SUMMARY OF WEST NILE VIRUS SURVEILLANCE IN ALBERTA 2003

ALBERTA ENVIRONMENT
ALBERTA HEALTH AND WELLNESS
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
ALBERTA AGRICULTURE FOOD AND RURAL DEVELOPMENT
PROVINCIAL LABORATORY OF PUBLIC HEALTH

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I. *Introduction*

In 2003, the Alberta *West Nile virus Response Plan* was prepared by an interdepartmental committee with the following membership:

Dr. Gloria Keays	Deputy Provincial Health Officer and Chair Alberta Health and Wellness
Mr. Jock McIntosh	Pesticide Specialist Alberta Environment
Dr. Gerald Ollis	Chief Provincial Veterinarian Alberta Agriculture, Food and Rural Development
Dr. Margo Pybus	Wildlife Disease Specialist, Fish and Wildlife Division, Alberta Sustainable Resource Development

Regional medical officers of health, communications staff and the Provincial Laboratory for Public Health (Microbiology) also provided input.

The overall goal of the plan was to minimize the risk of WNv infection in humans and horses by providing a graded response based on four risk assessment categories. Response strategies were focused on surveillance and communication.

The purpose of this technical summary is to present an overview of the surveillance programs in each department and an analysis of data collected for birds, humans, horses and mosquitoes in 2003 as well as a description of the Communication initiatives. The surveillance provided valuable information regarding the location of the virus in the province, the role of *Culex tarsalis* as a vector, WNv infection in corvids (crows and magpies) and horses and the frequency and severity of infection in humans and now forms the basis of Alberta's *2004 West Nile virus Response Plan.*

This summary is organized into chapters with data on WNv in birds, horses, humans and mosquitoes, an overview of geographical location and timing of positive WNv in all species, information on human and mosquito testing at the Provincial Laboratory of Public Health (Microbiology) and a review of the 2003 Communications plan.

Additional copies of this summary are available from the Provincial Health Office, Alberta Health and Wellness and on the Alberta Health and Wellness website.

II. *Wild Bird Surveillance*

Summary

Approximately 2300 dead birds were received during the West Nile Virus (WNv) surveillance program implemented by the Fish and Wildlife Division of Alberta Sustainable Resource Development in 2003. Nestlings were not examined and approximately 450 (20%) of the birds received were unsuitable for analysis (dry, rotten, too young, or unsuitable species). Thus testing was limited to 1843 corvids (899 crows, 835 magpies, 60 ravens, 49 blue jays). All usable corvids were tested with the VecTest, an antigen-based screening assay that was initially validated in crows and, based on data collected during this program in 2003, was later validated in magpies. In addition, 5 sage grouse, 3 goshawks, 1 swainson's hawk, 1 shrike, and 1 great horned owl were assessed for WNv using a PCR molecular test.

We confirmed WNv in 439 corvids, including 203 crows, 231 magpies, and 5 blue jays from the Grassland (n=210) and Parkland (n=190) as well as southern Boreal Forest (n=34), and eastern Foothills regions (n=1) [plus 4 positive birds from unknown locations]. Five sage grouse, 2 goshawk's, 1 swainson's hawk, 1 shrike, and 1 great horned owl were also confirmed positive. Birds were collected over a wide geographic range throughout the province, although most birds (87%) came from the Grasslands (n=779) and Parkland (n=816) areas of southern and central Alberta. No evidence of the virus was found in either the Mountain or Canadian Shield Natural regions.

A similar proportion of VecTest-positive crows (23%) and magpies (28%) were found in affected areas. However, adjusting for the reduced sensitivity of the test in magpies, the actual proportion of positive magpies tested in Alberta in 2003 may be as high as 46%. Based on VecTest results, crows were the predominant infected corvid in the Boreal region, while in the Parkland region; the proportion of positive magpies (33%) was 2X greater than the proportion of positive crows (17%). In the Grassland region, the proportion of positive crows and magpies were similar (29 and 26%, respectively).

The first positive bird was a magpie found dead on June 17. The overall time between collection and testing of individual corvids in Alberta in 2003 was 5.51 ± 4.01 days (n=1548). The number of positive birds increased steadily from mid July to a peak in late August. In August, the proportion of positive crows and magpies was consistently more than 60% of the birds tested each week.

