SUMMARY OF WEST NILE VIRUS SURVEILLANCE IN ALBERTA 2004

ALBERTA ENVIRONMENT
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I. *Introduction*

Building on the successful West Nile surveillance programs in 2002 and 2003, representatives from five provincial departments (Alberta Health and Wellness, Alberta Agriculture, Food and Rural Development, Alberta Environment, Alberta Municipal Affairs, and Alberta Sustainable Resource Development) prepared a provincial response plan for 2004 to address the potential risks posed by West Nile virus in Alberta. The interdepartmental committee including the following members:

Dr. Karen Grimsrud (Chair)	Deputy Provincial Health Officer and Chair Alberta Health and Wellness
Debra Mooney	West Nile virus Coordinator Alberta Health and Wellness
Mr. Jock McIntosh	Pesticide Specialist Alberta Environment
Dr. Gerald Ollis and Lisa Morin	Chief Provincial Veterinarian Office Alberta Agriculture, Food and Rural Development
Dr. Margo Pybus	Wildlife Disease Specialist, Fish and Wildlife Division, Alberta Sustainable Resource Development
Marie Juengel	Coordinator, Policy and Grants Municipal Affairs
John Tuckwell David May Dave Ealey Marie McDonnell	Public Affairs Officers

Regional medical officers of health, communications staff, the Provincial Laboratory for Public Health (Microbiology) and Canadian Blood Services also participated.

The plan contained three primary components: communication, surveillance and targeted mosquito control. Communication occurred largely through the ***Fight the Bite*** public awareness campaign and information provided in departmental web pages and fact sheets as well as technical information provided directly to health care, wildlife, and veterinary professionals. The surveillance programs focused on monitoring "at risk" populations - physicians monitored human illness, veterinarians monitored horse health, and the Fish and Wildlife Division monitored mortality of wild corvids found dead by the public. The surveillance programs were designed to identify the presence of the virus in natural regions of the province and thereby support the needs of assessing the health risks to humans and assist Alberta Health and Wellness in providing appropriate provincial information to health care professionals and to the public. The targeted mosquito control program provided funds to municipalities throughout the province to support surveillance of mosquito breeding sites and chemical control of mosquito larvae, particularly C*ulex tarsalis,* the mosquito vector for WNv in Alberta.

The purpose of this technical summary is to present surveillance information on WNv in birds, horses, humans and mosquitoes, an overview of the geographical location and timing of positive WNv in all species, information on human and mosquito testing at the Provincial Laboratory of Public Health (Microbiology), a summary of the targeted larval control program delivered by the municipalities and an outline of the 2004 Communications plan.

Epizootiology of West Nile virus:

West Nile virus occurs in a wide geographic area throughout the world. It was first detected on the North American continent in 1999 in the northeast United States (US). To date, it has spread in migrating wild birds and local mosquitoes to encompass most of the US and southern Canada, east of the Rocky Mountains. Virus activity in northern areas is limited to summer months when mosquitoes are active.

Birds are the primary habitat for West Nile virus and it occurs in a wide range of bird species, most of which show little or no clinical effect. Now that the virus is well established over much of North America, billions of birds in Canada and the US are potentially infected with WNv. This includes the tiniest hummingbirds; the biggest swans, cranes and eagles; and everything in between. However, members of the corvid family (crows, magpies, ravens, and jays) are unable to effectively control the virus with their immune system. As a result, the virus reproduces quickly in a wide range of tissues, but especially in the brain and spinal cord. Fatal infections often occur in corvids, particularly in crows and magpies. In contrast, **mammals generally are quite resistant to infection** but rare fatal cases can occur in horses and humans.

A variety of mosquito species are able to draw virus from the blood of infected birds and pass the virus on to others; however, in *Culex* spp. the virus replicates (reproduces) and thus increases its population within each mosquito. Thus *Culex* mosquitoes are the most efficient transmitters of WNv and directly contribute to increasing the amount of virus circulating in the environment. In Alberta, *Culex tarsalis* is the primary vector of WNv. This species prefers shallow, non-moving waterbodies and thrives in the hot dry conditions present in southern Alberta. Pools of standing water that accumulate in mid to late summer at the edges of drying ponds, in old tires and rain gutters, or on irrigated lands are perfect for the development of this species. A few large, hardy females overwinter and emerge in April and May to lay the first generation of eggs. Adults produced in the summer are relatively short-lived and two, three, or four generations occur each summer, depending on suitable environmental conditions. As day-length shortens in the fall, metabolic changes direct the last generation of females to abstain from taking blood. Instead, they seek a warm dry place to spend the winter in a state of suspended animation.

Additional background material about West Nile virus in Alberta can be found on the following websites:

Alberta Health and Wellness
http://www.health.gov.ab.ca/public/WNv/Index.html

Alberta Agriculture, Food and Rural Development
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex5455?opendocument

Fish and Wildlife Division of Alberta Sustainable Resource Development
http://www3.gov.ab.ca/srd/fw/diseases/WNv/index.html

Surveillance in Canada and United States

The surveillance information on human cases of WNv throughout North America shows a dramatic decrease in cases all across Canada and again no human cases in the territories or maritimes. In the United States, while the total number of cases decreased, the number of cases in California, Arizona and Nevada increased as the virus became established along the west coast. There are still no human cases reported in the state of Washington.

In broad areas across the southern United States, *Culex* species do not go dormant and thus year-round transmission of WNv now occurs from the Atlantic and Gulf coast states westward to southern California. West Nile virus can also overwinter in a few dormant individual mosquitoes. The virus is still extending its continental range and establishing populations within Mexico as well as Central and South America. There is little doubt that West Nile virus will establish itself throughout the Western Hemisphere, although the full picture in a North American context is still evolving.

WNv Cases in Canada (as of November 30, 2004)

Province	Positive Cases 2004	Positive Cases 2003
British Columbia	0	19 (all travel related)
Alberta	1 (travel related)	275
Manitoba	3	139
Saskatchewan	10	848
Ontario	13	89
Quebec	1	17
Maritimes	0	3 (all travel related)
Territories	0	1 (travel related)
Canada	28	1391

WNv Cases in the United States (as of April 30, 2005)

State	2004	2003	2002
Alabama	15	37	49
Arizona	391	13	0
Arkansas	28	25	43
California	778	3	1
Colorado	291	2947	14
Connecticut	1	17	17
Delaware	0	17	1
District of Columbia	1	3	34
Florida	41	94	28
Georgia	21	50	44
Idaho	3	1	0

Illinois	60	54	884
Indiana	13	47	293
Iowa	23	147	54
Kansas	43	91	22
Kentucky	7	14	75
Louisiana	109	124	329
Maryland	16	73	36
Massachusetts	0	17	23
Michigan	16	19	614
Minnesota	34	148	48
Mississippi	51	87	192
Missouri	36	64	168
Montana	6	222	2
Nebraska	53	1942	152
Nevada	44	2	0
New Hampshire	0	3	0
New Jersey	1	34	24
New Mexico	88	209	0
New York	10	71	82
North Carolina	3	24	2
North Dakota	20	617	17
Ohio	12	108	441
Oklahoma	21	79	21
Oregon	3	0	0
Pennsylvania	15	237	62
Rhode Island	0	7	1
South Carolina	2	6	1
South Dakota	51	1039	37
Tennessee	14	26	56
Texas	176	720	202
Utah	11	1	0
Vermont	0	3	1
Virginia	5	26	29
West Virginia	0	2	3
Wisconsin	12	17	52
Wyoming	10	375	2
Total	**2535**	**9862**	**4156**

II. *Wild Bird Surveillance*

Summary

Approximately 762 dead birds were received during the West Nile virus (WNv) surveillance program implemented by the Fish and Wildlife Division of Alberta Sustainable Resources Development in 2004. Nestlings were not examined and approximately 96 (12.6%) of the birds received were unsuitable for analysis (dry, rotten, too young, or unsuitable species). Thus testing was limited to 666 corvids (335 crows, 264 magpies, 40 ravens, 26 blue jays, and 1 Clark's nutcracker). All usable corvids were tested with the VecTest, an antigen-based screening assay. In addition, 2 great grey owls and 1 great horned owl were assessed for WNv using a PCR molecular test.

We confirmed WNv in 9 corvids, including 7 crows, 1 magpie, and 1 blue jay. Positive birds were found primarily in the Grassland region (n=7) but also the southeastern Boreal Forest (n=1) and eastern Parkland (n=1) natural regions. West Nile was not confirmed in any other bird species. Birds were collected over a wide geographic range throughout the province, although most birds (85%) came from the Parkland region (n=400) and the Grassland region (n=166) areas of central and southern Alberta. No evidence of the virus was found in the Rocky Mountain, Foothills, or Canadian Shield natural regions.

The first positive bird was a crow found dead on August 14, 2004 in Lethbridge. The overall time between collection and testing of individual corvids in Alberta in 2004 was 7.72 ± 10.15 days (n=617). The time between when the birds arrived at the lab and testing of the individual corvids in Alberta in 2004 was 0.39 ± 0.86 days (n=617). Positive birds were collected from mid-August to mid-September, with most birds found in late August and early September.

Post mortem examinations were conducted on 158 crows as well as 116 magpies negative for WNv, to assess the cause of death. Blunt trauma was the most common cause of death in both crows (51%) and magpies (55%).

The current report provides data only from the wild bird component of the provincial West Nile virus surveillance program. In 2004, the program focused on corvids (particularly crows and magpies) as the primary bird species likely to exhibit fatal infections and thus reflect the presence or absence of the virus in Alberta populations. In addition, Fish and Wildlife staff as well as the public were encouraged to report unusual clusters of mortality in any wild bird or mammal. A few additional birds of other species also are received. Fresh dead birds collected by the public were dropped off at any Fish and Wildlife office. Following up on the WNv-related mortality detected in sage grouse in southern Alberta in 2003, special attention was given to monitoring the grouse population and preliminary attempts to limit mosquito populations in prime occupied range in 2004.

Fresh or frozen birds were transported or sent to the Fish and Wildlife Division's Wildlife Diseases Laboratory in Edmonton. Birds were thawed and then tested with a VecTest strip. Non-corvid birds to be tested for West Nile virus were sent to the diagnostic laboratory of the Canadian Cooperative Wildlife Health Center, Saskatoon, SK for testing with a DNA-based polymerase chain reaction test (PCR).

Bird Surveillance Data

Species Composition

Over 750 birds were received for West Nile testing between May and October 2004. Information from 666 corvids from 5 of 6 natural regions within the province was logged into the surveillance data file. The remaining birds (12.6%) were unsuitable for testing (dry, rotten, too young) and for efficiency, were not included in the file. The majority of the tested birds were corvids (99.6%), primarily crows and magpies (90%). A few ravens and blue jays and one Clark's nutcracker were received. In addition, 1 great horned owl and 2 great grey owls met the appropriate criteria and were sent to the Canadian Cooperative Wildlife Health Centre in Saskatoon to be assessed for WNv using the PCR molecular test.

West Nile Results

Corvids

West Nile virus was found in 9 of 666 (1.4%) corvids tested (Table 1). The virus was found in 7 of 335 (2.1%) crows, 1 of 264 (0.4%) magpies, and 1 of 26 (3.8%) blue jays, but not in the Clark's nutcracker or in any of the 40 ravens tested.

The positive corvids were collected from the Grassland (7 of 166, 4.2%), eastern Parkland (1 of 400, 0.3%) and the southeast edge of the Boreal Forest (1 of 72, 1.4%) natural regions of central and southern Alberta (Table 1, Figure 1). Viral activity was not found in the northern forests and Peace River country, nor in the Foothills or Mountain natural regions.

Non-Corvids

No evidence of West Nile virus causing death in non-corvids was detected in Alberta in 2004. The great horned owl and two great grey owls were tested but were found to be negative for West Nile virus. A small number of individuals of other species was examined but did not meet the criteria for further WNv testing. Each bird either had an identifiable cause of death or was too decomposed for appropriate examination.

Other Species (Non-Birds)

Note that in other components of the provincial surveillance program in 2004, Alberta Environment detected WNv in only one pooled sample of mosquitoes collected in the County of Vulcan. This sample contained infected *Culex tarsalis*. West Nile virus is a provincially-reportable disease and Alberta Agriculture, Food and Rural Development received reports of 4 positive horses in the Grassland (n=3) and Parkland (n=1) natural regions. Alberta Health and Wellness documented one human travel-related case as of December 1, 2004.

Geographic Distribution

Most of the tested birds were found sick or dead in the Parkland (60%) and Grassland (25%) natural regions (Table 1). The preponderance of birds largely reflects the presence of urban centers, particularly the greater Edmonton area (Table 2). Remaining birds were collected widely throughout the area from the southern fringe of the Boreal Forest south to the US border and from the edge of the Foothills east to the Saskatchewan border (Figure 1). Banff and Lake Louise areas provided a few samples from the Mountain natural region. No birds were received from the small portion of Canadian Shield in the far northeastern corner of the province.

Temporal Distribution

In 2004, the WNv bird surveillance program ran from May 1 to September 30 (Table 5, Figure 2). The average time between collection and testing was 7.72 ± 10.15 days (n=617). Bird submissions were tracked on a weekly basis. Overall, there was a slow rise in the number of birds submitted in May and June, followed by a steep peak in late June and early July, and a subsequent slow decline through August and September (Figure 2). The first positive bird was collected in Lethbridge on August 14, 2004 (week 33) and subsequent positive birds were found in late August and into September (weeks 35-37) (Table 3, Figure 2).

Diagnoses

Post mortem examinations were completed on 158 WNv-negative crows and 116 WNv-negative magpies, selected to represent the overall spatial and temporal distribution of corvids submitted for virus testing. Trauma was the primary cause of death in 59% of the crows (51% blunt trauma, 8% gunshot wounds) and 70% of the magpies (55% blunt trauma, 14% gunshot wounds, 1% predation) (Table 4). Only 5% of the crows and 6% of the magpies had no visible lesions (NVL) or, in other words, no visible cause of death.

Respiratory tract infection (involving the lungs, air sacs, or both) with the fungus *Aspergillus* sp. was found in 5% of the crows and 3% of the magpies submitted during the late summer and early fall (Table 4). Although *Aspergillus* is found throughout the environment, increased rainfall during the spring and early summer likely permitted greater than normal spore development in the environment. Miscellaneous bacterial infections were diagnosed more commonly in crows (20%) than in magpies (10%) (Table 4).

Post mortem assessment of WNv-positive corvids was not conducted.

Discussion

In recent years migratory birds, primarily songbirds and waterfowl, systematically moved West Nile virus westward across North America from the Atlantic Flyway in 2000, to the Mississippi Flyway in 2001, the Central Flyway in 2002 and 2003, and now the southern portion of the Pacific Flyway in 2004. This movement resulted in a steady geographic expansion of infections in birds, horses, mosquitoes, and humans from the northeastern US in 1999/2000, to the area east of the Mississippi River (including southern Ontario) in 2001, the area east of the Rockies (including southern Saskatchewan, Manitoba, Ontario, Quebec as well as Nova Scotia) in 2002. In 2003, the greatest viral activity was up against the east side of the Rocky Mountains, including its first appearance in Alberta.

The transmission of all viruses is driven by a complex interaction of biological and non-biological factors. In the case of West Nile virus, this involves birds, mosquitoes and weather. However, the species, distribution, migration, immune response and previous exposure to the virus all affect its success in birds. Similarly, the species distribution and life stage (only adults transmit the virus) affect the success of the virus in mosquitoes. Infected birds and mosquitoes must overlap in time and space in sufficient numbers to establish and maintain a viral population. In 2003, these components all came together: the virus was introduced in late spring/early summer by migrating birds and established local viral populations in *Culex tarsalis* mosquitoes. During a relatively hot dry summer, the virus multiplied and spread in at least three generations of suitable mosquito vectors. By the end of the summer in 2003, there was evidence of extensive viral activity throughout the southern and central areas of the province. Thus, there was reason to believe that spring migration in 2004 would bring the virus back to northern states and provinces, including Alberta.

Indeed, the virus was found in Alberta in 2004, but the pattern of occurrence differed significantly from that in 2003: there were fewer dead birds found and a lower proportion that were positive in 2004 (Figures 3, 4, 5). The first positive bird was found two months later in 2004 (mid June in 2003 versus mid August in 2004). Similarly, there were fewer infections detected in mosquitoes, horses, and humans in 2004. While the underlying causes cannot be definitively identified, there are contributing factors that are readily apparent.

There may be two driving factors that affect the extent to which WNv can establish a significant summer population in northern regions: weather and avian immunity. Only adult mosquitoes can transmit West Nile virus, and the development of *Culex tarsalis* from larval to adult stages is temperature dependant. Spring and early summer in 2004 were relatively cool and evidence from mosquito surveillance conducted by Alberta Environment indicates that *Culex tarsalis* activity was significantly suppressed by weather conditions in 2004 in comparison to 2003. It may be that when infected migrating birds arrived, there were inadequate numbers of *Culex tarsalis* adults available to transmit the virus and thus a new viral population in Alberta was not established.

The late summer evidence of West Nile virus activity in 2004 may have been associated with movements of birds gathering at staging/moulting lakes during the period between fledging (when the young are able to fly) and migration. Previous banding results show that birds from areas such as Saskatchewan and Montana move into Alberta during August, and there was evidence of WNv activity in these regions during July and August in 2004. By late August and early September, the occurrence of a few positive birds, horses, and one human suggest there were sufficient *Culex tarsalis* mosquitoes to transmit the virus and establish a relatively small viral population in southern and east central Alberta.

There is growing evidence of significant build up of immunity in non-corvid bird species exposed to WNv. During the summer of 2003, birds throughout the Grassland and Parkland regions of Alberta were exposed to a massive population of the virus. A significant number of birds that survived the infection may have developed immunity to WNv. Similarly, young birds likely were exposed to the virus while they were still in Alberta or in the wintering areas in the U.S. and Central America. These factors may have affected the amount of virus that was present in migratory birds that returned to Alberta in 2004. A similar immunity may have developed in birds that are year-round residents of the southern and central areas of the province, such as magpies. Immune birds do not have virus circulating in their blood and thus cannot pass WNv to biting mosquitoes. The combined effects of the slow development of *Culex* mosquitoes and the presence of immunity in many individual birds may be reflected in the lack of viral activity in June and July of 2004.

The provincial West Nile virus Response Plan is based on passive surveillance of birds found dead by the public. In particular, people are encouraged to submit fresh-dead crows and magpies to any office of the Fish and Wildlife Division. Information is provided regarding appropriate precautions when handling any wild animal found dead of unknown causes. These are general precautions and do not reflect a specific concern from handling birds that died of West Nile virus. While no surveillance program can ever be 100% effective, the combined tools of passive public submission of found dead corvids and the unique susceptibility of crows and magpies to fatal infections of West Nile virus provide appropriate means to detect the presence and activity of the virus, even with the low levels of activity seen in 2004. Dead corvids positive for West Nile virus were found temporally and geographically near the single human and several equine cases, and reflected the distribution of *Culex tarsalis* mosquitoes in Alberta in 2004.

