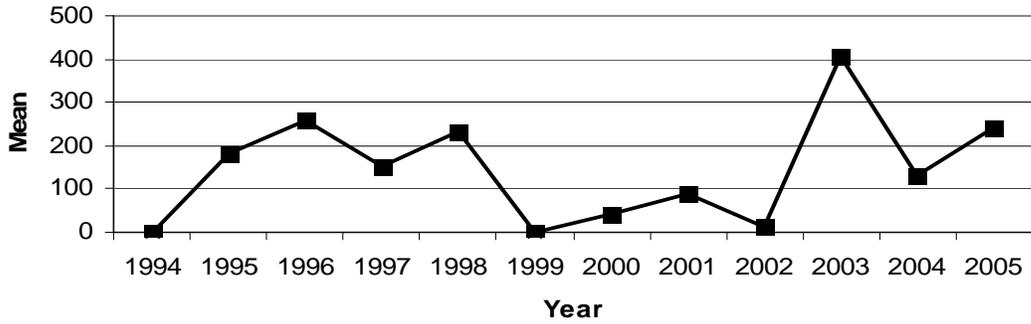
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Appendix B includes graphs of the annual trap counts from the last week of May through the last week of September. These graphs depict how the mosquito trap counts have changed between 1994 and 2004. Each year, the general trend of North Dakota's mosquito population is a steady rise in population peaking in early to late July, followed by a gradual decrease through the rest of the mosquito season. Yearly and weekly variances in trap numbers can be attributed to factors such as rainfall, temperature and wind speed.

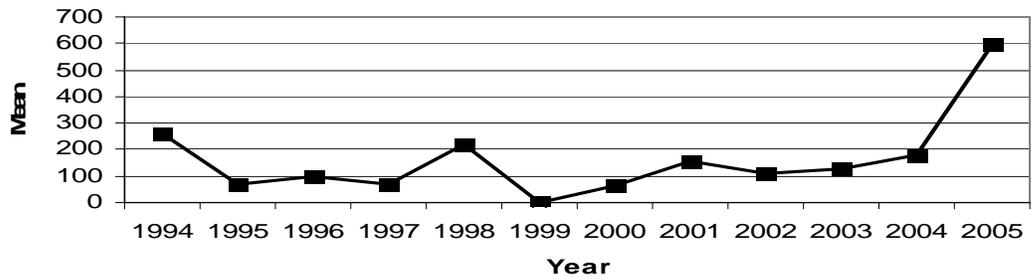
**Weekly Mean of New Jersey Mosquito Trap Counts from 1994-2005**



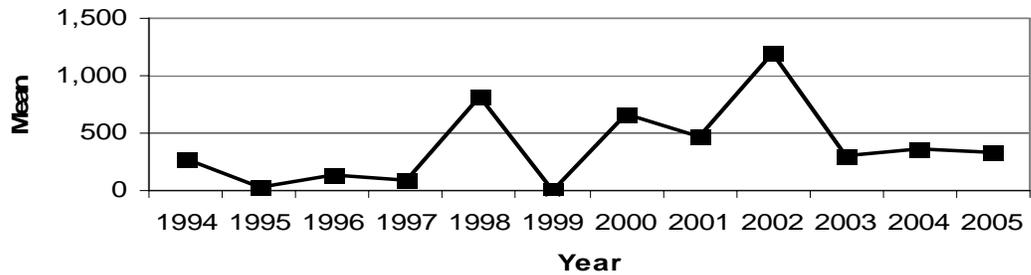
**Weekly Mean of New Jersey Mosquito Trap Counts for Third Week of June**