Post mortem examinations were conducted on 196 crows (all negative for WNv), as well as 217 magpies (80 negative, 137 positive for WNv) to assess the cause of death. The majority (70%) of crows died as a result of blunt trauma. Similarly, blunt trauma was the most common cause of death of the PCR-negative magpies (40%) but only 18% of the PCR-positive magpies.

M.J. Pybus, PhD, Wildlife Disease Specialist

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 northeast 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 immuno-compromised humans (people whose immune systems do not work as well as they should).

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.

In broad areas across the southern US, *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 the first cases of infected birds in Mexico as well as Central and South America were detected in 2003. 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.

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

Alberta Health and Wellness
http://www.health.gov.ab.ca/healthier/diseases/west_nile.html

Alberta Agriculture, Food and Rural Development
http://www.agric.gov.ab.ca/surveillance/west_nile_virus.html

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

Alberta's WNv Program

Building on the successful West Nile surveillance program of 2002, representatives from four provincial departments (Alberta Health and Wellness, Alberta Agriculture, Food and Rural Development, Alberta Environment, and Alberta Sustainable Resource Development) prepared a provincial response plan for 2003 to address the potential risks posed by West Nile virus in Alberta. The plan contained two primary components: communication and surveillance. Communication occurred largely through the ***Fight the Bite*** public awareness campaign and information provided in departmental web pages and fact sheets (see above) 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, Alberta Environment monitored adult mosquitoes 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.

This chapter provides data only from the wild bird component of the provincial West Nile virus surveillance program. In 2003, 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 were received. Fresh dead birds collected by the public were dropped off at any Fish and Wildlife office.

Fresh or frozen birds were transported or sent to the Fish and Wildlife Division's Wildlife Disease Laboratory in Edmonton. Birds were thawed and then tested with a VecTest strip. Initial positive birds were sent to the diagnostic laboratory of B.C. Agriculture in Abbotsford, B.C. for confirmatory testing with a DNA-based polymerase chain reaction test (PCR).

Bird Surveillance Data

Species composition

Over 2300 birds were received for West Nile testing between May and October 2003. Information from 1843 corvids from 5 of 6 natural regions within the province was logged into the surveillance data file. The remaining birds (20%) 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%), primarily crows and magpies (94%). A few ravens and blue jays were received as well as one or two individuals of various other species. Specifically, 5 sage grouse, 3 goshawks, 1 swainson's hawk, 1 shrike, and 1 great horned owl 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 Testing Results

Corvid*s*

West Nile virus was found in 439 of 1843 (24%) corvids tested (Table 1). Crows and magpies accounted for 99% of the infected corvids, with similar numbers of positive crows and magpies and similar incidence of infection (23% of 899 crows tested, 28% of 835 magpies). However, given the 74% specificity of the VecTest in magpies (see *Diagnoses* below), approximately 25% of the 604 VecTest negative magpies likely were infected, thus adding another 151 positive magpies and changing the adjusted positivity rate in magpies to 46% of 835 tested. In addition, 10% of 49 blue jays were infected (using the VecTest sensitivity as for crows). The virus was not found in any of the 60 ravens tested.

The positive corvids were collected throughout the Grassland (48%) and Parkland (43%) natural regions of central and southern Alberta and stretching northwards into the southern Boreal Forest fringe (8%) from Athabasca to Cold Lake (Figure 1). Only one positive crow was found in the Foothills natural region. Viral activity was not found in the northern forests and Peace River country nor in the Mountain natural region.

Non-corvids

Five sage grouse, 2 goshawks, 1 swainson's hawk, 1 shrike, and 1 great horned owl were also confirmed positive for WNv. WNv was found throughout various tissues of these birds and was considered the direct cause of death.

Other Species (Non-birds)

Note that in other components of the provincial surveillance program, Alberta Environment detected West Nile virus in 31 separate pooled samples of mosquitoes collected throughout central and southern Alberta. Thirty of these samples contained infected *Culex tarsalis*. Alberta Agriculture, Food and Rural Development identified WNv as a provincially-reportable disease and received reports of 170 positive horses throughout the Parkland, Grassland, and Boreal natural regions. The number of human cases began to rise in late August and Alberta Health and Wellness documented 275 confirmed cases as of 2 January 2004. Cases generally were concentrated in southeastern and central Alberta, reflecting the distributional pattern seen in birds, mosquitoes, and horses.