It is of interest that, as observed last year, the great majority of birds collected did not die of West Nile virus. Indeed, trauma is the most common cause of death even in the two bird species highly susceptible to the virus (crows and magpies). Human activities in the 21st century provide a multitude of risk factors for wild birds. Fast-moving vehicles are among the most deadly. Crows and magpies that do become infected with West Nile virus appear to die very quickly as a direct result of the viral infection. Thus road-kills and gunshot birds are less likely to have WNv than those that die without trauma.

The small sage grouse population in southern Alberta was closely monitored for WNV-related mortality in 2004. In addition, the study to compare mortality in two areas treated repeatedly with a standard biological control for mosquito larvae [*Bti*] and a control area that received no treatments was logistically successful, although not without a few hiccups. There were no sage grouse mortalities detected in 2004; however, the general evidence of low viral activity in southern Alberta this year prevented any further assessment of the potential risk to sage grouse. The cooperative program among the Division, the University of Alberta, Alberta Environment, and the City of Medicine Hat was well designed and implemented and should be considered again for 2005.

Table 1: Species composition, and geographic distribution of corvids tested for West Nile virus and incidence of WNv positive corvids in Alberta in 2004.

	Boreal (north)	Foothills (west)	Grassland (south)	Mountain (far west)	Parkland (central)	Species TOTAL
Blue Jay	2	0	7 (1)*	0	17	26 (1)
Crow	40 (1)	7	99 (5)	5	184 (1)	335 (7)
Magpie	18	3	58 (1)	3	182	264 (1)
Raven	12	4	2	5	17	40
Clark's Nutcracker	0	0	0	1	0	1
All Corvids	72 (1)	14	166 (7)	14	400 (1)	666 (9)

* number tested (number positive)

Table 2: Primary source of birds tested for WNv in Alberta in 2004.

Urban center	WNv positives and # tested	Proportion of total # tested (%)	Natural Region
Edmonton	0 of 198	30	Parkland
Greater Edm*	0 of 266	40	Parkland
Lethbridge	3 of 20	3	Grassland
Medicine Hat	3 of 7	1	Grassland
Calgary	0 of 85	13	Grassland
All urban centers	6 of 576	87	

* Includes Edmonton, St Albert, Sherwood Park, Beaumont, Spruce Grove, Stony Plain.

Table 3: Birds positive for West Nile virus in Alberta in 2004 (by date found).

Species	Date Found	Town / District
crow	14-Aug-04	Lethbridge
crow	24-Aug-04	Brooks
crow	27-Aug-04	Medicine Hat
crow	28-Aug-04	Bonnyville
crow	31-Aug-04	Vermilion
blue jay	4-Sep-04	Lethbridge
crow	7-Sep-04	Lethbridge
crow	10-Sep-04	Medicine Hat
magpie	12-Sep-04	Medicine Hat

Table 4: Post mortem results of sampled WNv-negative crows and magpies in 2004.

	Number examined	
Diagnosis	**Crows**	**Magpies**
Blunt Trauma	81 (51%)	64 (55%)
Gunshot	13 (8%)	16 (14%)
Miscellaneous Bacterial Infections	32 (20%)	12 (10%)
Respiratory Infection (*Aspergillus spp.*)	5 (3%)	3 (3%)
Emaciation	8 (5%)	10 (9%)
Electrocution	2 (1%)	0 (0%)
Other	9 (5%)	4 (4%)
No Visible Lesions	8 (5%)	7 (6%)
TOTAL	158 (100%)	116 (100%)

Table 5. Standardized 2004 Table of Weeks**.**

Week #	Month	Days
18	April/May	26-2
19	May	3-9
20		10-16
21		17-23
22		24-30
23	May/June	31-6
24	June	7-13
25		14-20
26		21-27
27	June/July	28-4
28	July	5-11
29		12-18
30		19-25
31	July/Aug	26-1
32	Aug	2-8
33		9-15
34		16-22
35		23-29
36	Aug/Sept	30-5
37	Sept	6-12
38		13-19
39		20-26
40	Sept/Oct	27-3

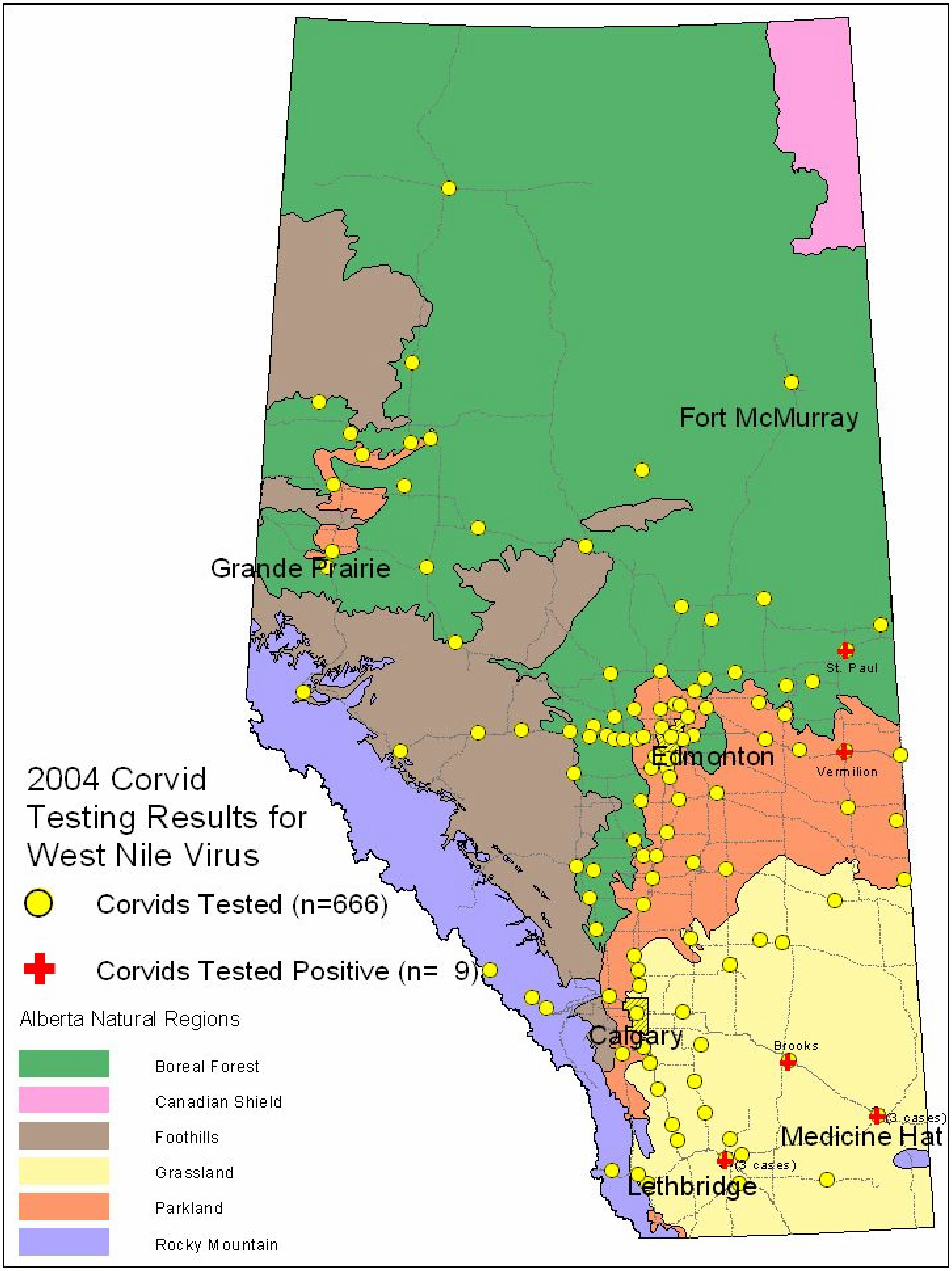


Figure 1. Distribution of corvids tested for West Nile virus in natural regions of Alberta in 2004

Figure 2: Weekly collection of corvids tested for West Nile virus in Alberta in 2004.

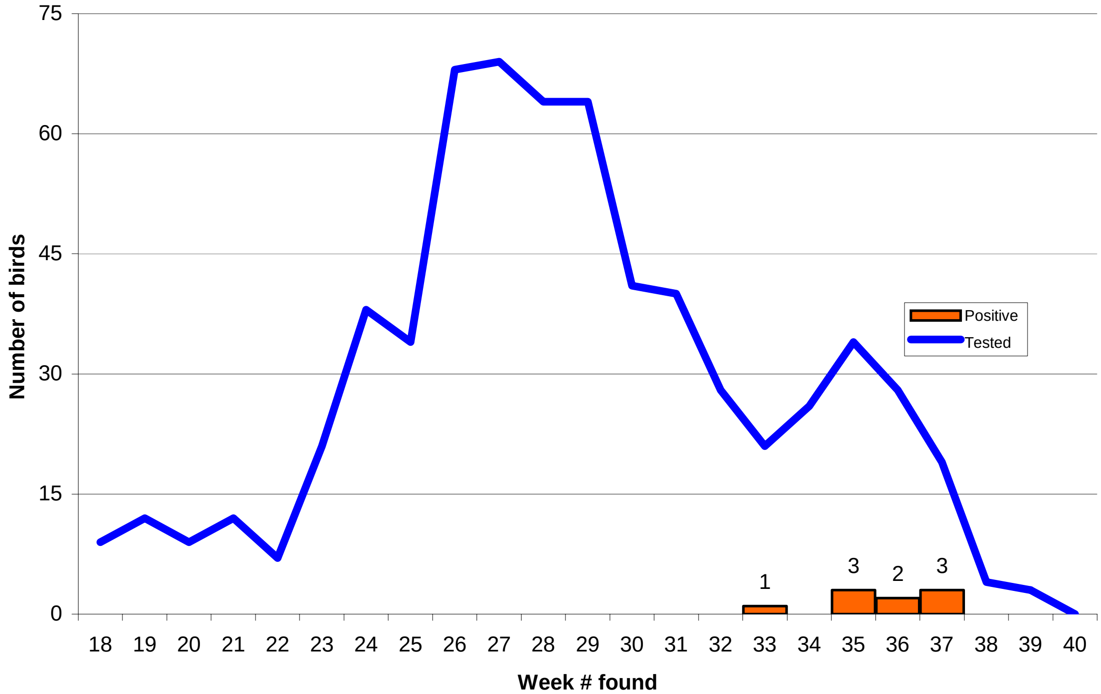


Figure 3: Weekly collection of corvids tested for West Nile virus in Alberta, 2003 and 2004.

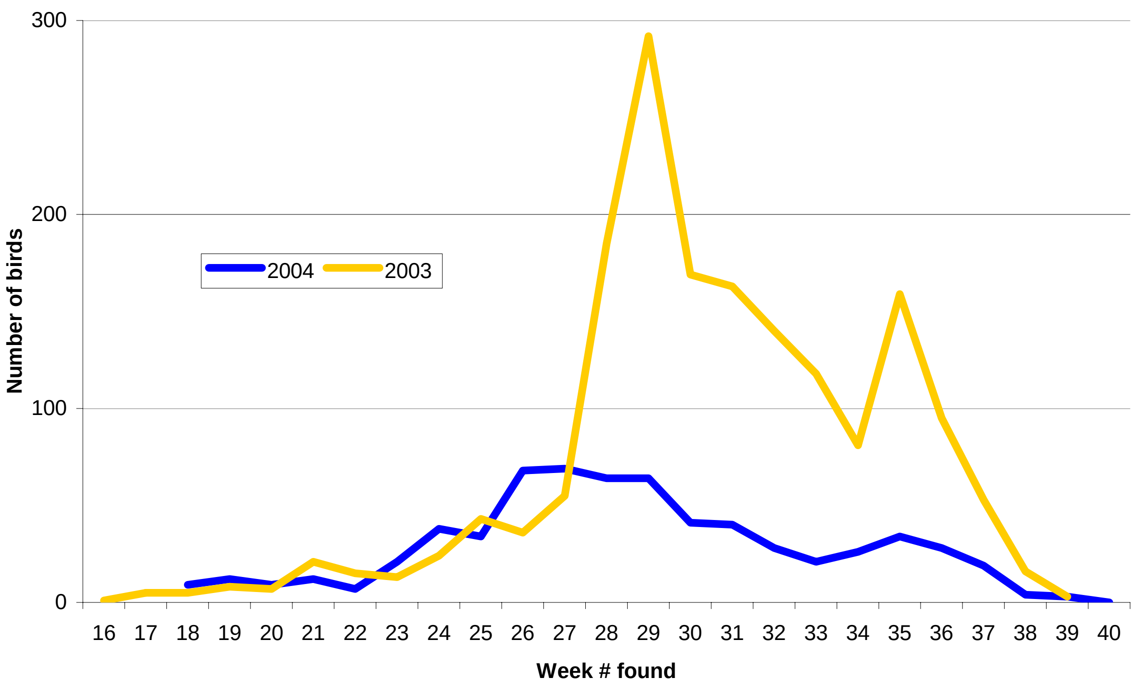


Figure 4: Weekly percentage of corvids positive for West Nile virus in Alberta, 2003 and 2004.

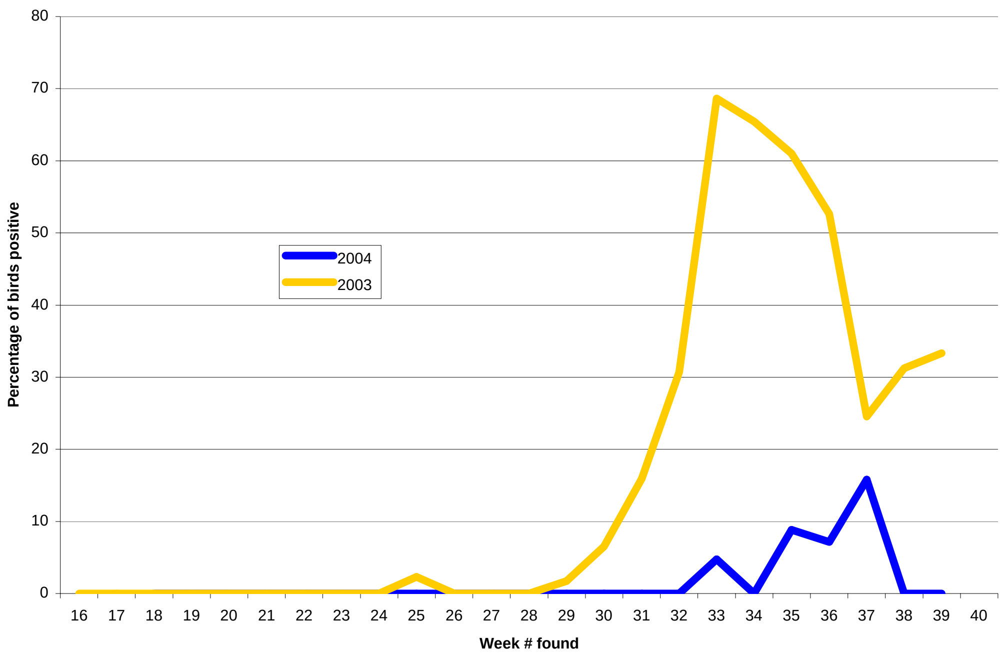
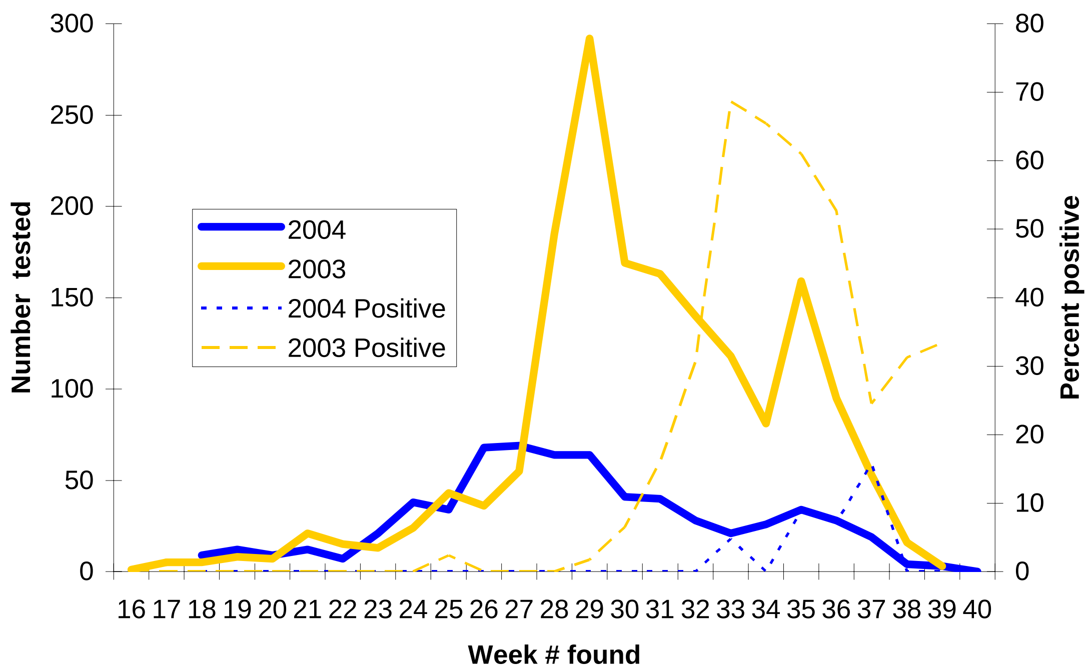


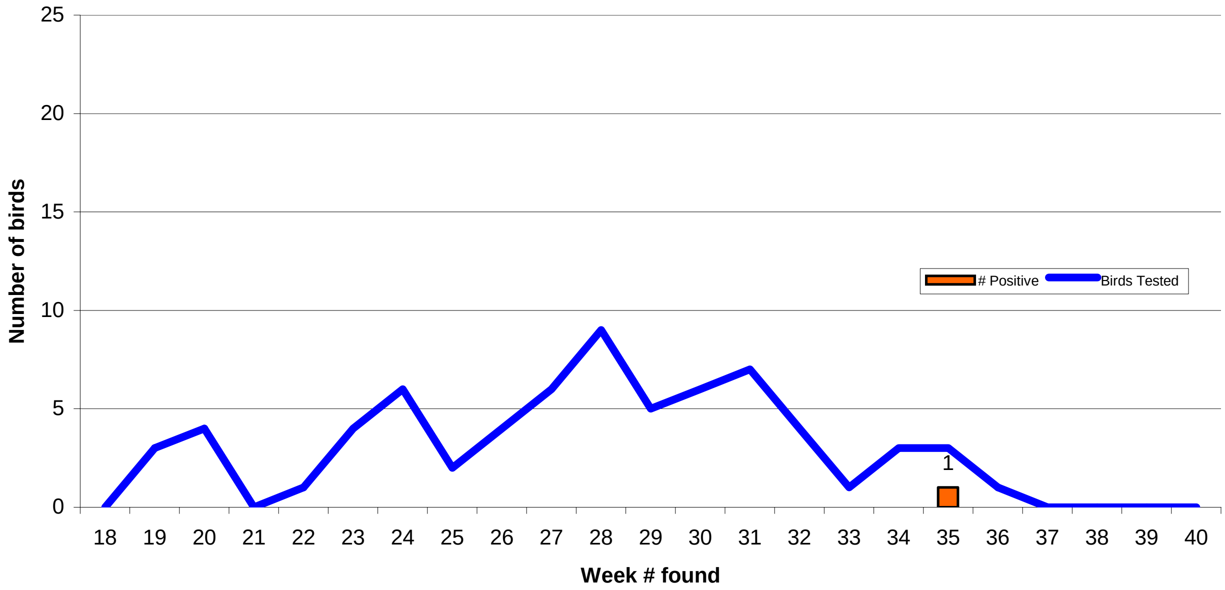
Figure 5: Weekly collection of corvids tested for West Nile virus in Alberta, 2003 and