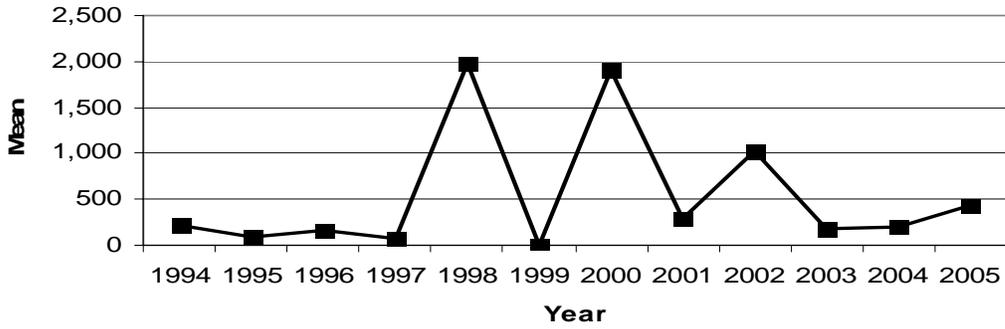
**Weekly Mean of New Jersey Mosquito Trap Counts for Fourth Week of June**



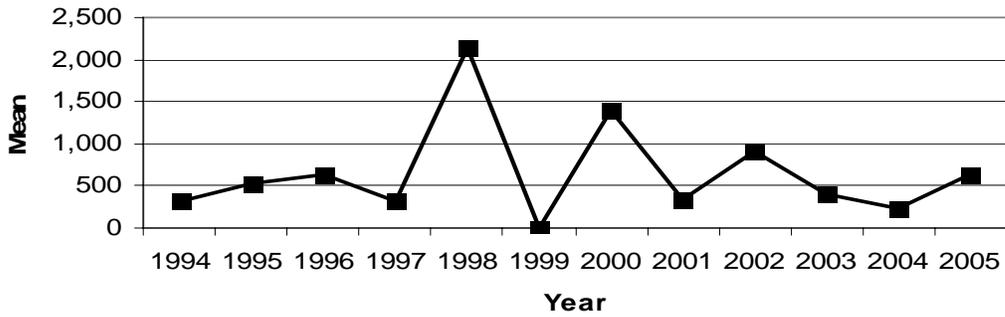
**Weekly Mean of New Jersey Mosquito Trap Counts for Fifth Week of June - First Week of July**



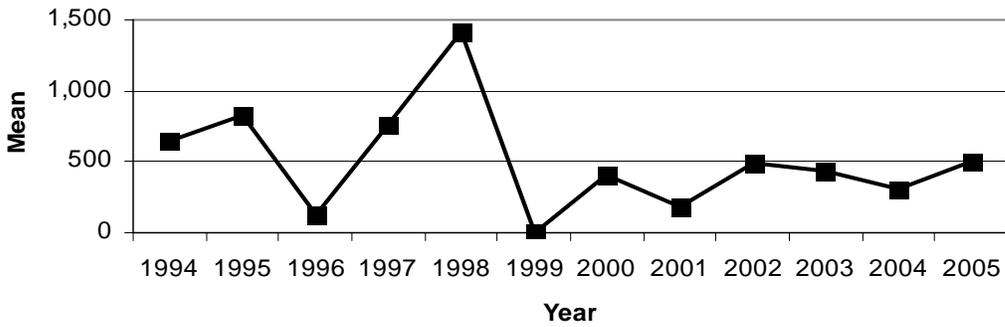
**Weekly Mean of New Jersey Mosquito Trap Counts for Second Week of July**