Geographic Distribution

Most of the tested birds were found sick or dead in the Grassland (42%) and Parkland (44%) natural regions (Table 1) and largely reflected the presence of urban centers (Table 2). The number of crows and magpies collected were similar in these two natural regions (Table 1). The 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 Jasper 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

The WNv bird surveillance program in 2003 ran from May 1 to September 30, although a few birds collected in April were tested (Figure 2). The average time between collection and testing was 5.51 $\pm$ 4.01 (n=1548). Bird submissions were tracked on a weekly basis. Overall, there was a slow rise in the number of birds submitted in April, May, and June, followed by a steep peak in early July, and a subsequent slow decline through August and September. The first positive bird was collected near Medicine Hat on June 17 (week 25) (Figure 3). The number of positive birds rose steadily from mid July, peaked in late August and steadily declined through September. There was a decline in the actual number of positives in the third week of August (week 34) but this reflected the decreased number of birds submitted in that week. However, the proportion of positive birds per week was consistently high throughout August (over 60% of the birds tested each week) (Figure 4). The timing of dead birds and positive birds was similar in Grassland, Parkland, and the southern Boreal regions and reflected the overall pattern described above (Figure 5, 6). However, the number of positive crows was consistently higher in the Boreal region and lower in the Parkland than the number of positive magpies. Similar numbers of positive birds of both species were seen in the Grasslands region.

Diagnoses

In conjunction with the Canadian Cooperative Wildlife Health Centre in Saskatoon and Health Canada in Winnipeg, the VecTest was validated for magpies. A total of 226 magpies (113 VecTest-positive, 113 VecTest-negative) from Alberta were assessed using PCR analysis of tissue samples of brain, heart, and kidney. Test specificity was 100% (113 of 113 positive), while test sensitivity was 74% (29 of 113 were false negatives). Thus the VecTest failed to detect 25% of the actual number of positive magpies.

Post mortem examinations were completed on 196 WNv-negative crows selected to represent the overall spatial and temporal distribution of corvids submitted for virus testing. Trauma was the primary cause of death in 86% of the crows examined (70% blunt trauma, 12% gunshot wounds, 4% predation) (Table 3). Less than 10% had no visible lesions (NVL) or, in other words, no visible cause of death. Post mortem assessment of WNv-positive crows was not conducted.

Post mortem exams were completed on negative and positive magpies sent to Saskatoon. Trauma was the primary cause of death in the 80 magpies confirmed negative by PCR (40% blunt trauma, 9% internal congestion, 8% cranial congestion, and 6% gunshot wounds) (Table 4). An additional 26% showed no visible lesions. Of the 137 PCR-positive magpies, most of the birds had no visible lesions (48%), while 28% had cranial congestion, and only 18% had signs of blunt trauma (Table 5).

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, and the Central Flyway in 2002 and 2003. This movement resulted in a steady geographic expansion of infections in birds, horses, and humans from the northeastern US in 1999/2000, to the area east of the Mississippi River (including southern Ontario) in 2001, and the area east of the Rockies (including southern Saskatchewan, Manitoba, Ontario, Quebec as well as Nova Scotia) in 2002.

Thus, there was reason to believe that spring migration in 2003 would bring the virus back to northern states and provinces including for the first time, Alberta. As a result, West Nile virus surveillance of wild birds in Alberta in 2003 was designed to detect the presence of the virus and thus the potential for health risks to humans and horses in the province. Indeed this appears to be exactly what happened. The efficiency of natural systems apparently provided suitable conditions for the virus to transfer from the spring migrating birds and establish local viral populations in *Culex tarsalis* and summer birds which then amplified over time. Bird surveillance data indicate that the virus was established in Alberta as early as mid June in the southern grasslands. Magpies are year-round residents and the dead magpie found in Medicine Hat in June was either bitten by an infected mosquito or perhaps ate a number of infected small birds. The viral population subsequently increased temporally and spatially in birds throughout the summer. By the end of the summer, there was evidence of extensive viral activity widespread in the area bounded by the Highway 16 corridor on the north and the Highway 2 corridor on the west. Within this area of central and southeastern Alberta, crows and magpies were equally useful as sentinel indicators of presence of the virus and preceded the occurrences of WNv in horses, humans, and mosquitoes.