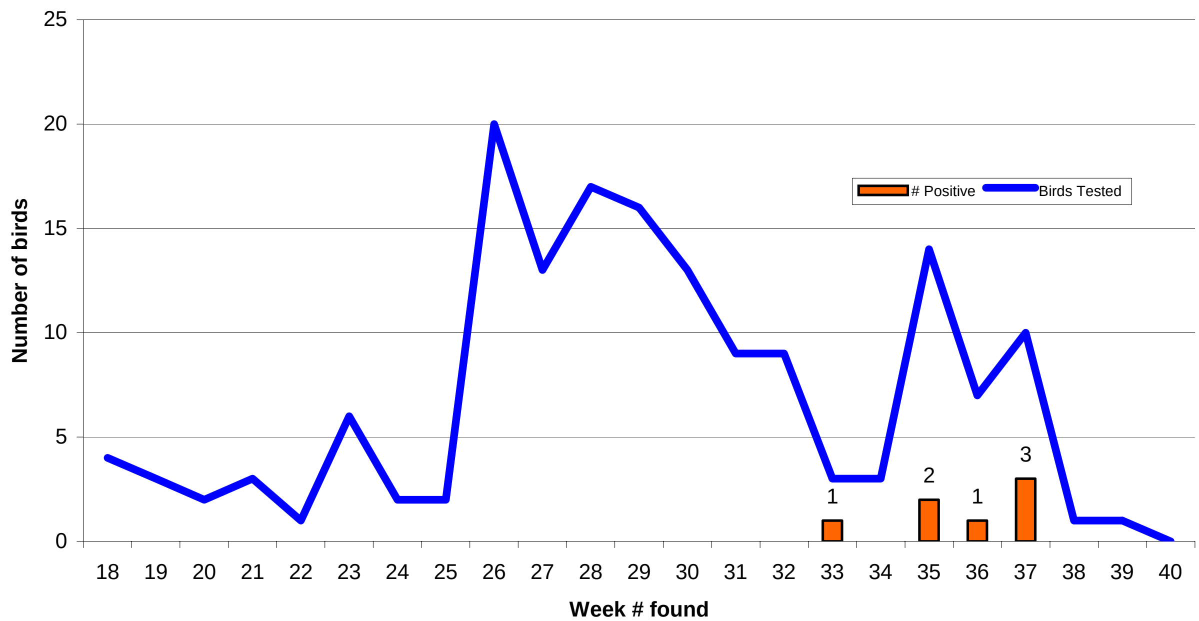
2004.

Figure 6. Weekly collection of corvids tested for West Nile virus in Alberta in 2004, by Natural Region

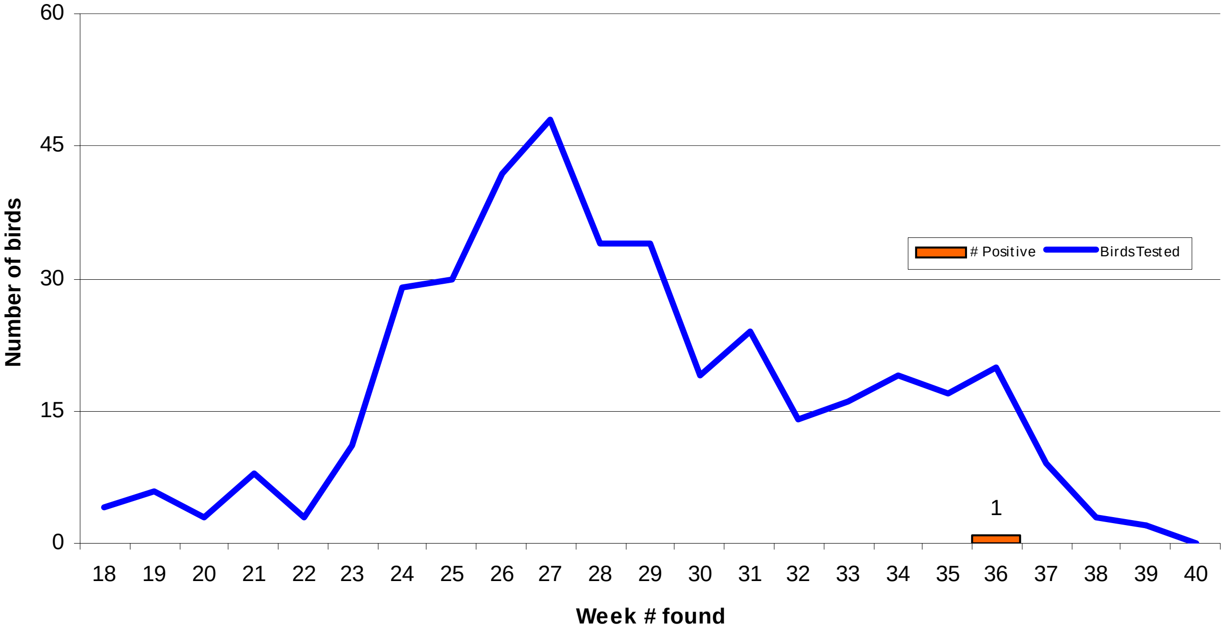
6a) Boreal Forest Natural Region



6b) Grassland Natural Region



6c) Parkland Natural Region



III. *Horse Surveillance*

Introduction

Horses become infected by WNv by being bitten by mosquitoes that carry the virus. Research suggests that most horses bitten by infected mosquitoes will not develop clinical disease, but instead will eliminate the virus uneventfully. Symptoms of WNv can include weakness, fever, incoordination, listlessness and an inability to rise. There is no specific treatment for horses affected with WNv. Up to 35 percent of horses that develop clinical signs may die or have to be euthanized due to complications of illness.

WNv in horses became a provincially reportable disease in Alberta in 2003, meaning all suspected or confirmed cases are required to be reported to the Chief Provincial Veterinarian (CPV). Alberta veterinary practitioners were asked to complete an initial survey when they suspected a case and then a follow-up survey if the case was confirmed positive. There were 222 suspected case of WNv in 2003. Of these, 170 were laboratory confirmed positive and 59 horses died or were euthanized.

In 2004, private veterinary practitioners were asked to complete a survey for each horse they suspected of having the virus. The survey focused on clinical signs, environmental risk factors and preventive measures. The CPV Office was notified of the results of confirmatory testing by the laboratory conducting the test. Owners of horses that were confirmed positive were asked a follow-up question regarding the horse's recovery status.

WNv in all species of animals is Immediately Notifiable under Canada's *Health of Animals Act*, meaning that laboratories are required to contact the Canadian Food Inspection Agency (CFIA) regarding the suspicion or diagnosis of the virus.

Objectives

The objectives of the 2004 WNv surveillance program and survey of WNv suspect horses in Alberta were to:

- Determine the number of horses affected with WNv in Alberta in 2004,
- Explore the distribution of environmental risk factors involved, and
- Determine the use of preventive measures.

Methods

WNv is a reportable disease in horses in Alberta, therefore, all veterinary practitioners who examined a horse with suspicious clinical symptoms were required to report this fact to the CPV. Veterinarians were asked to complete a survey for each suspect horse, which focused on clinical signs, environmental risk factors and preventive measures used, if any. The CPV Office was notified of the results of laboratory tests (IgM Elisa serology) and a follow-up question regarding the horse's recovery status was asked of owners whose horses tested positive for WNv.

Results

The first suspected case of WNv in horses was reported in early August 2004, with reporting continuing until October 2004. During 2004, private veterinary practitioners reported 65 suspect cases of WNv. Of these, 4 were laboratory confirmed positive, 57 were negative and 4 horse owners declined confirmatory testing. Of the 4 horses confirmed positive, 3 recovered and 1 (25 percent) was euthanized due to complications associated with the virus. Of the 65 horses suspected of possible WNv infection, 23 had been vaccinated, either for the first time or with a follow-up booster. None of the horses confirmed positive for the virus had been vaccinated.

Although veterinarians completed a survey for each “suspect” case of WNv, not every case could truly be defined as suspect. Veterinarians who submitted a blood sample to the laboratory, may have only been doing so to rule-out WNv as a potential diagnosis. Consequently, data collected from suspect cases that were confirmed negative will not be summarized in this report.

Clinical Findings

To investigate the presence of clinical signs of WNv infection in horses, veterinarians were asked to report if the horse demonstrated specific clinical signs. Survey results for the four horses that were laboratory positive indicated that one had a fever, two experienced loss of appetite, two experienced depression, one developed muscle tremors, two exhibited circling and/or hyperexcitability, all four experienced weakness in their hind limbs, three demonstrated an inability to rise, and none exhibited head pressing, seizures, blindness or coma, which can also be associated with WNv infection.

Environmental Risk Factors

Veterinarians were asked to indicate what type of environment the horse lived in, including: 1) in a corral all of the time, 2) on pasture all of the time, 3) in a stable with an outdoor corral, 4) in a stable or barn all of the time, or 5) on pasture during the day and in a stable at night. All four laboratory confirmed horses were on pasture all of the time. Of these, two had access to bodies of water, while two had access to thick bush.

Horse Age/Breed/Condition

The four horses confirmed positive for WNv were male. One was under two years of age, two were between three and ten years and one was over fifteen years of age. This horse had to be euthanized due to complications associated with the virus. Three of the confirmed positive horses were quarterhorses and one was a draft horse. The survey inquired about body condition of the suspect horse, under the assumption that a fit horse is more likely to recover from WNv than a thin or fat horse. Three of the confirmed positive horses were reported to be fit, while one was thin. The thin horse did not recover from the virus and was euthanized.

Geographic Distribution

The locations of confirmed positive horses according to natural region are shown in Figure 1. Three of the horses confirmed positive for WNv lived in the Grassland natural region, while the fourth was located near the boundary of the Grassland and Parkland natural regions. The geographic distribution of confirmed WNv cases according to health authority region is illustrated in Figure 2. Two horses confirmed positive for WNv were from Chinook, one was from Palliser and one was from David Thompson health regions.

Conclusion

In 2004, there were four horses that were laboratory confirmed positive for WNv in Alberta. Due to the fact that there were so few positive cases, it is impossible to draw meaningful conclusions about risk factors that may predispose an animal to WNv.

A summary of WNv in Alberta horses for 2003 and 2004 is provided in Table 1.

Surveillance for WNv in horses will be continued in 2005, however, veterinarians will be asked to indicate whether the horse in question is a true suspect, or if they are only requesting WNv serology as a rule-out. Eliminating data from rule-outs will provide a more accurate evaluation of the risk factors and preventive measures present.

Table 1. Summary of West Nile virus (WNv) in Horses in Alberta for 2003 and 2004

Year	Total Positive	Total Deaths	Deaths per Positive Case (%)	Positive Vaccinates
2003	170	59	34.7	11
2004	4	1	25.0	0

Figure 1. Geographic Distribution of Equine Laboratory Confirmed Positive Cases of West Nile virus (WNv) by Natural Area in Alberta (2004) (n = 4)

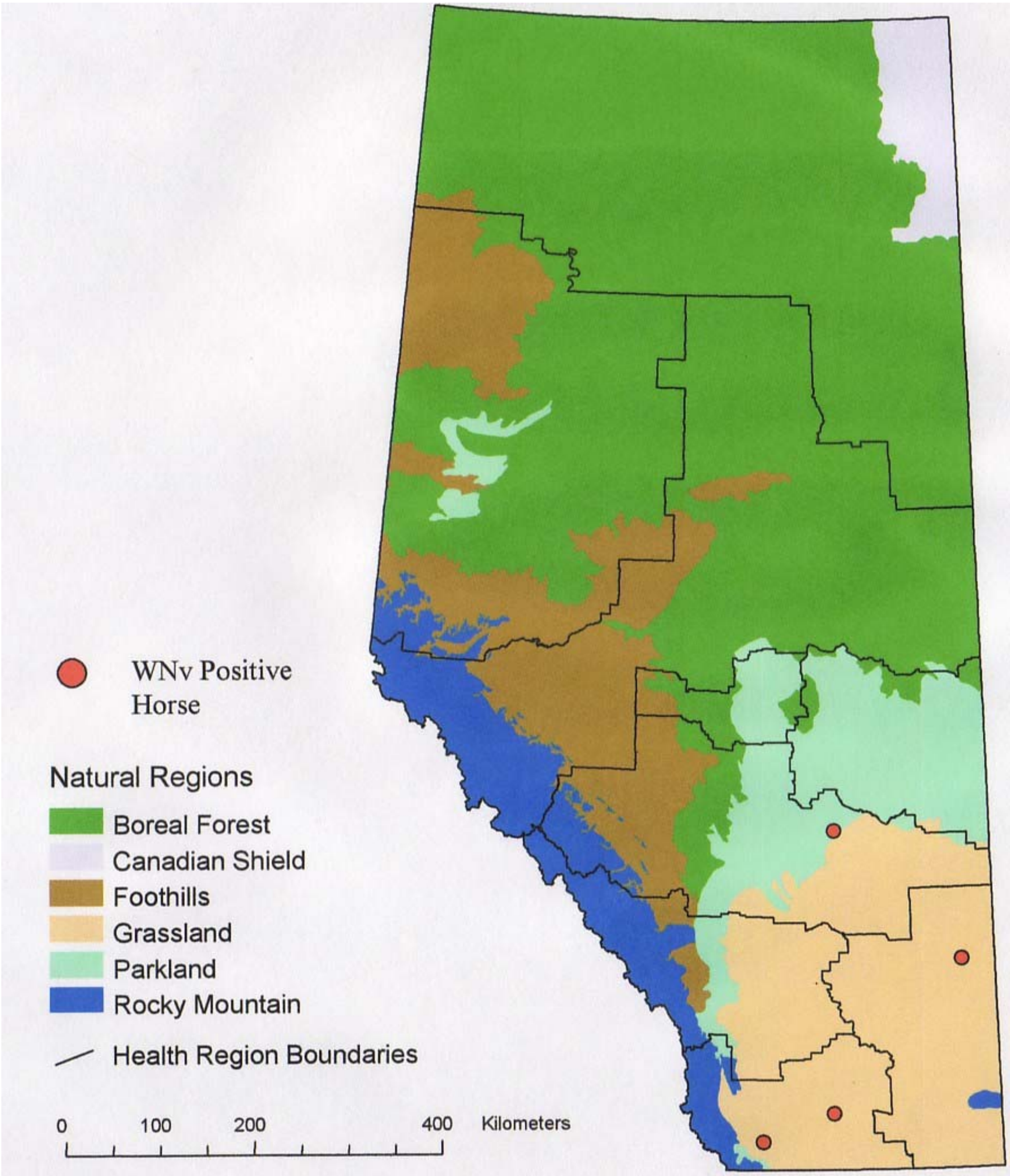
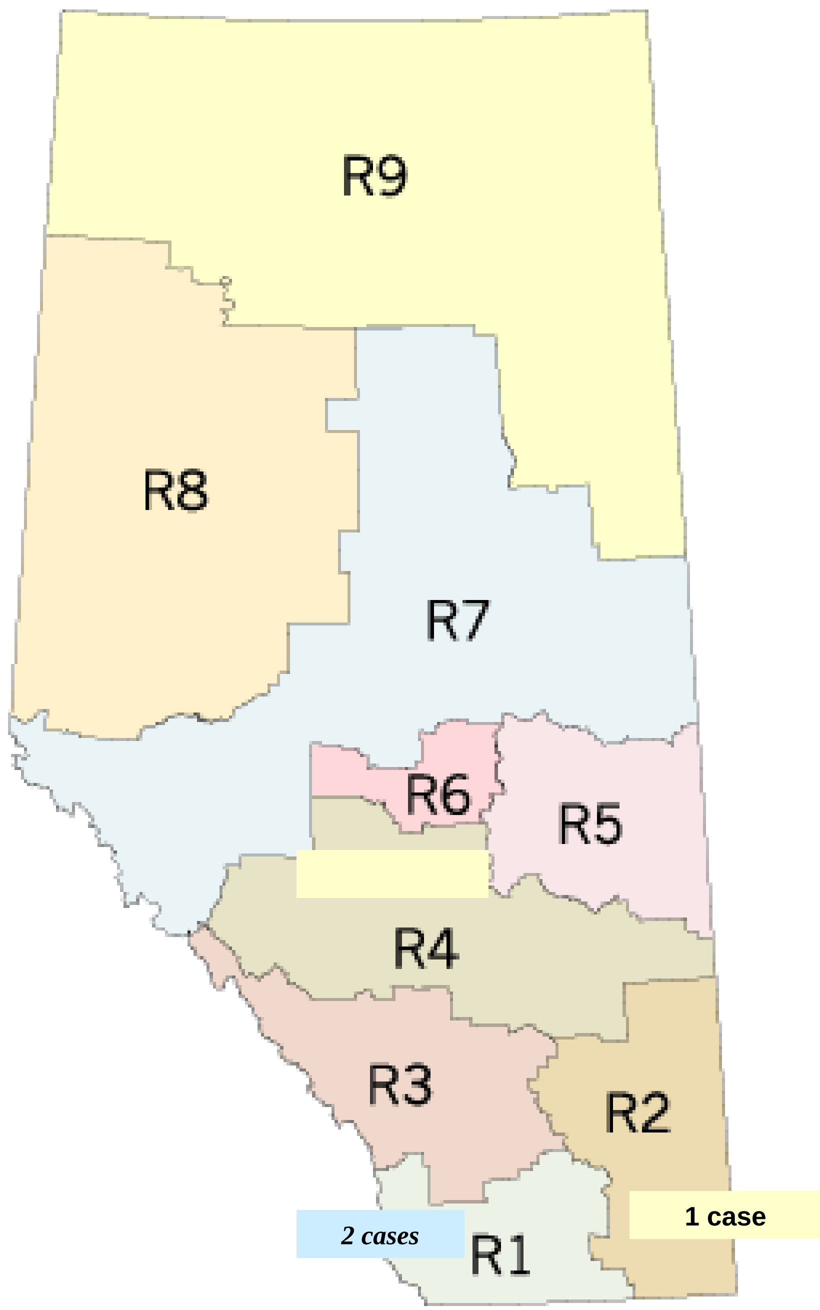

WNv Positive Horse
Natural Regions
Boreal Forest
Canadian Shield
Foothills
Grassland
Parkland
Rocky Mountain
Health Region Boundaries
0
100
200
400
Kilometers

Figure 2. Geographic Distribution of Equine Laboratory Confirmed Positive Cases of West Nile virus (WNv) by Regional Health Authorities in Alberta (2004) (n = 4)



IV. *Human Surveillance*

A. Surveillance

Surveillance of WNv in humans continued in 2004 through physician, blood donor screening, and organ/tissue testing. Any positive results were reported to Alberta Health and Wellness (AHW). The 2004 West Nile virus (WNv) season was much different from the 2003 season. Alberta reported only one confirmed travel-related case of West Nile fever (WNF) in June 2004. No indigenous cases of WNv were reported. While in 2003, 275 human cases were reported: 48 West Nile Neurological Syndrome (WNNS), 223 WNF, one West Nile Asymptomatic Infection (WNAI) and one case with unknown clinical manifestation. No deaths related to West Nile virus infection were reported in Alberta in either year.