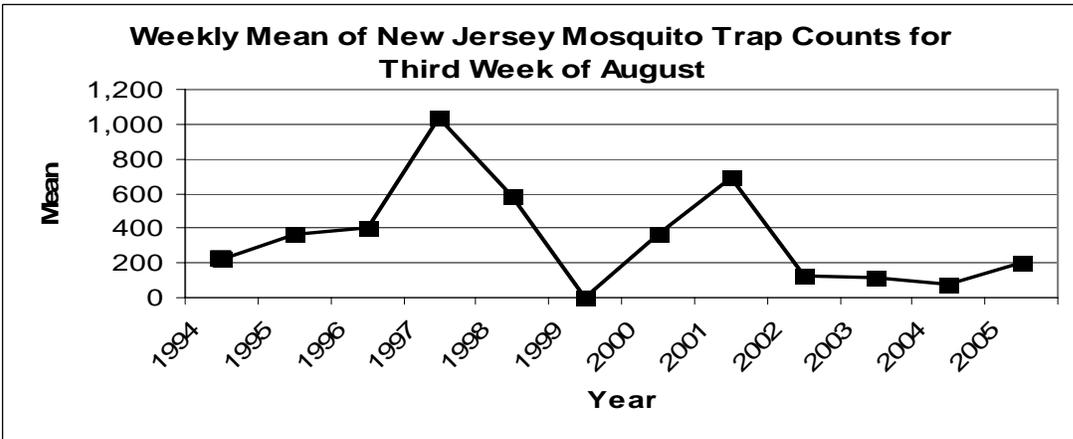
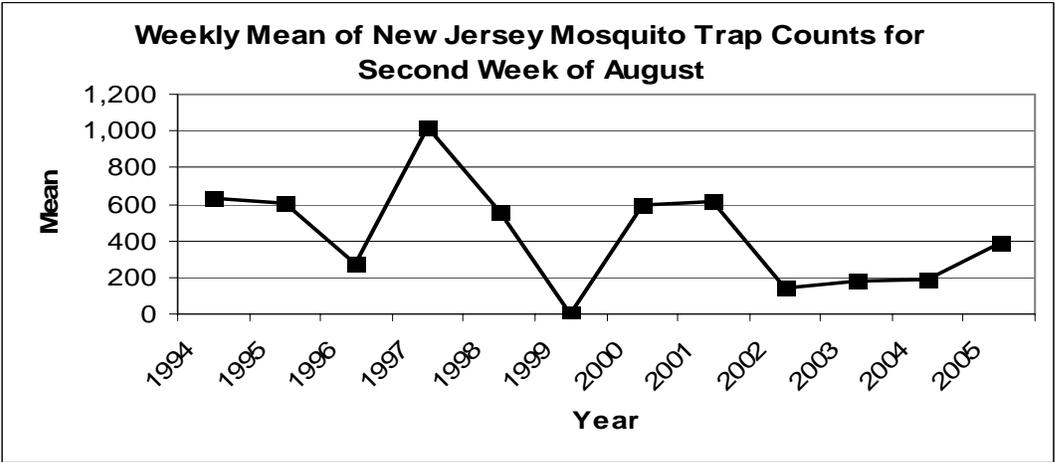
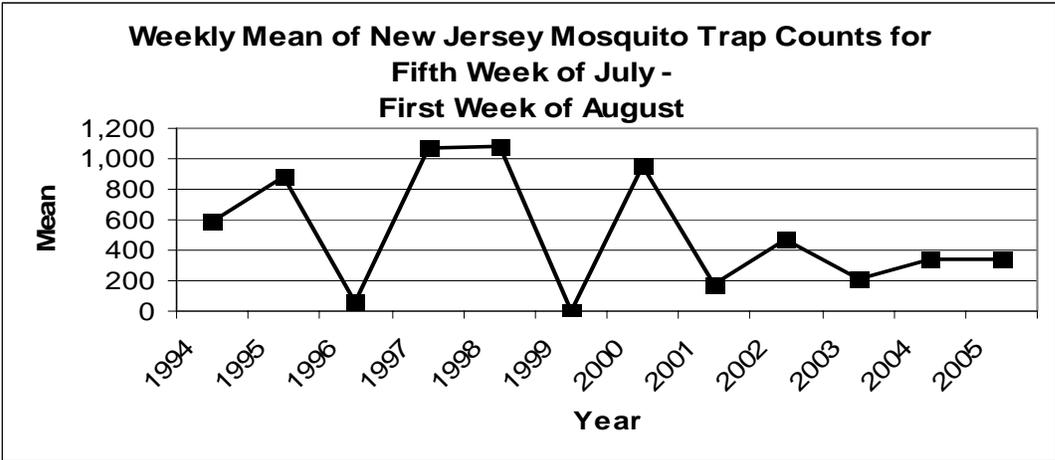