Based on the biological features of WNv transmission and the limitations of weather and climate on the development of *Culex tarsalis,* the concentration of viral activity in the grasslands and parklands of Alberta is fully predictable. Within these regions there is a coming together of all the components necessary to sustain the virus and to provide a suitable sentinel system of detecting its presence: an abundance of early migrant birds and then a subsequent addition of naïve birds which fledge from the nest, an ever increasing population of suitable mosquito vectors throughout the summer, hot dry weather conditions that promote rapid *Culex* development, an abundant population of susceptible crows and magpies, and random clusters of people who could find the dead birds. Throughout the entire month of August, these factors were all at peak levels in southern and central Alberta and as a result over 60% of the crows and magpies turned in each week in August were infected. The pattern in human infections, as reported by Alberta Health and Wellness, indicated the majority of infected people were exposed from late July through August, when viral populations are at their peak throughout the grasslands and parklands.

The provincial West Nile virus Response Plan was based on passive surveillance of birds found dead by the public. In particular, people were encouraged to submit fresh-dead crows and magpies to any office of the Fish and Wildlife Division. Information was provided regarding appropriate precautions when handling any wild animal found dead of unknown causes. These were general precautions and did not reflect a specific concern from handling birds dead 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 provided appropriate means to detect the presence and activity of the virus. Transmission of WNv was later confirmed in horses, mosquitoes, and humans throughout the same area where dead corvids were found, an area consistent with the general distribution of *Culex tarsalis* and environmental conditions suitable for the virus to maintain a summer population.

It is of interest that 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 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.

The finding of WNv in predatory raptors (birds of prey) was not unexpected. Although we will never know for sure exactly how these birds were infected, it is likely that they ate a number of small birds that themselves were infected with WNv. Immature goshawks, for example learn to hunt by catching small, less agile birds. Small birds infected with WNv may be easier to catch and thus the young goshawks are exposed to greater amounts of live virus, sufficient to establish infection in some individuals. There was no evidence that significant numbers of raptors died as a result of WNv infection in Alberta last year.

On the contrary, the WNv infections in sage grouse are more disconcerting. Sage grouse are listed as endangered in Alberta and the current provincial population estimate ranges from 300-400 birds. The mortality in local sage grouse populations from late July to mid August 2003 was significantly higher than in previous years (Cam Aldredge, University of Alberta, pers. comm.). Similar alarming results were seen in Wyoming and Montana in 2003. It may be that sage grouse are exposed to greater amounts of virus as they move to specific waterbodies on the hot dry prairie just as the population of *C. tarsalis* and the number of infected mosquitoes reach a peak in mid to late summer. Discussions are underway to determine whether management intervention is appropriate to reduce the risks to sage grouse.

Future Outlook

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 2004 and will follow the same general pattern of increase through the summer. However, the potential effects of changing resistance and immunity in wild birds are more difficult to predict. As such, the overall extent to which the viral population will build in Alberta in July and August is unknown.

The WNv bird surveillance program will again be used in 2004 to identify when the virus returns. Once 5 or 6 positive corvids have been detected in the Grassland and Parkland natural regions, further bird surveillance will be discontinued so that the program can focus on northern and western areas where the virus was not found in 2003 and it is not yet known whether the virus can establish a population.

The actual impact on wild populations of birds remains largely unknown. The local and perhaps overall populations of crows in eastern provinces and states appears to have declined in some areas. However, 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 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

This program could not have been completed without the significant efforts of many Fish and Wildlife staff, particularly the district officers, wildlife biologists, and administration staff who fielded countless calls by the public and took direct action as appropriate and as possible. In addition, laboratory technicians Chris Onderka and Laura MacPherson spent tireless long hours in the lab documenting and testing the mountains of dead birds that appeared throughout the summer. 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 bird surveillance programs could not have happened. Their efforts, and often their patience and understanding, are gratefully acknowledged.

Table 1: Incidence (%), species composition, and geographic distribution of West Nile virus in corvids tested by VecTest in Alberta in 2003.

	Boreal (north)	Foothills (west)	Grassland (south)	Mountain (far west)	Parkland (central)	Unk-nown	Species TOTAL
Blue Jay	1 of 4	0 (1)*	11 (19)	0	8 (25)	0	10 (49)
Crow	26 (107)	8 (12)	29 (376)	0 (13)	17 (386)	2 of 5	23 (899)
Magpie	10 (50)	0 (2)	26 (379)	0 (22)	33 (380)	2 of 2	28 (835)**
Raven	0 (22)	0 (3)	0 (5)	0 (5)	0 (25)	0	0 (60)
Geographic Total	19 (183)	6 (18)	27 (779)	0 (40)	23 (816)	4 of 7	24 (1843)

* % infected (number tested) ** adjusted positive rate is 46% of 835. See details in text.

Table 2: Primary source of birds positive for West Nile virus in Alberta in 2003.