Cooler weather throughout the summer resulted in extremely low numbers of *Culex* mosquitoes with low infection rates. This limited the spread of the virus from birds to mosquitoes and ultimately, there were few infected mosquitoes to bite humans.

B. Enhanced Pregnancy Algorithm- WNv Public Health Guidelines

In response to new information on the potential risks of intrauterine WNv infection, the *Pre-Natal Assessment and Investigations for West Nile virus: Maternal and Fetus,* and *Post-Natal Assessment and Investigations for WNv – Infant* reporting forms were developed and included in the 2004 WNv Public Health Guidelines. The content was adapted from the Morbidity and Mortality Weekly Report, *Interim Guidelines for the Evaluation of Infants Born to Mothers Infected with West Nile virus During Pregnancy.* (Vol.53,154-157).

C. WNv Cases in Alberta

A *confirmed case of WNF* (related to travel in Arizona) was reported with an onset date of June 26, 2004. Acute and convalescent sera sent to the National Microbiology Laboratory (NML) in Winnipeg confirmed the diagnosis.

A *probable case of WNNS* was reported with an onset date of September 16, 2004. The serology was reported as IgM +, IgG -, and the patient's symptoms included fever, headache, muscle/joint pain, unusual forgetfulness, blurred vision, photophobia, unusual fatigue/sleepiness, stiff neck, enlarged glands, and tremors. Acute and convalescent sera were sent to the NML for confirmation and all testing was found to be negative.

Five other *possible cases* were reported but they either did not meet the case definition, or convalescent serology was inconclusive, or other disease events were in progress. All five cases were determined to be IgM persisters from 2003.

D. **Canadian Blood Services (CBS) Screening**

(June 28 to October 25, 2004)

There were no WNv positive blood donors detected by CBS in 2004 (in contrast to 14 blood donors found positive by CBS in 2003), and there have been no Canadian transfusion-transmitted West Nile virus infections since CBS began testing blood donors in July 2003.

The arrangement with Public Health and CBS in Alberta in 2004 worked extremely well in ensuring that CBS received early notification of any suspect cases. CBS was able to recall product which was potentially at risk.

E. Seroprevalence

Earlier studies in Ontario and New York demonstrated that the majority of WNv infections are asymptomatic and go undetected. The transmission cycle in the western provinces is different and the previous study results could not be confidently applies to the local scenarios. A study was organized to measure the prevalence of infection in one high risk region, Palliser, and the remainder of the province following the introduction of WNv into Alberta in 2003.

Study objectives:

1. To provide an estimate of the prevalence of WNv infection in Alberta
2. To assess the knowledge, risk perception and personal protective behaviours of Albertans related to WNv in urban and rural areas.

Study Methods:
A sample of 3000 Albertans were interviewed in the spring of 2004 using a survey questionnaire and 2,518 provided a blood specimen for WNv testing.

Seroprevalence Results:
Following confirmatory testing by the National Microbiology Laboratory in Winnipeg, 35 specimens were confirmed positive. When applied to the general population, this study estimates an overall prevalence in Alberta of 0.3% (6,941 cases on Alberta in 2003) with a higher prevalence of 4.6% in the rural areas of Palliser Health Region, and 0.8% prevalence in urban areas of Palliser. One in every 142 infected people developed West Nile Neurological Syndrome.

Survey Results:
<u>Awareness</u>
The majority of people have heard about WNv and its association with mosquitoes.
<u>Concern:</u>
About 50% of Albertans and a little or very worried about WNv and with the remaining 50% not worried or don't know. Residents in Palliser reported a higher level of worry.

<u>Risk Perception:</u>
75% recognized that seniors were at risk for severe complications but only 60% of seniors viewed themselves at risk and 43% (incorrectly) felt that young children were also more likely to develop severe complications.

<u>WNv Transmission</u>
Almost all respondents knew that mosquito bites were a route of transmission. 47% identified blood transfusion, 26% organ transplant, 2.1% shaking hands and 62% contact with dead birds as routes of transmission.

<u>Sources of Information</u>
Information on WNv was obtained from television (70%); newspapers (52%) radio (28%) and less than 10% for internet, doctors and pamphlets.

<u>Personal Protective Measures</u>
Over 80% do not restrict their outside activity to protect themselves from WNv. Approximately

30% of the respondents avoided heavily infested areas, wore long sleeves and pants, light colored clothing, avoided active mosquito times. 39% almost always wear mosquito repellent and of those, 74% used a DEET based repellent. Of the 33% who never or rarely used repellent, the reasons for not using DEET include: didn't bother, perceived low risk, allergy, unpleasant smell, and concern about chemical use.

Conclusions:
There is a good knowledge of the principal mode of transmission and low levels of concern. Personal protective behaviours are not practiced consistently. A significant number of seniors do not always recognize their increased risk for complications and many mistakenly indicated that children were at high risk. Passive sources of communication such as TV, newspaper and radio are the most effective tools for public health messages while the internet is not.

A more detailed report on the study will be released in 2005.

V. *Adult Mosquito Surveillance*

Summary

Alberta Environment implemented the 2004 mosquito surveillance component of the West Nile virus Alberta Response Plan in cooperation with 30 Alberta municipalities, 3 research facilities and the Canadian Forces Base Suffield. A total of 934 trapping nights occurred over the span of 17 weeks from June 1 until September 25, 2004. There were up to 72 carbon dioxide baited CDC (Centre for Disease Control) traps that operated at least one night per week to capture 131,281 adult female mosquitoes. A total of 47,105 of these mosquitoes were submitted in a total of 2,144 mosquito-pooled samples. These were forwarded from points throughout the southern half of the province on a weekly basis to the Provincial Laboratory for Public Health (Microbiology), Calgary where they were analyzed for the presence of West Nile virus (WNv).

WNv was confirmed in only one pool of *Culex tarsalis* mosquito adult specimens, which was obtained August 4, 2004 from the Vulcan area located in the Grassland natural region. No other pools of mosquitoes (of the total 2,144) tested positive for WNv during the 2004 surveillance period.

Possible contributing factors as to why more cases of WNv did not occur in Alberta during 2004 include:

- the suppressed activity of the *Culex tarsalis* mosquito population numbers to effectively amplify and transmit WNv to susceptible hosts;
- cooler temperatures suppressed WNv amplification in mosquito populations;
- more pronounced fluctuations in daily temperatures suppressed mosquito activity, and virus amplification in the mosquitoes;
- the presence of WNv was not as prevalent in 2004 as in 2003;
- increased immunity/resistance to WNv in birds and susceptible hosts; and
- reduced virulence of the WNv strain.

Introduction

Mosquitoes are a key factor in the build-up and spread of WNv. The 2003 surveillance program for mosquitoes operated in conjunction with Alberta's surveillance programs for birds, horses and humans and demonstrated:

1) the role of the *Culex tarsalis* mosquito species as the primary vector of WNv in this province,
2) that rainfall events through the summer were not a significant contributing factor to population peaks of *Culex tarsalis*,
3) the adaptation of *Culex* species to environmental conditions coupled with consistent warm weather above a previously reported threshold temperature (16^0C) may be the determining factor for the amplitude of virus transmission, and
4) successful overwintering of a large 2003 adult *Culex tarsalis* population might increase the vector capacity for the 2004 season.

The 2004 Response Plan anticipated that, should warm weather trends prevail in the 2004 season, the virus could be very active in southern Alberta; therefore, an enhanced mosquito surveillance program was developed and implemented.

Objectives

The overall objectives of the 2004 program were to:

- increase the number of trapping locations in southern Alberta where the risk of virus transmission was expected to be greater based on data obtained in the 2003 surveillance program;
- provide accurate and timely information to the public and health regions on the status of mosquito populations and the detection of WNv in pooled adult mosquito specimens;
- gain a better understanding of the *Culex* mosquito species (the primary vectors) and other mosquito species acting as potential bridging vectors of WNv in Alberta; and
- determine the general distribution, species composition and seasonal abundance of adult mosquito populations in selected locations.

To conduct the 2004 adult mosquito surveillance program, it was decided to continue the cooperative working relationship with municipalities that participated in the 2003 Program and to establish a similar working relationship with several newly formed Alberta municipal mosquito control programs. Surveillance centres were established in a relatively even spatial distribution in many of these participating municipalities located throughout all the southern regional health authorities.

Methods of Mosquito Surveillance

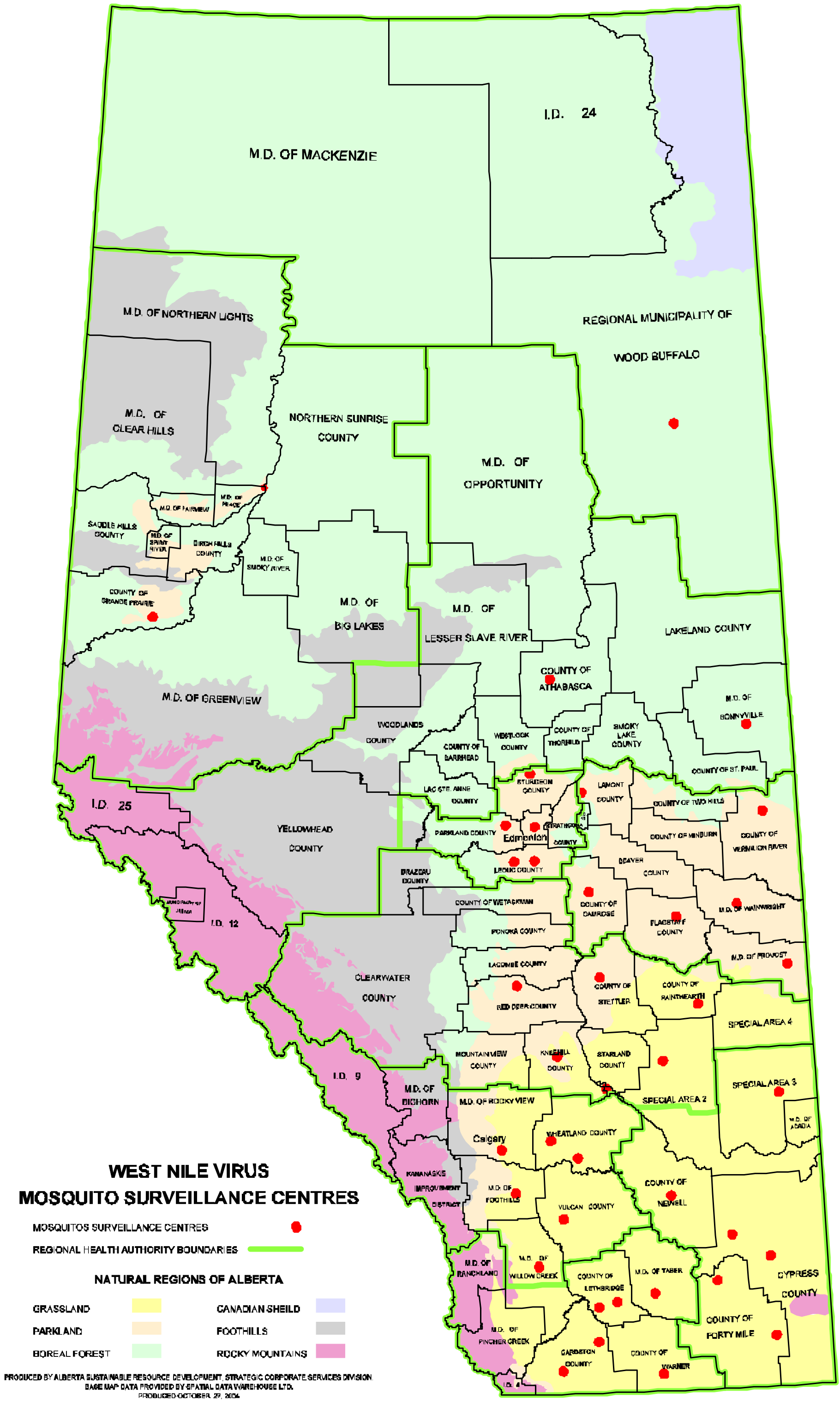
Surveillance Centres

Many of the Alberta municipalities that volunteered to undertake the task of trapping adult mosquito populations for virus analysis in 2003 also participated again in 2004. A number of new locations were added with a focus of operating a minimum of 6 trapping centres in each of the southern health regions. Participating municipalities included those listed in the following table.

Regional Health Authority	*Participating Municipalities*
Capital	City of Edmonton
East Central	City of Camrose, County of Vermilion River, MD of Wainwright, Flagstaff County, MD of Provost
David Thompson	City of Red Deer, County of Paintearth, Kneehill County, Town of Drumheller, County of Stettler, Special Areas
Calgary	City of Calgary, Wheatland County, Vulcan County, MD of Willow Creek, MD of Foothills, Siksika First Nations
Palliser	Town of Brooks, City of Medicine Hat, Town of Bow Island,
Chinook	City of Lethbridge, Cardston County, County of Warner

Agricultural Research Association staff operated two of the surveillance centres (Fort Kent and Oyen), the University of Alberta operated one centre in Manyberries as a part of their monitoring project involving the endangered Sage grouse, and one centre operated from the Canadian Forces Base Suffield.

Surveillance centres were also established in the City of Grande Prairie and the County of Athabasca, however these mosquitoes were captured for identification purposes and not virus analysis. In more northerly areas, the MD of Peace and the Regional Municipality of Wood Buffalo were also prepared to participate if the need was identified (see Figure 1).



Operational Procedure and Testing

Municipalities with existing mosquito abatement programs were again relied on to take the lead in the sorting and identification of adult female mosquitoes. In addition, Alberta Environment staff held clinics for some of the new participating municipalities to develop and improve their mosquito identification skills. Depending on their level of expertise, municipal staff were capable of at least separating *Culex* species from the other mosquito species.

Traps used to capture mosquitoes were the standard CDC (Centre for Disease Control) model[1] used for monitoring diseases in insects. At least two traps were issued to all surveillance centres. Traps were operated in accordance with the West Nile virus National Steering Committee Guidelines (i.e. they were baited with carbon dioxide, in the form of dry ice, and operated without lights).

Traps commenced operation on June 1, with most winding down in late August and some continuing until September 21. A maximum of 72 CDC traps were operated one night per week (usually Tuesday evenings) over the 17-week surveillance period for a total of 934 trapping nights. Live adult female mosquitoes were collected, killed by freezing, identified to species, and sorted into pools of no more than 50 adults per pool (usually each Wednesday). The pooled mosquitoes were placed in vials and shipped to the Provincial Laboratory for Public Health (Microbiology) in Calgary (on Thursdays and Fridays).

The Provincial Laboratory analyzed the mosquito pools for presence of WNv using both Nucleic Acid Sequence Based Amplification (NASBA) and Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) methods. Results of analysis were provided to Alberta Environment on a maximum 4-day turnaround basis and, in turn, Alberta Environment provided the results to participating surveillance centres the following day. Weekly summaries were also posted on the Alberta Health and Wellness "Fight the Bite" website.

Results

Season Synopsis

In many respects, the 2004 mosquito season was quite opposite to 2003 primarily due to weather conditions. In 2003, most of the Province experienced warm temperatures and very little rain between June and September. By contrast in 2004, cooler temperatures prevailed through June and several rain events greater than 15 mm occurred in each surveillance area throughout May to September. This resulted in the hatching of many 'nuisance' mosquito eggs deposited on the margins of many temporary, semi-permanent and permanent water bodies.

Cooler weather in the spring through mid-July significantly reduced the annoying level of adult mosquito activity experienced during this same period in 2003. Evening temperatures regularly dropped below 10ºC on a daily basis in most areas during the 2004 season. It was common throughout the 2004 summer months for daily average temperatures to drop below 16°C, the baseline temperature thought to be necessary for *Culex tarsalis* (the primary virus transmitting vector) to actively amplify and spread WNv.

Even though *Culex tarsalis* larvae were first found in early June (similar to 2003) most of the larval population appeared to develop more slowly this year; consequently, emergent adult activity was not noticeable until late-June / early-July. This delay in *Culex tarsalis* development is most likely due to the cooler average daytime and evening temperatures that occurred throughout June 2004. Even if a significant number of *Culex tarsalis* adults had been able to successfully over-winter, it is likely that the cool spring weather severely suppressed adult activity and their ability to obtain blood meals and produce eggs. In effect, this very likely resulted in a delay of succeeding generations, as it was not until about mid-August that surveillance centres in southern Alberta, were able to find small to medium numbers of *Culex tarsalis* larvae that had been produced by the second cohort adults. Again, cooler temperatures delayed the development of these larvae, particularly in the Parkland natural region, and it is suspected that the emergence of a third cohort of *Culex tarsalis* adults in the

[1] BioQuip Products, Inc., California

latter part of August and early September may not have been very successful. If such is the case, it may be reasonable to conclude that the over-wintering population of *Culex tarsalis* will be significantly smaller than what occurred in 2003.

More rainfall events throughout the spring and summer improved growing conditions in southern Alberta in 2004 but, at the same time, also contributed significantly to the increase in populations of other mosquito species common to the province. The emergence of these 'nuisance' species reached a peak in early August as illustrated by the combined trapping data of all surveillance centres shown in Figure 2. Numbers of captured 'nuisance' mosquitoes were considerably higher in the Parkland natural region where rain events were more significant, whereas *Culex tarsalis* captures were of greater significance in the Grassland natural region where rain events were less pronounced (see Figures 3 and 4).