**Weekly Mean of New Jersey Mosquito Trap Counts for Third Week of July**

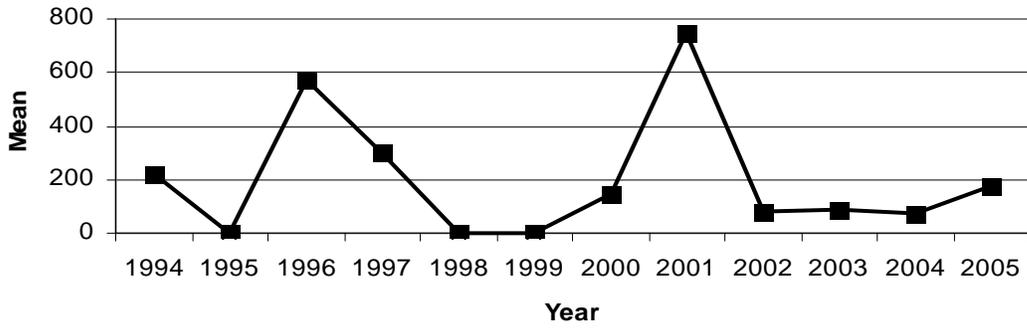


**Weekly Mean of New Jersey Mosquito Trap Counts for Fourth Week of July**

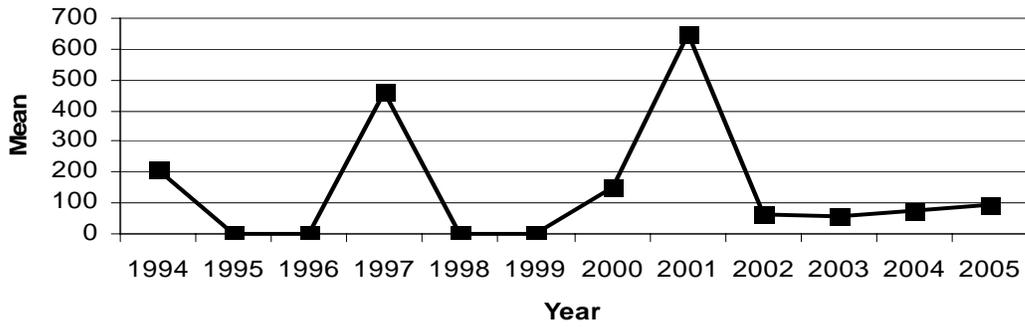




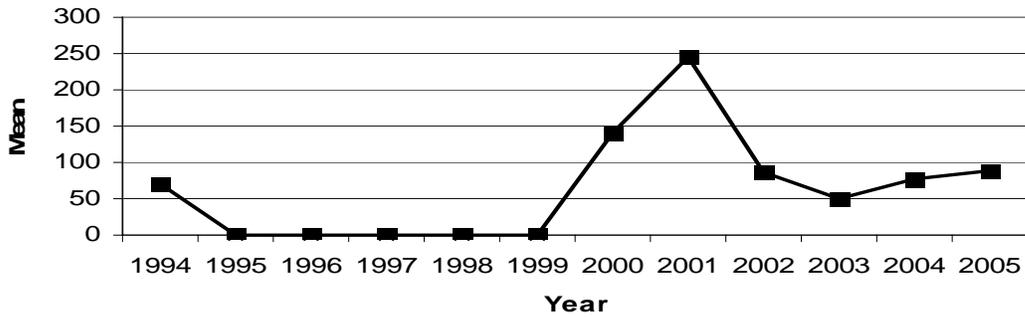
**Weekly Mean of New Jersey Mosquito Trap Counts for Fourth Week of August**



**Weekly Mean of Trap Counts Fifth Week of August**



**Weekly Mean of Trap Counts Sixth Week of August - First Week of September**



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8. Schulz, Travis; Bichler, Mike; Voller, Laura; Hoff, Jennifer. (2003, December). *2003 North Dakota Mosquito Surveillance Program Report*. Bismarck, North Dakota: North Dakota Department of Health, Division of Microbiology.
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10. Hoff, Jennifer; Matt Paul; Adam Wegner. (2004). *2004 North Dakota Mosquito Surveillance Program Report*. Bismarck, North Dakota: North Dakota Department of Health, Division of Microbiology.