Species	WNv Positives	%	Natural Region
Edmonton	95 of 326	29	Parkland
Greater Edm*	128 of 488	26	Parkland
Lethbridge	34 of 92	37	Grassland
Medicine Hat	27 of 67	27	Grassland
Calgary	35 of 293	12	Grassland
Overall	439 of 1843	24	5 of 6 regions

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

Table 3: Post mortem results of sampled WNv-negative crows in 2003

Diagnosis	Number examined	% of those examined
Aspergillus [respiratory fungus]	1	<1
Blunt Trauma	136	**70**
Emaciation	4	2
Gall Bladder Inflammation	1	<1
Gunshot	24	**12**
Miscellaneous Bacterial infections	6	3
Myiasis	1	<1
No Visible Lesions	15	**8**
Predation	8	**4**
TOTAL:	**196**	**100**

Table 4: Post mortem results of confirmed PCR-negative magpies collected in Alberta in 2003

Diagnosis	Number examined	% of those examined
Autolyzed (unsuitable)	8	10
Blunt trauma	32	**40**
Cranial congestion	6	8
Electrocution	1	1
Gunshot	5	**6**
Internal congestion	7	9
No Visible Lesions	21	**26**
TOTAL:	**80**	**100**

Table 5: Post mortem results of confirmed PCR-positive magpies in 2003

Diagnosis	Number examined	% of those examined
Autolyzed (unsuitable)	8	6
Blunt trauma	25	**18**
Cranial congestion	38	28
Internal congestion	1	<1
No Visible Lesions	65	**48**
TOTAL:	**137**	100