Figure 2: 2004 Combined Total of Mosquitoes Captured from Surveillance Traps by Alberta Communities

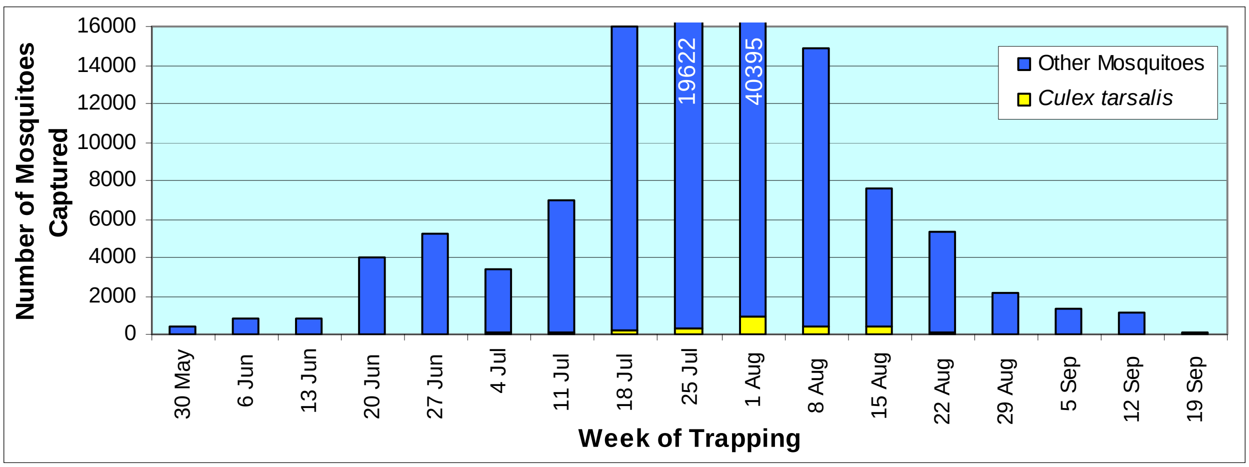


Figure 3: 2004 Combined Total of Mosquitoes Captured from Surveillance Traps within the Parkland Natural Region

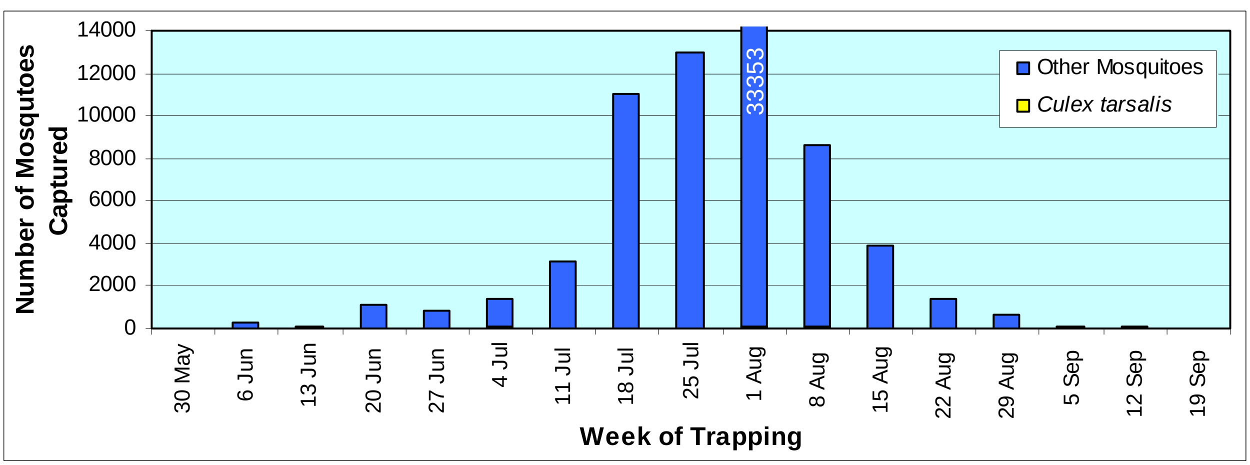
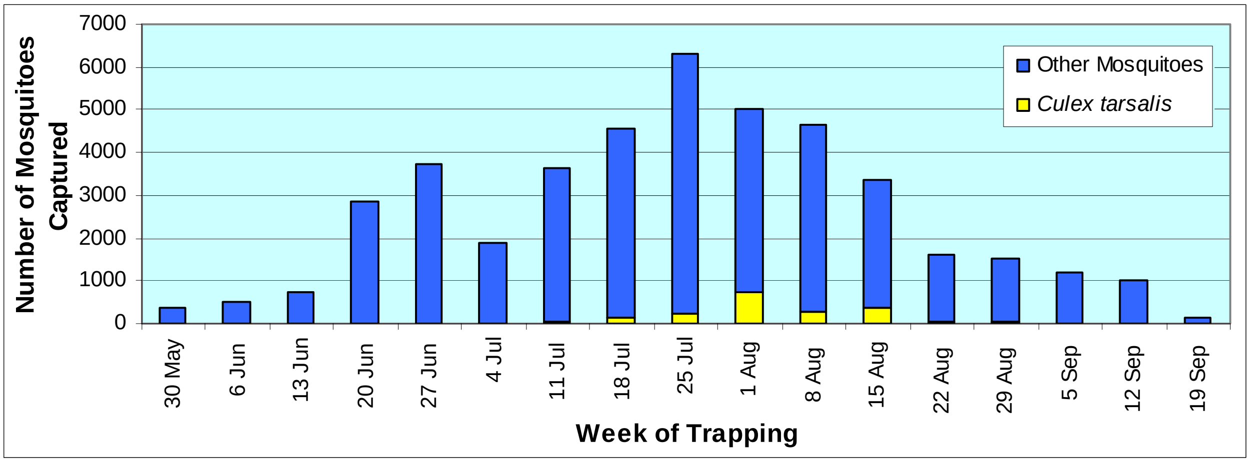


Figure 4: 2004 Combined Total of Mosquitoes Captured from Surveillance Traps

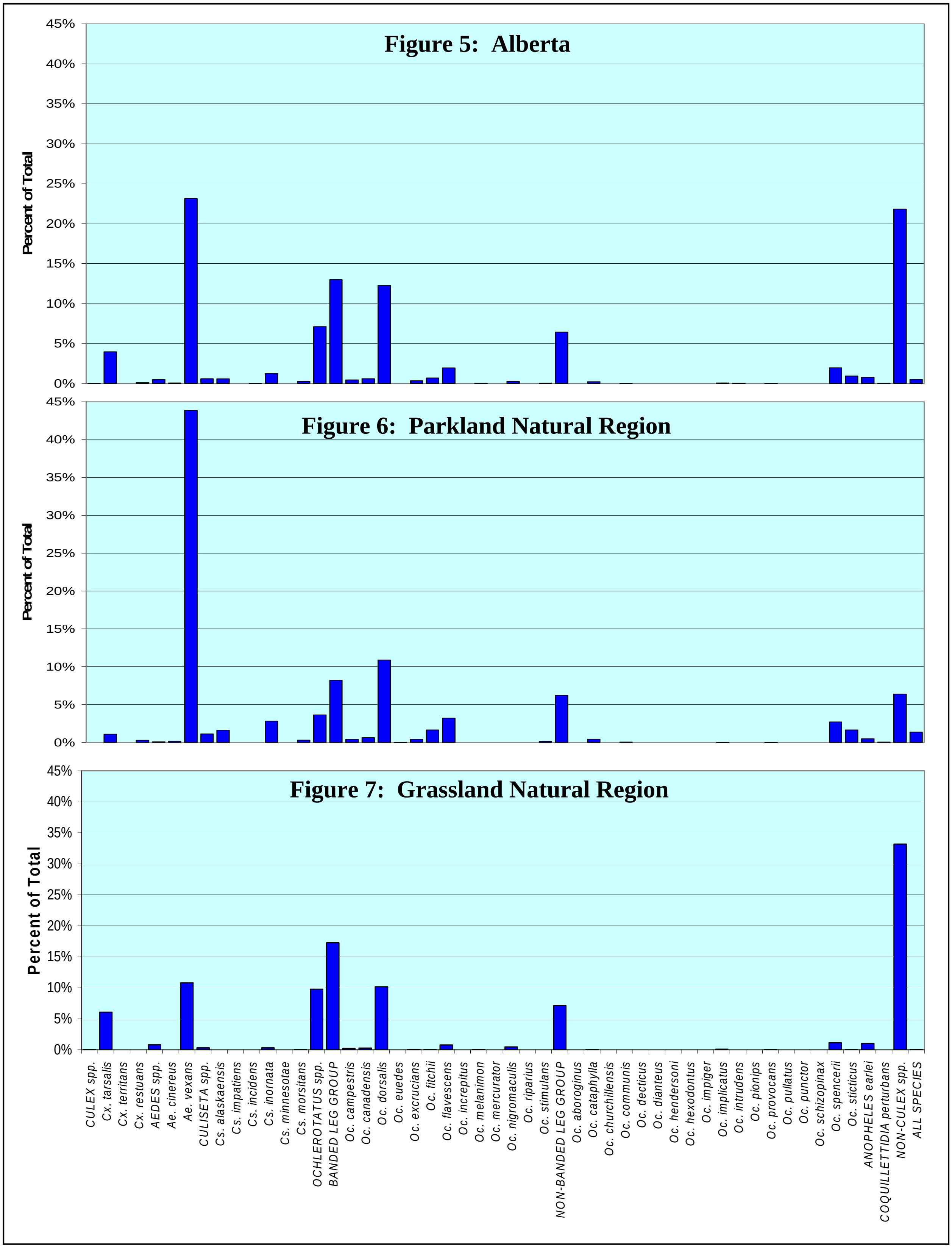
within the Grassland Natural Region



Species Abundance and Distribution

The increased number of surveillance centres (and traps) greatly enhanced monitoring capabilities for mosquito species and collection of weather data. Over the 17 week surveillance period there were a total of 131,281 adult female mosquitoes captured, of which 47,105 of these were separated, identified, and sorted into 2,144 pools of mosquitoes that were submitted for WNv testing. The sorting and identification of mosquitoes by the municipal surveillance centres provided a valuable understanding of the abundance and distribution of the most common mosquito species found in the province. Data for each surveillance centre is provided in a second document entitled *Details of the 2004 Mosquito Surveillance Program* available from Jock McIntosh, Alberta Environment, and has been combined for the province as a whole (Figure 5) and for the two natural regions (Figures 6 and 7).

Figures 5-7: 2004 Abundance of Species in Alberta, the Parkland Natural Region, and the Grassland Natural Region



The Parkland natural region experienced more rainfall than the Grassland natural region and subsequently produced greater numbers of ‘nuisance’ mosquito species. A summation of the trap catches show that *Culex tarsalis* comprised only about 6% of the total number of mosquitoes trapped in the Grassland natural region and only about 1% of all mosquitoes captured in the Parkland natural region. By contrast, the *Culex tarsalis* percentage of the total caught within the Grassland and Parkland natural regions in 2003 was 25% and 15%, respectively. There can be little doubt that the cooler and wetter weather conditions in 2004 helped to suppress *Culex tarsalis* populations while promoting a greater abundance of ‘nuisance’ mosquito species.

Of the other species predominant in the traps, *Aedes vexans* is the most common and was more prevalent in the Parkland natural region (~44%), as compared to the Grassland natural region (~11%). This is likely related to the greater frequency of rainfall events that occurred in the Parkland region. Ranking second in abundance was *Ochlerotatus dorsalis* that was found to occur throughout both natural regions at the same proportion (~10%) of all species captured.

Of note this year, was the presence of *Culex territans*, which was first observed as larvae in early June in more northerly Parkland natural region locations such as Wetaskiwin, Camrose, Wainwright, and up through the Boreal natural region. This species is known to have a biting preference for birds, reptiles and amphibians; the species does not generally seek blood from humans and are very rarely captured as adults in the baited CDC traps. However, the presence and activity of *Culex territans* should not be discounted at this time as they too may play a key role in the spring amplification of WNv in birds, reptiles and amphibians, particularly in the area around Lloydminster and east-central Alberta where this mosquito species is more prevalent.

Figure 8: 2004 Alberta Mosquito Trap Surveillance: Number of pools of the mosquito vector *Culex tarsalis* in relation to the number of pools of other mosquito species that were analyzed for the presence of West Nile virus.

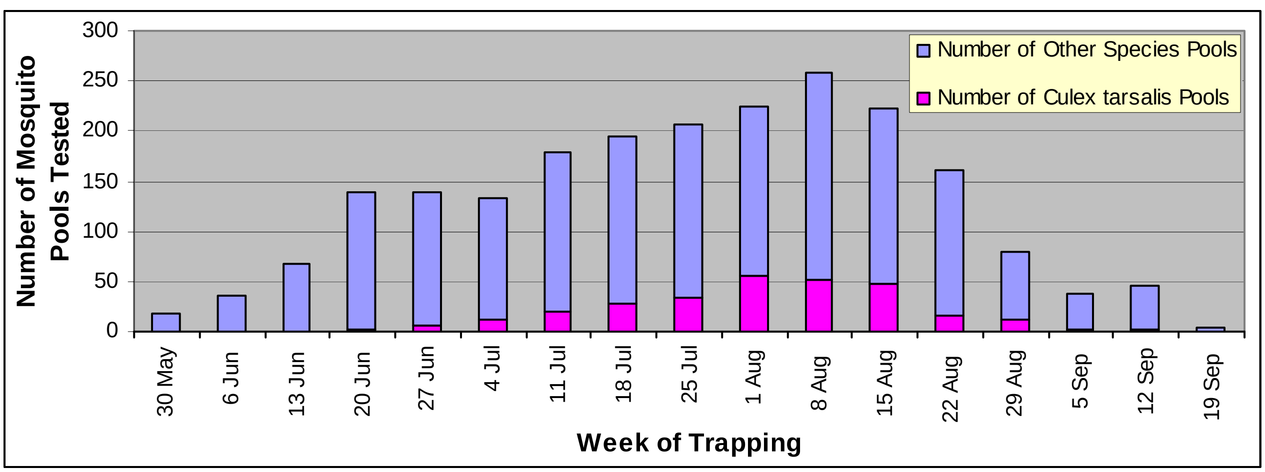
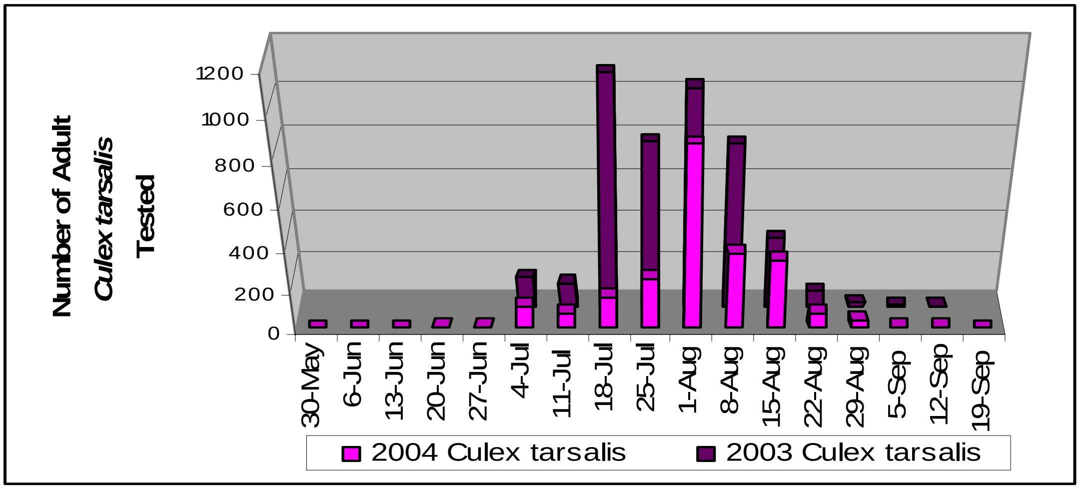


Figure 9: **2003 & 2004 Comparison of Total Number of *Culex tarsalis* Tested per Week in Alberta**



Habitat Types

As a result of an increased number of municipalities monitoring for *Culex tarsalis* populations and conducting mosquito control where and when required, significant attention was given to the types of habitat where *Culex tarsalis* is found to develop. It is well known that this species, at the height of its season, will typically deposit its eggs on open water that is:

a) protected from wind and wave action;
b) shallow and warm (above 20ºC to facilitate quick development through the larval stage); and
c) high in organic matter and nutrient content.

In the drier, warmer weather of 2003, the notable larval habitat for *Culex tarsalis* consisted of abandoned sewage lagoons, water associated with compost areas, stored tire piles, tree plantation holes, and the typical small pools of water from declining water levels surrounding large sloughs and rivers. These shallow, protected habitats would normally be the only habitat option for a species that best thrives in the drier and warmer parts of the province.

In contrast to 2003, the increased rainfall during 2004 raised the levels of many natural open water bodies. This resulted in more diverse and widespread habitats for *Culex tarsalis* larvae, as verified by a number of municipal surveillance personnel who found larvae in the flooded, grassy and vegetated margins of overflow areas surrounding more permanent water bodies (see following Photographs) during the latter part of August. For municipalities conducting control programs, these areas should not be overlooked as 'unlikely' habitats.

Picture 1: Inlet off the St. Mary's Reservoir (clear water) – larvae found in surrounding grassy margins.

Picture 2: Inlet off the St. Mary's Reservoir (high density of *Culex tarsalis* larvae in protected grassy margins).

Picture 3: Flooding along waters edge of Payne Lake (clear water)

Picture 4: Shoreline of Payne Lake. *Culex tarsalis* larvae found in flooded grassy foreground.

Conclusions

Culex species are known to be the primary vectors of WNv throughout the Canadian Prairie Provinces and the northwestern United States. Despite a significant increase in surveillance centres and the number of pooled mosquito samples collected and analyzed during 2004, only one sample of adult mosquitoes tested positive for WNv. The WNv-positive *Culex tarsalis* sample was captured in the midwest portion of the Grassland natural region (Vulcan area -see Table I) during early August when the population of *Culex tarsalis* reached its peak for the season. All other pooled samples of *Culex* and other mosquito species tested negative for the virus even though positive bird specimens (9) and horses cases (4) were confirmed within the mosquito surveillance area.

Very little is known about the spring/early summer activity of first cohort (i.e. over-wintering) *Culex tarsalis* females. Even though most surveillance centres began trapping operations during the last week in May, no *Culex tarsalis* adults were captured until the latter part of June. In addition, surveillance centres were finding very few developing larvae in this time period. Although the capture rate was quite small, it is suspected that the majority of the *Culex tarsalis* females captured at this time of the season were second cohort adults.

Cool weather conditions throughout most of June and early July is thought to have played a predominant role in suppressing *Culex tarsalis* larval/pupal development and adult activity during this period. Under warmer weather conditions that would normally occur at this time of year, this is the period when *Culex tarsalis* populations begin to amplify significantly, continuing to build through July and peak in early August.

Although some *Culex tarsalis* larval activity was observed by municipal surveillance centres beginning in mid-July, elevated larval population numbers were not found until mid-August. These observations suggest that much of the second cohort of adults were not able to successfully blood-feed and oviposit until late-July and early August. The greater numbers of larvae observed in mid-August is evidence that they were giving rise to a third cohort of adults, but it is unlikely that many of these adults would blood-feed following emergence due to shorter day-length and cooler temperatures triggering the onset of diapause. As previously observed in 2003, trap collections of adult *Culex tarsalis* females decreased noticeably during late August of 2004 as surviving females ceased blood-seeking activity and began to seek out suitable habitat to over-winter. In addition, the comments from Alberta municipalities that were operating New Jersey Light Traps (without carbon dioxide attractant) noted that they did not observe any increase in adult *Culex tarsalis* numbers into September. This would suggest that the colder temperatures suppressed larval development and likely reduced the population of third cohort adults that were able to over-winter.

The suppressed activity of the second cohort of *Culex tarsalis* adults appears to have been a major deterrent to the buildup and spread of WNv throughout southern Alberta in 2004. Trapping results for 2004 indicate a decreased and delayed population of second cohort adult female mosquitoes that were available to amplify and spread the virus. Limited transmission of WNv by the second cohort females is expected to have occurred in 2004, but only in those areas where weather conditions remained warm for a period of time (e.g., Grassland natural region) and suitable for amplification and spread of WNv (see mean temperature ranges above 16ºC threshold in *Appendix* weather data during early- to mid-August). The temperature differences can be best observed in Figures 10 and 11 that show the weather data from the Town of Brooks for the past two years. The period of time when virus was active in Brooks in 2003 was from mid July to early September. Maximum, mean and minimum temperatures remain fairly consistent with little fluctuation in comparison to the same period in 2004 when there are more pronounced fluctuations and no virus activity. An examination of this phenomenon should receive further attention in future surveillance programs.

Figure 10: Town of Brooks 2003 Weather Data

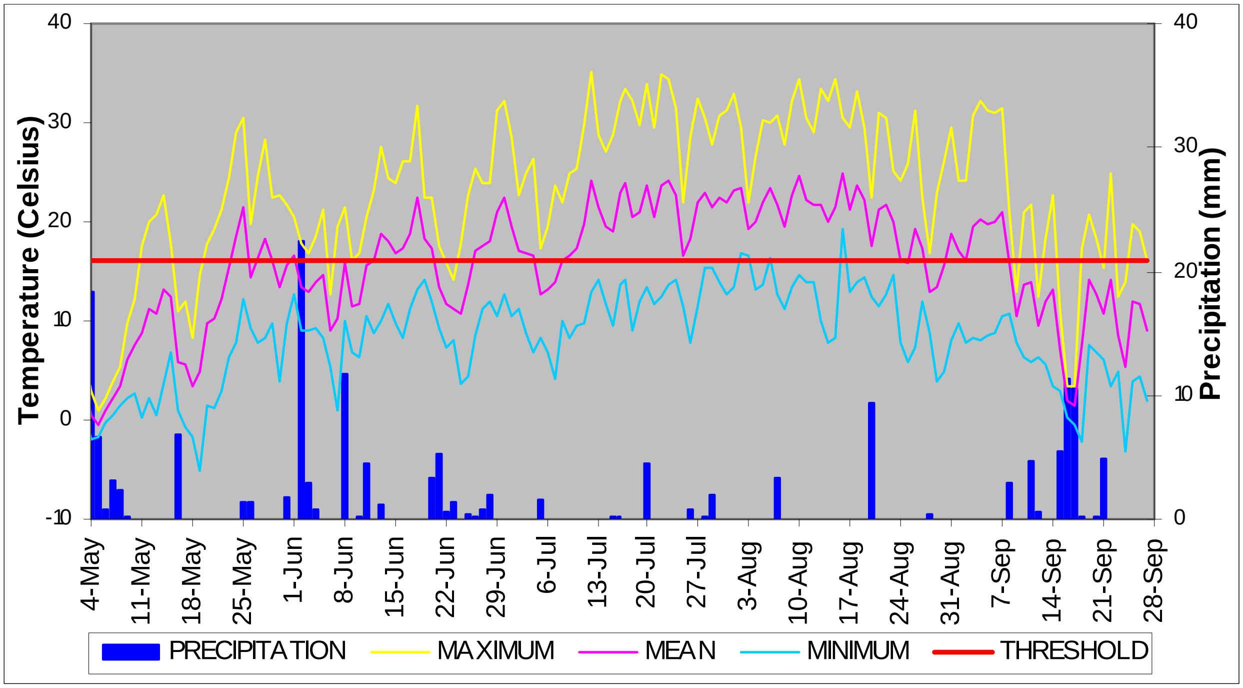
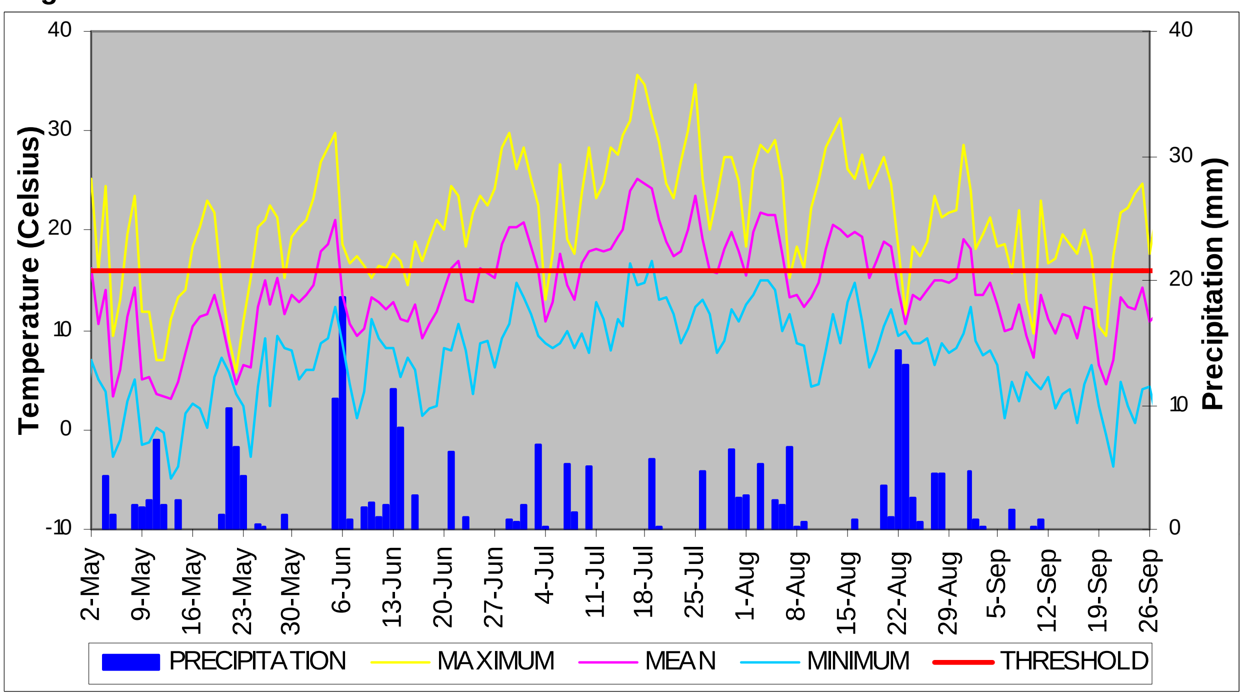


Figure 11: Town of Brooks 2004 Weather Data



Heavy precipitation events throughout the Parkland and Grassland natural regions contributed significantly to population peaks of nuisance mosquito species. Precipitation also created a great diversity in larval habitats, however it appeared to have little overall effect on *Culex tarsalis* population numbers.

The results of the 2004 Alberta WNv Mosquito Surveillance Program provide strong circumstantial evidence that weather conditions played a crucial role in the activity of *Culex tarsalis* populations and the ability of this primary vector to amplify and transmit WNv in Alberta. Cooler weather conditions during May, June and July suppressed *Culex tarsalis* populations that would have been necessary to effectively spread WNv from birds to other susceptible hosts, including horses and humans. Precipitation events did produce a significant increase in other 'nuisance' mosquito species during 2004; however, none of the pooled samples yielded any evidence of WNv infection in these other mosquito species. In the absence of contradictory information, it must be assumed that *Culex tarsalis* remains the primary mosquito vector of WNv in Alberta.

The results of the 2004 Mosquito Surveillance Program provide no conclusive evidence as to why more cases of WNv did not occur in Alberta during 2004, however some possible contributing factors may include:

- *Culex tarsalis* population numbers were too low in 2004 to effectively amplify and transmit WNv to susceptible hosts;
- cooler temperatures suppressed WNv amplification in mosquito populations;
- more pronounced fluctuations in daily temperatures suppressed mosquito activity, and virus amplification in the mosquitoes;
- the presence of WNv was not as prevalent in 2004 as in 2003;
- increased immunity/resistance to WNv in birds and susceptible hosts; and
- reduced virulence of WNv strain.

Although there is anecdotal evidence to support the argument that cool weather conditions suppressed *Culex tarsalis* populations and WNv amplification in the vector mosquito populations during 2004, there is little or no evidence at this time on which to assess the relevance of increased immunity/resistance or reduced virulence factors. The continuation of mosquito surveillance programs in 2005 will help to provide further insight regarding the status/presence of WNv in Alberta.

ENVIRONMENT

Table 1: Province of Alberta 2004 Summary of the Mosquito Surveillance Program for West Nile virus.

CUM # of + POOLS	+ POOLS FOR WEEK	WEEK	# OF CULEX POOLS TESTED	CUM TOTAL # OF CULEX POOLS TESTED	TOTAL # OF POOLS TESTED	CUM TOTAL# OF POOLS TESTED	RANGE OF POOL SIZE	POOL MEDIAN	MEAN POOL SIZE
0	0	**30 May – 5 Jun**	0	0	18	18	2:50	7	20
0	0	**6 Jun – 12 Jun**	0	0	35	53	1:50	5	15
0	0	**13 Jun – 19 Jun**	0	0	68	121	1:50	3	11
0	0	**20 Jun – 26 Jun**	1	1	139	260	1:50	13	22
0	0	**27 Jun – 3 Jul**	6	7	140	400	1:50	20	25
0	0	**4 Jul – 10 Jul**	12	19	134	534	1:50	15	22
0	0	**11 Jul – 17 Jul**	20	39	178	712	1:50	19	23
0	0	**18 Jul – 24 Jul**	28	67	194	906	1:50	30	27
0	0	**25 Jul – 31 Jul**	33	100	206	1112	1:50	13	22
1	1 *	**1 Aug – 7 Aug**	56	156	224	1336	1:50	24	26
1	0	**8 Aug – 14 Aug**	52	208	258	1594	1:50	13	21
1	0	**15 Aug – 21 Aug**	47	255	223	1817	1:50	9	18
1	0	**22 Aug – 28 Aug**	16	271	160	1977	1:50	8	18
1	0	**29 Aug – 4 Sep**	11	282	79	2056	1:50	9	20
1	0	**5 Sep – 11 Sep**	1	283	38	2094	1:50	37	29
1	0	**12 Sep – 18 Sep**	2	285	46	2140	1:50	34	31
1	0	**19 Sep – 25 Sep**	0	285	4	2144	9:44	44	35

* *Culex tarsalis* collected in Vulcan County

VI. Targeted Mosquito Larval Control Program

Summary

In anticipation of an increase in activity and spread of West Nile virus during the 2004 summer months, Alberta Health and Wellness provided funding to municipalities to control mosquitoes. The intent of this program was to impart the current understanding of West Nile virus and to train, authorize and guide municipalities through their implementation of control strategies. Mosquito control was specifically targeted at the *Culex tarsalis* mosquito developing as larvae in some standing water habitats, prior to their emergence as adults. The biting female is known in the Prairie Provinces to be primarily responsible for the transmission of the disease to humans.

Of 362 municipalities eligible to partake in the funding offered for mosquito control, 203 (56%) of these municipalities participated, predominantly from the southern half of the province. Alberta Environment trained municipal staff and issued pesticide applicator certificates restricted to the use of specific larvicides for the 2004 season. The Department issued certificates to 172 municipal employees and received 198 applications for authorization to conduct spraying within their municipalities.

Municipal mosquito program personnel received training in late April and commenced their operations June 1, concluding August 31, 2004. Following training in April, personnel conducted surveillance of standing water in their control zones and attempted to identify source development sites of *Culex tarsalis*. In southern Alberta, *Culex tarsalis* larvae were first noticed in small numbers in mid-June but did not become significant in number until mid-July. In late July and early August, population numbers reached peak level for the year. The first and only West Nile virus positive mosquito sample was detected near Vulcan on August 4, 2005. There were 9 positive bird and 4 horse detections that followed until October.

As a result of cooler weather through the remainder of August, mosquito population development and flying/biting activity was suppressed and resulted in limited intervention. The resulting low virus activity made it difficult to assess the effectiveness of municipal control programs. All participating municipalities provided feedback in their year-end summaries indicating support for the initiative and recognition of the limiting factors associated with large-scale programs. Concern was expressed for the ability to cover large areas in a narrow window of time if conditions (i.e. cumulative and consistent heat) were to support rapid *Culex tarsalis* development. Recommendations included continuation of technical training to municipal staff following seasonal hiring, continuation of mosquito-virus surveillance (to provide an alert system), consideration for access to larvicides with more residual action, the formation of partnerships to better utilize limited resources, and funding notification earlier in the year to allow for advanced planning and mobilization of municipal programs.

Introduction

Targeted mosquito control programs have been responsible for keeping many diseases controlled, particularly in the eastern hemisphere and southern parts of the western hemisphere. In Alberta, prevention of diseases associated with mosquitoes has never been required, although Western Equine Encephalitis was the subject of some monitoring and concern in the early 1980's. The build up and spread of West Nile virus through southern Alberta in 2003 was higher than expected, although similar to what happened where the virus arrived for the first time in other areas of the North American continent over the last four years.

The success in controlling mosquitoes, particularly through targeting the larval stage of their development, has been well documented and practiced throughout the world. In Alberta, some municipalities have conducted larval-focused mosquito control programs since the mid 1970's and have met with success in keeping "nuisance/annoyance" populations to tolerable levels. Municipalities with the most success are those with dedicated budgets, a larger populated support base, and an annual commitment to maintaining mosquito populations at tolerable levels for their community. Even so, there may be years where mosquito populations are high due to significant rainfall events that produce extensive numbers of adult mosquito populations migrating into established control zones.

In 2003, the consistent warm weather experienced in the south half of Alberta (average mean temperatures above 16ºC) produced large numbers of the primary mosquito vector species, and some communities were able to reduce the number of *Culex* mosquitoes. A funding program was developed to educate and support all municipalities interested in implementing targeted mosquito control measures for the 2004 season.

Objectives

The information that has been learned across Canada and the United States regarding the transmission of West Nile virus from mosquito to man has confirmed that the primary vector is *Culex* species of mosquitoes, particularly in the Prairie Provinces. The most prevalent *Culex* in Alberta over the years has been *Culex tarsalis*, which is found primarily in the south half of the province but has been found northward into the Northwest Territories. As a result, the challenge for 2004 was:

- to distinguish this species from other species that have been documented in Alberta and focus on strategies targeted at its control.
- to administer, fund and implement targeted mosquito control programs that encompassed a defined area around populated communities/municipalities, in particular those in higher risk zones.
- to identify larval development sites and to take appropriate and responsible control measures, which would include the application of approved mosquito larvicides.

Guidelines for Mosquito Control

The "*West Nile virus Targeted Mosquito Control Program – 2004 Grant Program Guidelines*" were developed and announced to Alberta municipalities in early March

2004. Grants were allocated to interested municipalities and were based on a graded scale of risk established by scientific information obtained through the 2003 surveillance program.

Funding Formula

Municipalities located within each risk zone (Figure 1) were eligible for a minimum amount of funding of $1,500 and as follows:

- RISK ZONE 1 (Highest Potential - RED) funded up to $4 per capita.
- RISK ZONE 2 (Medium Potential - ORANGE) funded up to $3 per capita.
- RISK ZONE 3 (Lower Potential - YELLOW) funded up to $2 per capita.
- RISK ZONE 4 (High Population Centres - GREEN – Calgary and Edmonton) provided a grant of $300,000.00 each.
- RISK ZONE 5 (Minimal Potential - WHITE) funded up to $1 per capita.

The 2003 Alberta Municipal Affairs' Official Population List served as the population index for each municipality on which funding was calculated.

Funding Guidelines

Participating municipalities in this 2004 program were expected to:

1) identify an individual responsible for the program that would have or obtain certification to conduct or supervise all mosquito larvicide applications when and where required,
2) develop a mapping system to record all mosquito larval development sites within their established control zones (area within jurisdictional limits and including a 2 to 5 km surrounding buffer area),
3) submit an application for a Pesticide Service Registration, required to conduct mosquito larvicide applications within their jurisdiction,
4) operate their control program between June 1 and August 31, 2004
5) attend government sponsored training sessions/clinics for larvicide applicator certification and mosquito identification,
6) provide community notification regarding intent to conduct mosquito control and obtain authorizations from residents residing in the buffer areas established around their jurisdictional limits,
7) provide a year end summary report that included expenses, chemical application records, and an evaluation of their program, and
8) return all unexpended funds related to the grant issued to them by Alberta Health and Wellness.

Funding Process

In February 2004, each municipality was invited to submit a 'Notice of Intent' to indicate their interest in the grant program. Those planning to participate were sent a grant application along with the Grant Guidelines. Alberta Health and Wellness and Alberta Environment staff processed 203 grant applications received from May through August. The Assistant Deputy Minister of Alberta Health and Wellness and the municipal representative signed each grant agreement. The funds were then dispersed electronically. Any unused portion was returned at the end of the season.

Season Synopsis

At the end of March, 309 municipalities provided their notification of intent. Information/training sessions were held from April 14 to May 7, 2004. A number of municipalities decided not to participate once risk was explained and more details of the program were provided. The sessions were open to municipal officials, health inspectors, administrators and staff that would be directly involved in control program implementation. Sessions were held in Medicine Hat, Lethbridge, High River, Airdrie, Wetaskiwin, Edmonton, Red Deer, Athabasca, Hanna, St. Paul, Wainwright, Peace River, Grande Prairie and the Elizabeth Metis Settlement. The training component of these sessions qualified some participants for pesticide applicator certification that were issued by Alberta Environment on a restricted basis. The restriction was for the 2004 season (June 1 to August 31) and only authorized the use of biorational larvicides. These are comprised of active ingredients that are microbial, such as *Bacillus thuringiensis* var. *israelensis* (*Bti*), or an insect growth regulator, such as Methoprene.

There were 203 municipalities, 64% which formed program partnerships, that commenced their programs in early May by having staff (existing and/or hired specific to the program) determine the boundaries of their control programs, obtain landowner authorizations, and identify and map the locations of mosquito larval habitat. To assist municipal staff to focus on identification of *Culex* species in the larval stage of development (and adults for those municipal employees participating in the provincial mosquito surveillance program) Alberta Environment held clinics in late June and early July in Camrose, Medicine Hat, Lethbridge, Calgary, and Red Deer.

Colder weather trends through June appeared to suppress the development and activity of *Culex* populations and municipal staff did not observe these mosquito larvae appearing in significant numbers until mid-July. There was limited use of mosquito larvicide until mid-August when larval counts were noted to increase in many southern Alberta municipalities. Weather continued to be colder through the latter part of August and early September, which again slowed the larval development of *Culex tarsalis.* It appeared through surveillance that this last generation of larvae was so slowed by colder weather conditions that low numbers of adult mosquitoes would be produced and able to overwinter.

Summary of Municipality Participation

The following Table summarizes the participating municipalities in each of the risk zones and the funding that was utilized to establish targeted mosquito control programs during 2004:

RISK ZONE	TOTAL NUMBER IN RISK ZONE	TOTAL NUMBER IN RISK ZONE THAT PARTICIPATED	% OF MUNICIPALITIES PARTICIPATING IN RISK ZONE	NUMBER IN PARTNERSHIPS	TOTAL NUMBER NOT IN PARTNERSHIP	GRANT ALLOCATION	GRANT SPENT*
1	12	12	100	8	4	$356,384	$277,912
2	92	69	75	51	18	$887,838	$381,438
3	160	96	60	60	36	$1,492,488	$615,937
4	2	2	100	0	2	$600,000	$301,121
5	96	24	25	11	13	$410,633	$87,997
TOTAL	362	203	56	130	73	$3,747,343	$1,665,405

* Based on municipal reports.