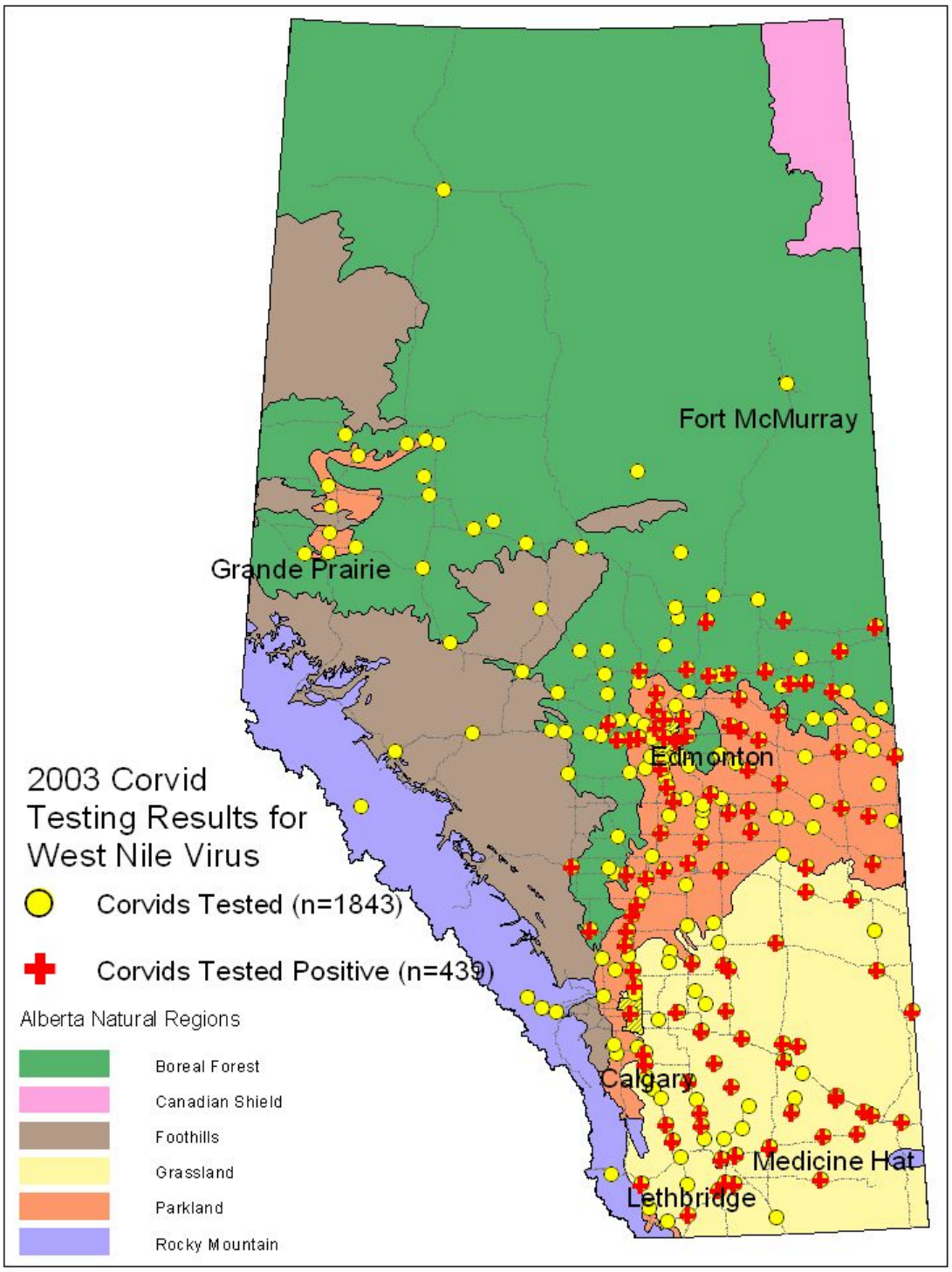


Figure 1. Distribution of corvids tested for West Nile virus in natural regions of Alberta in 2003.

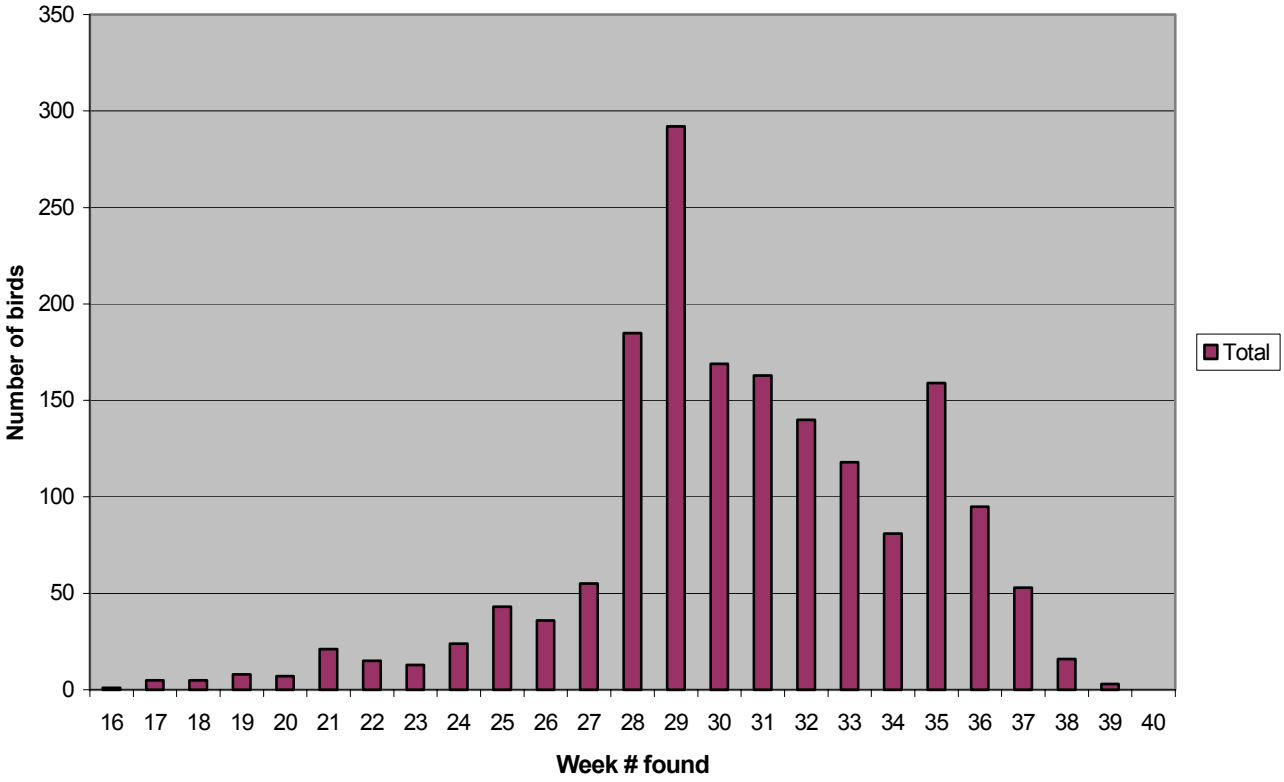


Figure 2: Weekly collection of corvids tested for West Nile virus in Alberta in 2003.

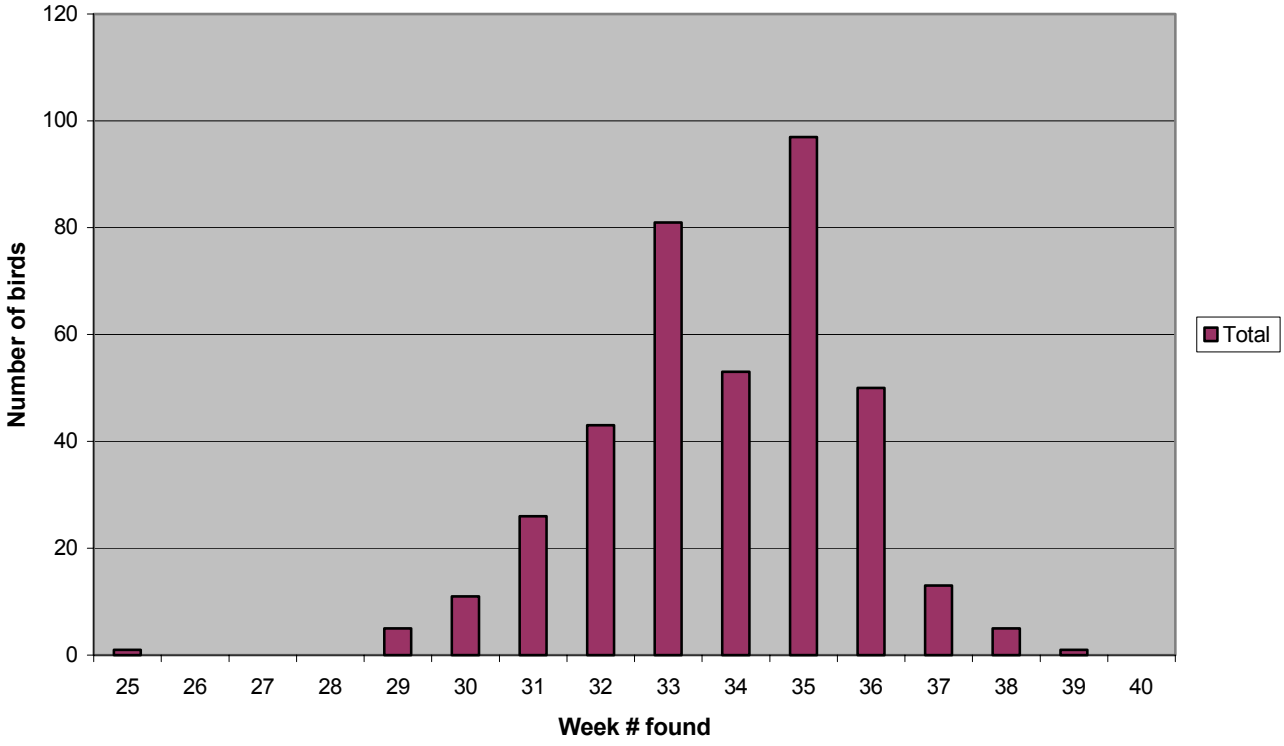


Figure 3: Weekly collection of corvids positive for West Nile virus in Alberta in 2003.