Chemical Selections

Mosquito larvicides registered for use in Canada fall within 5 insecticide groups: microbials; insect growth regulators; organophosphates; carbamates and pyrethroids. Municipalities entering this initiative for the first time were restricted to the use of microbial and insect growth regulator formulations because of:

- the lower toxicity associated with these pesticide products,
- the number of inexperienced applicators involved in this new initiative that would be potentially exposing themselves and the environment through application of these pesticides,
- federal law limiting the use of higher risk products only to certified applicators,
- the targeted nature of *Culex* mosquito control, and
- the simpler type of equipment used for lower risk granular applications.

Mosquito larvicides were to be applied only by certified applicators and only to water found to support mosquito larva populations. The preferred formulation was the active ingredients impregnated on either corncob granules or charcoal pellets/granules. These were applied to the margins of larval habitat through the use of fertilizer/seed manually operated spreaders or motorized backpack units calibrated as best as possible to federal label rates of application.

The microbial pesticides containing *Bacillus thuringiensis* var. *israelensis* (*B.t.i.)* used by municipalities were either the granular formulations VECTOBAC 200G or AQUABAC

200G. The *Bti* bacterium produces an endotoxin, that releases from the corncob granule when applied to the surface of water. As it settles through the water column it is ingested by the mosquito larva, activates in the alkaline mid-gut and ruptures the gut cell wall lining. This product is only taken up by actively feeding mosquito larvae and for best results must be timed for application to when the majority of larvae are in the mid stages of larval development.

The insect growth regulator pesticides containing Methoprene are formulated on charcoal granules and pellets and applied to the water to affect the larvae. This active ingredient mimics insect juvenile growth hormone resulting in a disruption of the insect's maturation (and reproductive) process from larva to adult. Use requires careful attention to timing and patience as the mosquito dies in arrested immaturity at some point following application. If the mosquito is successful in emerging it should not be able to reproduce as an adult. The active ingredient is formulated on the charcoal to release at different rates that claims to provide control in the order of 3 weeks.

In addition, one other product was used by some of the municipalities that have established 'nuisance' control programs and fully certified pesticide applicators. The active ingredient is chlorpyrifos, an organophosphate based insecticide known under the trade name DURSBAN 2½G. This product is formulated on clay granules and can only be applied to temporary bodies of water that are not located in residential areas. It has a residual effect, depending on the application rate and can last from two to six weeks (depending on application rate and environmental conditions). Due to training, safety and environmental concerns it was not permitted for use by any of the applicators that received "restricted" certificates.

Municipal Program Assessment

All participating municipalities were requested to respond to a series of questions that would assist in an assessment of the operation of the 2004 targeted mosquito control initiatives. An overview of responses is provided below.

Training

1. Almost the same number of municipalities that used existing staff resources to conduct their programs, as those that hired staff to specifically undertake the program from June through August. Hiring staff was most common in those municipalities that partnered their program initiatives or had large area programs.
2. Since training was offered in April, summer staff hired in May were unable to attend the sessions. Many municipalities were not able to adequately pass on information learned at these sessions to their field staff hired for the summer.

Municipalities have requested that, in the future, the Province:

- provide training in early May emphasizing control methodology and mosquito identification for temporary field staff.
- develop a system to share contact names of other participating municipalities, and
- provide regular updates on mosquito-virus activity.

Mapping

1. The practice of mapping, in whatever form, provides a historical record for subsequent years when consideration would be given to further mosquito control.
2. There were as many municipalities that supplemented existing GPS technology to locate and map their mosquito larval development sites as there were those that designed and used hard copy mapping systems.
3. Most of the rural municipalities (i.e. counties, municipal districts) that incorporated a larger program area used the GPS technology, and purchased hand-held field units to use for this program.

Mosquito Species, Development and Habitat

Mosquito Species

1. The extent of effort and monitoring of mosquito species and habitat by municipal control program personnel has never been as thorough for Alberta as it was in 2004.
2. The training provided in mosquito identification assisted in identifying the range of *Culex* species and their habitat preferences.
3. Of the three *Culex* species documented in Alberta, *Culex territans* larvae were observed from mid-June to mid-September and were found from the Grande Prairie area down to Wetaskiwin and east to Wainwright. They were not found south of this area and were few in number. Although *Culex restuans* has been documented in the central-east part of the province (Camrose area and east), few larvae of this species were found in 2004.

Larval Development

1. *Culex tarsalis* larvae were first noted in southern Alberta (Drumheller area) in early June. Most municipalities did not find this species until mid-July, and later further north in the Parkland area.
2. Around mid-August, *Culex* larvae became abundantly noticeable, particularly throughout southern Alberta. They were found in standing water until early September.
3. The much slower development of *Culex* larvae in late August and early September is attributed to the cooler weather.

Habitat

1. The habitats observed for *Culex* species are described in the Mosquito Surveillance Program Report. The primary difference noted for 2004 was that the increase in precipitation resulted in a more diverse type of habitat observed for this species as opposed to what was noted in 2003.
2. The drier, warmer weather conditions of 2003 found *Culex* developing in water that was more limited and typically shallow, warm and organic (e.g., tires, abandoned sewage lagoons).
3. In 2004, the flooded margins of many permanent water bodies, where water was shallow and protected by vegetation, were found to support larvae of this species. Some of these habitats are associated with larger open bodies of water (e.g. lakes, rivers, streams) and may require authorization (i.e. Pesticide Special Use Approvals) to attempt control measures.

Chemical Control

The amount of larvicide required in 2004 for *Culex* control is a relatively small part of that used in overall mosquito control programs (nuisance and vector). The records submitted by municipalities do not always provide a clear distinction as to what was used between ‘nuisance’ versus vector control. A summary of the amount of the different products used and recorded by the municipalities in 2004 is provided as follows:

Jurisdictions	*Number Reporting*		90	
	Number Reporting Use of Chemical		54	
	Percentage Reporting Use of Chemical		60%	
Larvicide Active Ingredient	***Larvicide Product***	***Total Amount of Larvicide Product Used***	***Amount of Active Ingredient in Product***	***Total Amount of Active Ingredient Used (kg)***
Chlorpyrifos	*Dursban 2.5G*	415.58 kg	2.5 %	10.390
	Dursban Turf	268.46 mL	480 g/L	0.129
B.t.i.	*Vectobac 200G*	909.86 kg	0.2 %	1.820
	Vectobac 1200L	3.55 L	1.2 %	0.043
	Aquabac Shaker Cans (Domestic)	13.27 kg	0.2 %	0.026
	Aquabac 200G	1018.43 kg	0.2 %	2.037
	Aquabac XT	21.32 L	1.2 %	0.256
Methoprene	*Altosid Pellets*	6.80 kg	4.25 %	0.289
	Altosid Granules	247.53 kg	1.5 %	3.713
			TOTAL	18.703 kg

B.t.i.

All municipalities reported good success using *B.t.i.* larvicides throughout the control period. Due to cooler weather in 2004, the efficacy period of *B.t.i.* could not be accurately assessed, as larval development was not at its maximum. The use of this product was new to many control personnel and a concerted effort was made to observe its efficacy. In monitoring for the time period that the 2004 program was in effect, municipalities reported efficacy periods of 3 to 10 days (majority noted 3 to 5 days), and some noted significant recolonization of treated areas occurred in about 15 days. This would be expected to be a shorter period in more consistently warm weather. The major concern expressed about use of this product was that in periods of rapid frequency of oviposition and larval development it would be difficult to impossible to cover large control areas with the manpower that is available. As a result, there was interest and concern in having access to larvicides that have a more residual effect, particularly in periods of consistent warm weather.

Methoprene

A few communities used some of the Methoprene formulations. Of the three products registered for use in Canada, two were recommended for use in Alberta. *Culex tarsalis* has not been found in storm catch basins in this province, and if it was documented it would not be expected to be found in significant numbers. Municipalities were advised in their training sessions that the Altosid Briquet formulation (the ingot) was illegal to use in any water but storm catch basins (federal label restriction) and there was no need to use it in Alberta at this time. The charcoal granule formulation was the product of choice and the majority of users did not conduct follow up monitoring to know how well it worked. The City of Edmonton undertook some detailed trials and reported less than satisfactory results (less than 70% efficacy).

Efficacy of Larviciding

Of interest to all those controlling a mosquito that transmits a disease to humans, such as West Nile virus, is whether or not the control measures undertaken are effective. In 2004, there was considerable effort throughout the southern part of the province to locate and target *Culex tarsalis* with larvicide. There has never been such an initiative undertaken in Alberta and although municipal personnel better understand the complexities involved they recognize through their experience in 2004 that:

- *Culex tarsalis* populations can be reduced significantly through larval control efforts
- their success is primarily limited to public lands within their jurisdictional control
- access to private land can be a limiting factor
- large area control can be a limiting factor
- partnering resources will assist in providing more effective control
- monitoring mosquito habitat is labour intensive and the major expense in most control programs

Administration of the Funding Program

1. Participating municipalities were unanimous in their support of the grant program, the delivery of operational funds pre-season, and the financial opportunity to better understand the complexities associated with vector mosquito control and to attempt measures to reduce the transmission of WNv to their residents.
2. Municipalities requested announcement by the Alberta Government of the intent to conduct a 2005 program as early as January for planning (e.g., staff recruitment, chemical and equipment ordering, and landowner authorizations) and budget preparation purposes.
3. As the 2004 funding formula was a new approach and not fully tested due to the cold weather effects on the mosquito-virus complex, all were satisfied with continuation of the present funding approach.
4. Regardless of the decreasing risk of WNv transmission in the more northern areas of the province, it is apparent the costs associated with conducting a program anywhere in the province relate more to larval surveillance (mosquito species and habitat identification) and other operational expenses. Chemical purchase and application costs do not comprise large expenditures in most small-scale programs. Therefore, the risk assessment formula may not suffice for the operation of many northern municipal control programs. As a potential solution, more consideration should be given to the formation of funding partnerships that might allow any grant allocations to go further. Dedicating manpower and resources for larval surveillance and, if necessary, some control where required might assist some of these municipalities, particularly with their public awareness in and around more populated or recreational areas.

Conclusions

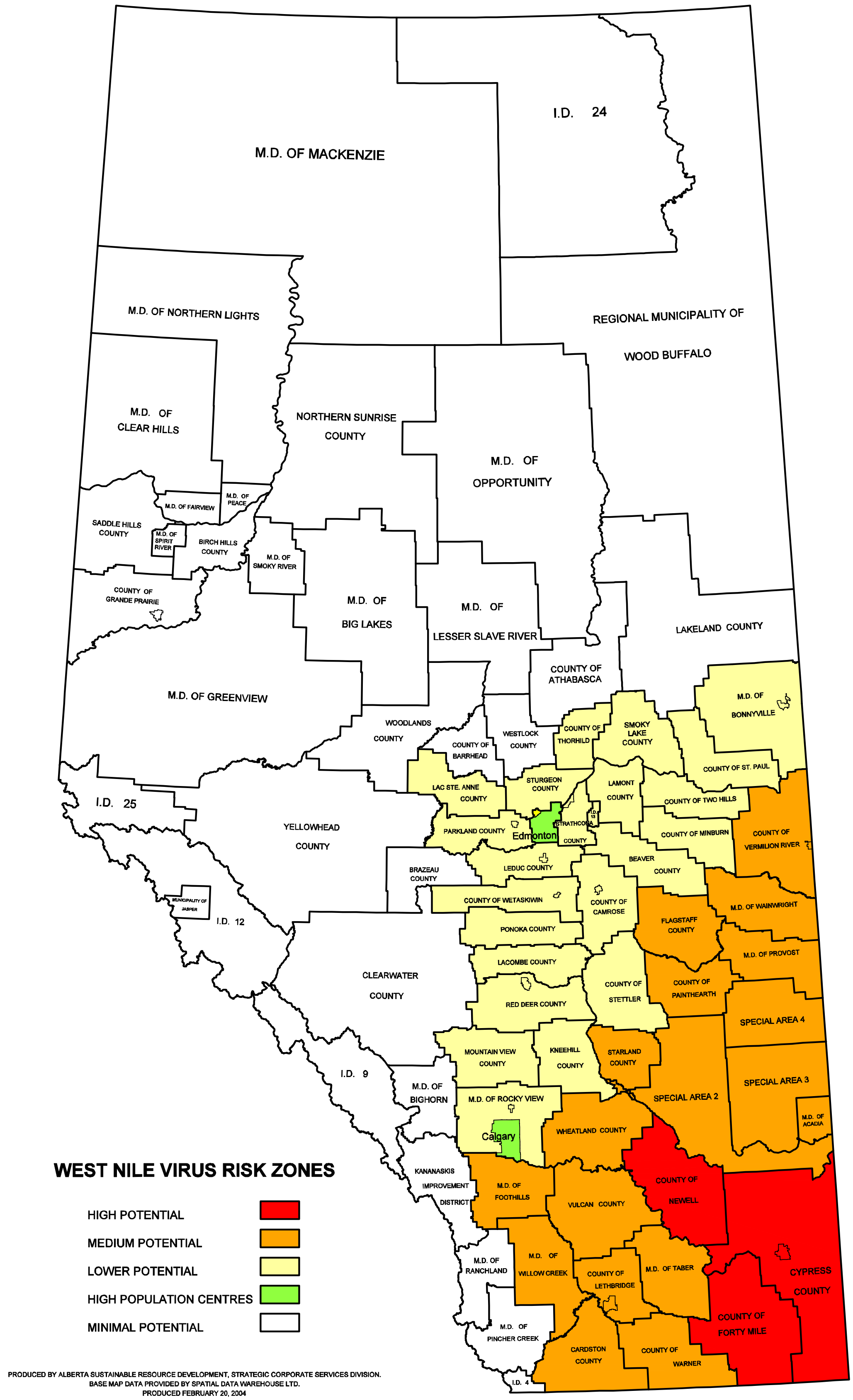
The intent of the 2004 West Nile virus Targeted Mosquito Control Program was to reduce numbers of mosquitoes known to transmit the disease to humans. The most crucial and effective means to accomplish this was to involve Alberta municipalities that could undertake control measures in and around more populated areas to protect the majority of their residents. Although the most effective strategy of protecting oneself against the disease is the use of personal protective measures, the municipalities were favorable in directing attention towards mosquito larval control to avoid the complications and issues associated with possibly spraying pesticides into the air for adult mosquito control.

The outcome of the funding in 2004 was the provision of up-to-date information of the West Nile virus to Alberta municipalities. The funding provided training on mosquito control strategies and established the foundation for longer-term mosquito control programs, if required. Mapping systems of mosquito habitats were developed for future reference, and served to specifically identify the locations where vector species were likely to develop. In addition, surveillance and chemical application equipment were obtained and experience gained in the selection and use of federally approved larvicides. Although mosquito-virus activity was suppressed in the 2005 season due to the impact of weather conditions, Alberta municipalities were not required to conduct a great degree of chemical intervention, however they were able to gain a fair degree of mosquito control program expertise.

Limiting factors that will affect the success of mosquito control programs have been identified. These factors will impact municipalities to various degrees depending on their geographical location and the presence of standing water suitable for mosquito development. As there are a number of environmental factors that will affect the success of the virus, the timing of the development of the vector mosquito, *Culex tarsalis*, appears to be consistent in Alberta. Mid-June until late August is the period where population numbers will steadily rise and their biting potential and ability to transmit disease will commence around mid-July, depending on the presence of consistently warm weather.

Municipalities have identified their willingness to continue to implement these measures while information is still being obtained about the activity of the virus in this province. It is recognized that virus activity during the 2004 season was minimal and provided time to develop experience in a new initiative.

Figure 1: West Nile virus Risk Zones



VII. Provincial Laboratory for Public Health (Microbiology)

Diagnostic Testing

Serology

In 2004, West Nile virus IgM again served as the primary diagnostic test, using a combination of 2 commercial kits. IgG testing was also performed on selected patients and convalescent samples to look for changes in antibody levels. Sera from probable cases were forwarded to the National Microbiology Lab for hemagglutination and neutralization titres, for confirmation.

A report in the literature indicated that WNV IgM could persist for over one year. A follow up study was performed in collaboration with Dr. Paul Schnee from Palliser Region, and it was confirmed that approximately 75% of the 2003 patients, tested 9 months after symptom onset, were still IgM-positive. In order to differentiate acute from past cases, convalescent sera were requested on all IgM-positive patients to assess changes in antibody levels. Ten patients in 2004 had a positive IgM test, and but only 2 were confirmed to be acute WNV infection.

Nucleic Acid Tests (NAT)

Data from 2003 showed that over 50% of WNV patients are viremic during the first week of illness, so the diagnostic strategy was enhanced in 2004 by a recommendation to test plasma on all acutely ill suspect WNV patients. There were only 2 cases in 2004, but plasma was submitted from one, and this patient was positive on two different WNV NAT tests, immediately confirming the diagnosis.

NAT testing was again performed on cerebrospinal fluids for WNV in 2004. While no WNV cases were detected, a number of enteroviral meningitis cases were identified, clarifying diagnosis. WNV NAT testing on blood and CSF will be continued for 2005 to rapidly and reliably identify WNV, as well as other organisms in the differential, as appropriate.

Serosurvey

To support the Alberta Health and Wellness WNV Seroprevalence survey, a WNV IgG kit was evaluated as a screening tool, and used to screen 2,515 sera submitted by the study team. All IgG-positive and borderline sera were forwarded to the National Microbiology Lab for the in-house CDC WNV IgG assay, and for confirmation by neutralization. (please refer to Human Surveillance Chapter)

Transplantation

NAT testing on plasma specimens was continued for 2004 on organ donors and recipients, as needed by the individual transplant programs. Testing was performed from June 1st to Dec 1st, and on request for travelers. All transplant screens were negative in 2004.

Mosquito Testing

In collaboration with Alberta Environment, NAT testing was continued for mosquito pools in 2004. Only one pool was positive this year, (*Culex tarsalis* , Vulcan).

WNV Testing Summary

Jan 1st – Dec 31st, 2004

Test	Population	Specimens		Patients		Positive patients	
		2004	2003	2004	2003	2004	2003
Serology	human diagnostic	1897	3050	1799	2353	10 IgM-positive 2 confirmed acute *	246
Serosurvey	healthy Albertans	2515	N/a	2515	N/a	35 confirmed	N/a
CSF NAT	human diagnostic	246	287	235	270	0	1
Plasma NAT	human diagnostic	801	1169	773	1128	1	89
Plasma NAT	transplant screen	598	330	544	288	0	0
Mosquito pool NAT	mosquito pools	2078 pools	1652	N/a	N/a	1 positive pool	31

NAT: Nucleic Acid Amplification Test (= PCR or NASBA)

* One case was travel related; one case was out of province.

VII. *Communications*

Alberta agreed with other Canadian jurisdictions in 2004 that in order to motivate personal protective behaviours in the public, the public had to be aware of the potential risks associated with a West Nile virus infection. Alberta's communications plan was geared to making those risks clear, and reminding the public of the risks at opportune times so they could make choices about personal protection measures.

The goals for the communication plan built upon the goals for the 2003 plan:

- Inform the public about WNv
- Provide access to reliable information and resources to guide the public and health professionals in reducing the risk of infection with WNv
- Inform agencies and stakeholders about specific strategies and responses
- Provide up-to-date information on WNv surveillance in Alberta.

Communication Strategies

A number of specific resources and communication strategies were identified and prepared for 2004. The strategy aimed to make information widely available and targeted to a variety of audiences.

A number of these resources and activities are listed below:

- A news conference and technical briefing provided members of the media with information on Alberta's provincial plan for 2004. *West Nile virus: Alberta's Response Plan (2004)* was distributed at that time, and posted to the Alberta Government website.
- A video and cd were provided to municipalities and regional health units with information suitable for presentations to community groups and the general public.
- A new URL was introduced on the Health and Wellness website – www.fightthebite.info became the Alberta Government's homepage for all information on West Nile virus, including links to resource available on other department websites, as well as Health Canada, U.S. CDC and other reputable sources. The website also provided responses to commonly asked questions.
- A public awareness campaign was developed to inform Albertans of the serious potential consequences of a WNv infection and about how to protect themselves. The campaign was built on the idea of taking a chance on every mosquito bite. Campaign materials included:
  - Brochure mailed to over 1.2 million Alberta households, physicians offices, local health units, visitor centres, MLA constituency offices.
  - Television ads: 3 three-week flights of ads province-wide during daily peak viewing periods, with a greater weight (frequency) of play in the southern, at-risk regions of the province
  - Print advertising: 4 placements province-wide, dailies and weeklies
  - Factsheets available at www.fightthebite.info

- A video and cd were provided to municipalities and regional health units with information suitable for presentations to community groups and the general public.

- Service Alberta (310-4455 throughout Alberta) and Health Link Alberta (408-5465 in Edmonton, 943-5465 in Calgary and 1-866-408-5465 elsewhere in Alberta) operators provided general WNv information as well as information on personal protective measures.
- News releases were issued with the first evidence of West Nile virus in the province for 2004, and the travel-related human case.
- Cumulative numbers of cases of WNv in birds, horses and humans and number of positive mosquito pools were posted on the Alberta Health and Wellness Web site every Friday.
- Every physician in Alberta received correspondence from the Provincial Health Office regarding the reporting processes.

The province prepared a public information campaign to raise awareness of the disease, and to give Albertans the information they would need to reduce their risk of infection. Alberta's messaging was consistent with Health Canada and other jurisdictions.

Media Relations

The Provincial Health Office was in daily contact with Health Canada and the other provinces, and we provided regular updates to the media. Evidence of disease appearing in Alberta was promptly released to ensure that Albertans knew when their risk of infection had increased. Evidence of disease was also stored on the department's Web site and updated regularly.

We launched Alberta's West Nile response for 2004 in May with a news release and a technical briefing for media. The briefing introduced the media to the four experts who developed Alberta's plan – the Provincial Health Officer, the Chief Provincial Veterinarian, the Provincial Wildlife Disease Specialist and a senior insect specialist. These four experts are the province's credible and reliable sources of information for the public.

We held other technical briefings through the summer, to announce the first positive bird, and also to announce the first human case.

Key Messages

- The risk of infection is low
- There are simple steps that Albertans can take to protect themselves.
- The government has an effective and responsive plan in place to minimize the virus's effects in Alberta.

Given the number of sources of information available, credible or not, all of the materials developed for our campaign promoted the government's Web site as a source of reliable and up to date information.

Audiences

- All Albertans
- Groups at greater risk like seniors, outside workers, and outdoor enthusiasts.
- Parents with young children.
- Stakeholders to deliver our messages – health care workers, other government departments

Public Information Campaign

FIGHT THE BITE was selected as the slogan for the campaign. It was used in Ontario and many U.S. states, so we could build on the awareness developed there.

The concepts for our campaign were influenced by the very successful Australian campaign, Slip, Slap, Slop, to raise awareness of skin cancer.

The idea of "simple steps" became the basis of our approach. Our key message became, "Protecting yourself from West Nile virus doesn't have to be complicated – by following some simple steps you can reduce your risk of infection."

The campaign components included:

- Direct mail piece – distributed to 1.2 million Alberta households, senior's lodges, long-term care facilities, and post-secondary institutions.
- Print ads – ran initially in the daily and weekly newspapers preceding the May long weekend, and in the dailies prior to each long weekend in the summer. We also ran very simple ads in senior's publications.
- Radio ads - the buy involved the four top stations in both Edmonton and Calgary, and local stations in six smaller cities and 30 towns during the same time-periods as the print advertising.
- Posters – distributed to a variety of stakeholders, including daycares, senior's lodges, fishing and hunting license offices, Travel Alberta visitor centres, summer arts festivals, outdoor recreation centres, parks and campgrounds.
- Factsheets – for children, homeowners, outdoor enthusiasts and workers, seniors. Also tips for cleaning up around the house and home and on the safe use of insect repellents.
- Point of purchase DEET reminder

All the campaign materials and detailed information on West Nile virus were located on the Web site. Detailed information includes a history of West Nile virus, symptoms to be aware of, and commonly asked questions. The Web site also provides links to other reputable sources of information, like Health Canada and the U.S. Centers for Disease Control.

Evaluation

A variety of informal measures were used to evaluate the information campaign for 2003. We monitored:

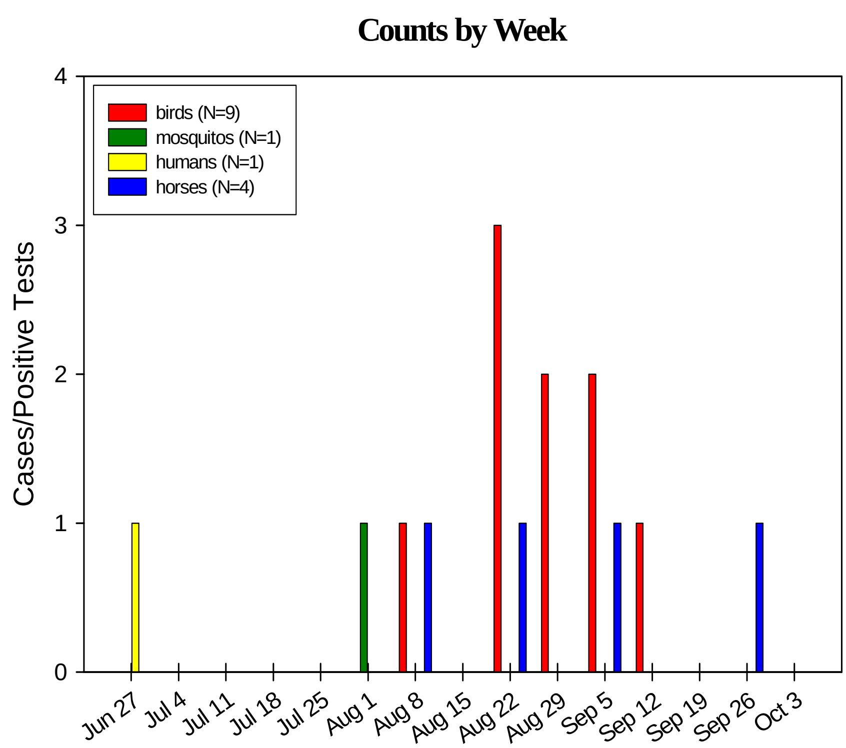
- Media coverage
- Web site visits
    - roughly 30,000 hits to our West Nile virus pages
- Phone calls to the provincial Health Link information line
- Public inquires to our ministry – letters, emails, phone calls, requests for materials
    - we had requests for over 50,000 additional direct mail brochures from major employers, schools and other jurisdictions
- Questions to determine knowledge, attitudes and behaviours around personal protection measures were also included in the serosurvey.

VIII. *Summary of Surveillance Across Species*

The second year of West Nile virus in Alberta revealed completely different patterns of infection and transmission in all species making it very difficult to predict what will happen in 2005. The combined results of the surveillance of birds, mosquitoes, horses and humans are provided in the following graphs.

West Nile virus Surveillance

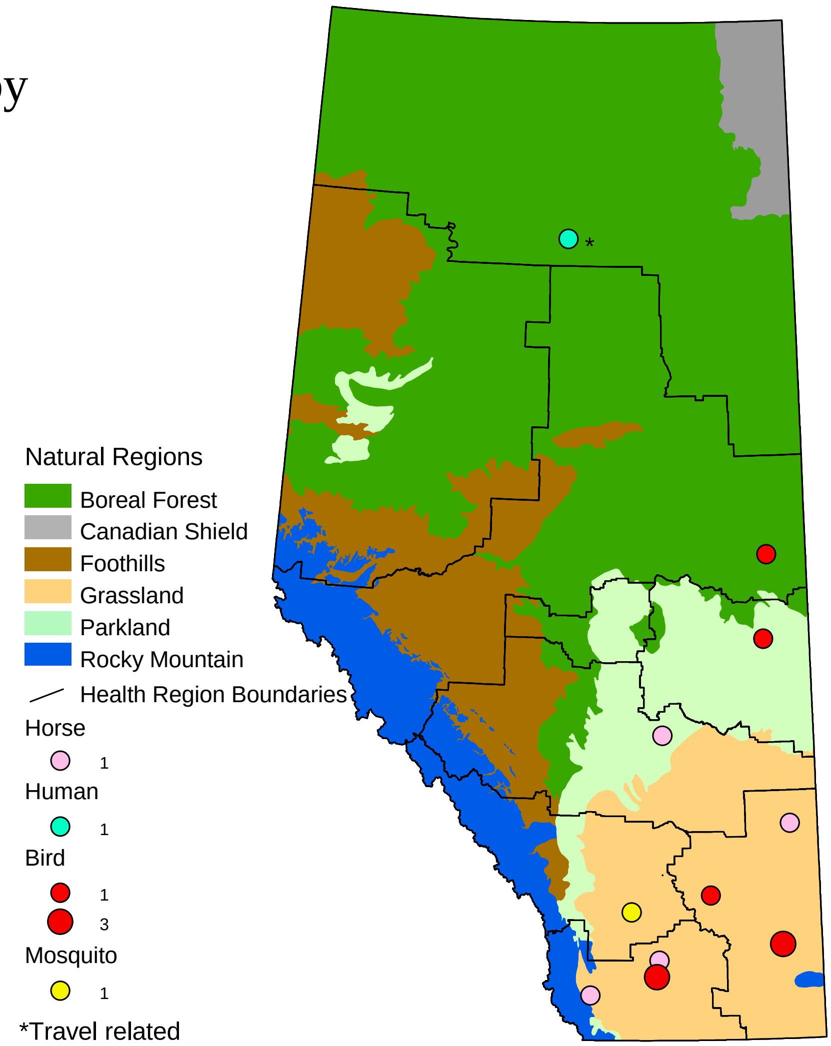
(July 3 – October 17, 2004)_

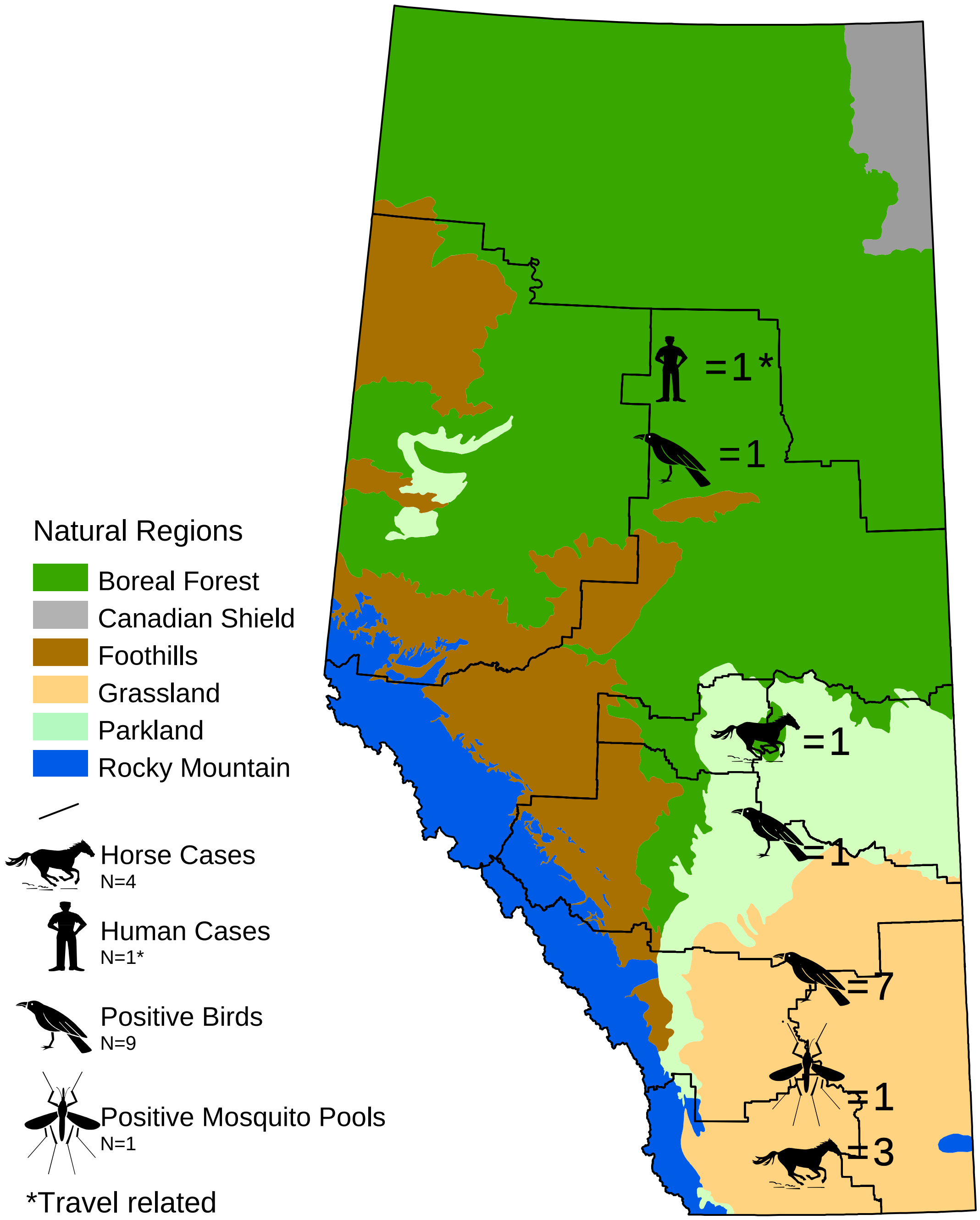


Note: Human case was travel related.

West Nile Surveillance by Natural Region

(as of September 26, 2004)




Natural Regions
Boreal Forest
Canadian Shield
Foothills
Grassland
Parkland
Rocky Mountain
Horse Cases
N=4
Human Cases
N=1*
Positive Birds
N=9
Positive Mosquito Pools
N=1
*Travel related
=1 *
=1
=1
=1
=7
=1
=3

Based on the biological factors that lay the foundation for viral transmission, there is little doubt that WNv will return to southern and central regions of Alberta in the spring of 2005. However, the potential effects of changing resistance and immunity in wild birds are unknown, and environmental conditions vary greatly from year to year. As such, the overall extent to which the viral population will build in Alberta in July and August 2005 is difficult to predict.

The actual impact of West Nile virus on wild populations of birds remains largely unpredictable across North America. While local and perhaps overall crow populations in eastern provinces and states appear to have declined in some areas, there are ample populations still present in Alberta and western jurisdictions. Mortality in other bird species has not been at the same level nor is there evidence that such mortality has been significant. There *may* be intense natural selection pressure to reduce the effects of the virus in conjunction with increased resistance in non-corvid birds and, perhaps, mosquitoes. Highly susceptible individual birds (and mosquitoes??) die and are removed from the population; resistant individuals remain to produce the future generations. Although we need to wait for further data, it may be that integration of WNv virus into North American ecosystems already is well underway.

Long-term Outlook

It is readily apparent that West Nile virus will establish populations across the continent and throughout Alberta wherever suitable bird and mosquito species exist. There is a high probability that West Nile virus eventually will occur in all states and provinces from the Atlantic to the Pacific, although perhaps at differing local levels. With its ability to circulate year-round in southern states and occasionally overwinter in some individual mosquitoes, in addition to continental transmission across a broad range of bird and mosquito species, West Nile virus is unlikely to be controlled or eradicated. Fortunately, it is a relatively benign virus and the evidence to date indicates limited direct impact on wildlife. Sporadic cases in horses and humans are likely to continue but with limited overall impact. All species will have to learn to live with West Nile virus as an integral part of the biodiversity of North America.

Acknowledgements

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Lisa Morin, Dr. Gerald Ollis, Marie McDonnell – Alberta Agriculture, Food and Rural Development
Marie Juengel, Mike Merritt and Shannon Rogalski – Alberta Municipal Affairs
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Dr. Judy Hannon, Canadian Blood Services
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- Dr. David Larson and staff, Augusta University College, Camrose
- Dion Burlock and staff, County of Vermilion River
- James Schwindt and staff, MD of Wainwright
- Burt Forbes, MD of Provost
- Brent Hoyland and staff, Flagstaff County
- Grant Moir and staff, City of Red Deer
- Kevin McDonald, County of Stettler
- Jeff Cosens, County of Paintearth
- Dug Major and staff, Special Areas Board
- Reg Bennett, Town of Drumheller
- Bruce Sommerville, Kneehill County
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- Pierre Denault, Health Canada

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- Kelly Malmberg, Vulcan County
- Ron MacKay, MD of Willow Creek
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- Matt Solberg, Town of Brooks
- Terry Schneider and staff, Town of Bow Island
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- Cam Aldridge, Jennifer Carpenter and staff, University of Alberta
- Ron Esau, City of Lethbridge
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- Rod Foggin and staff, Cardston County
- Jay Byer, Lakeland Agricultural Research Association, Fort Kent
- Diane Westerlund, Chinook Applied Research Association, Oyen

Bird Surveillance

This program could not have been completed without the significant efforts of many many Fish and Wildlife staff, particularly the district officers, wildlife biologists, and administration staff who fielded phone calls by the public and took direct action as appropriate and as possible. In addition, Lisa Yadernuk spent long hours in the lab documenting and testing dead birds throughout the summer and analyzing the results. The Interdepartmental West Nile Virus Steering Committee provided ongoing input and review of the program and the Fish and Wildlife Division managers were supportive at all times.

The program also began in most cases with a member of the public providing us with a dead corvid. Without this input, the WNv bird surveillance programs could not have happened. Their efforts, and often their patience and understanding, are gratefully acknowledged.

Cam Aldredge and Jennifer Carpenter, with assistance from Maria Olsen and Mike Swystun, largely designed and carried out the sage grouse program, in consultation with Jock McIntosh (Alberta Environment), Mark Boyce (University of Alberta), Dan Johnson (University of Lethbridge), and Steve Brecthel, Joel Nicholson, Dale Eslinger, and Margo Pybus from the Fish and Wildlife Division.

Horse Surveillance

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