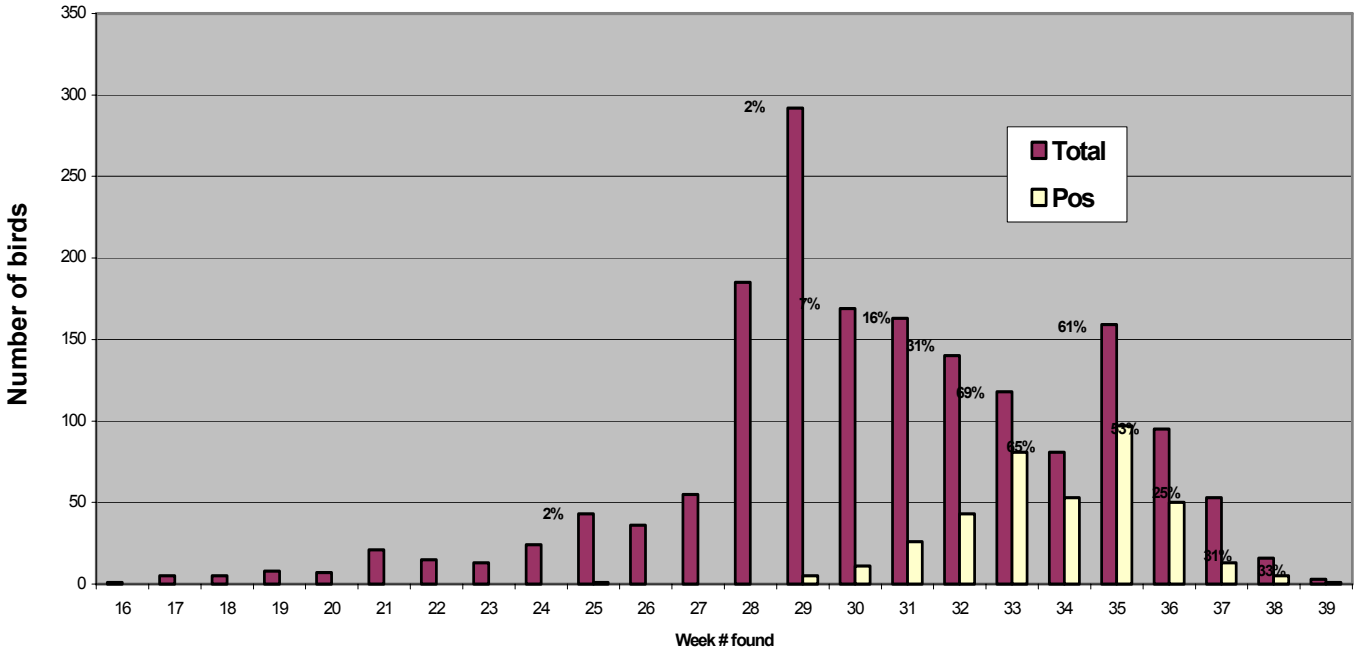
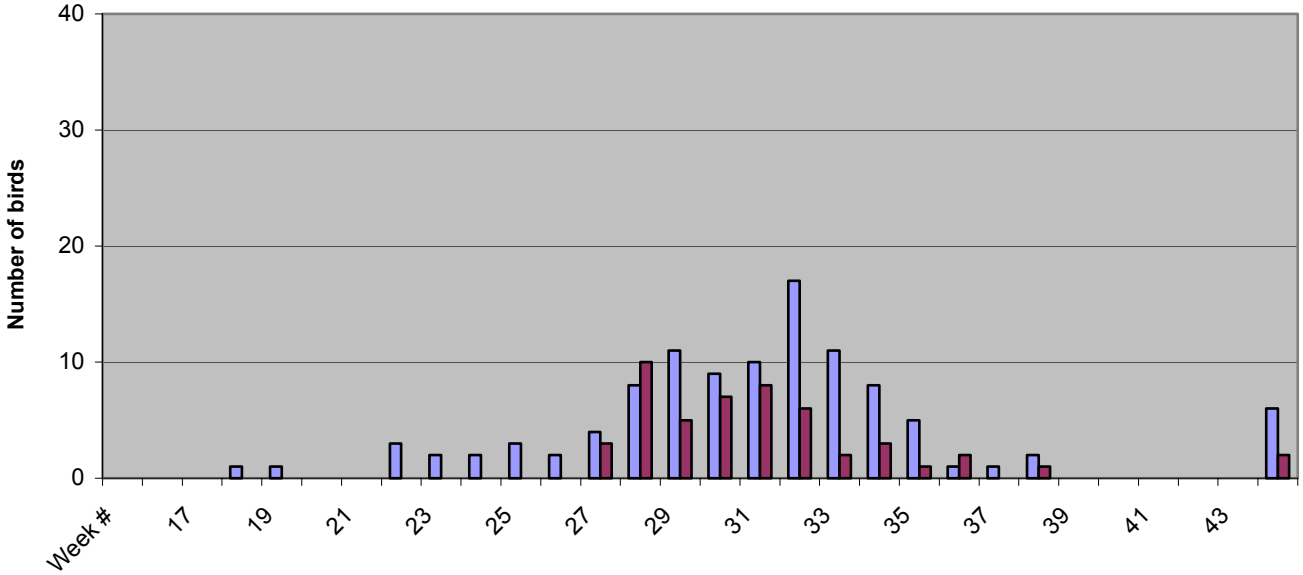


Figure 4. Weekly proportion of corvids positive for WNV in Alberta in 2003.

5a) Boreal



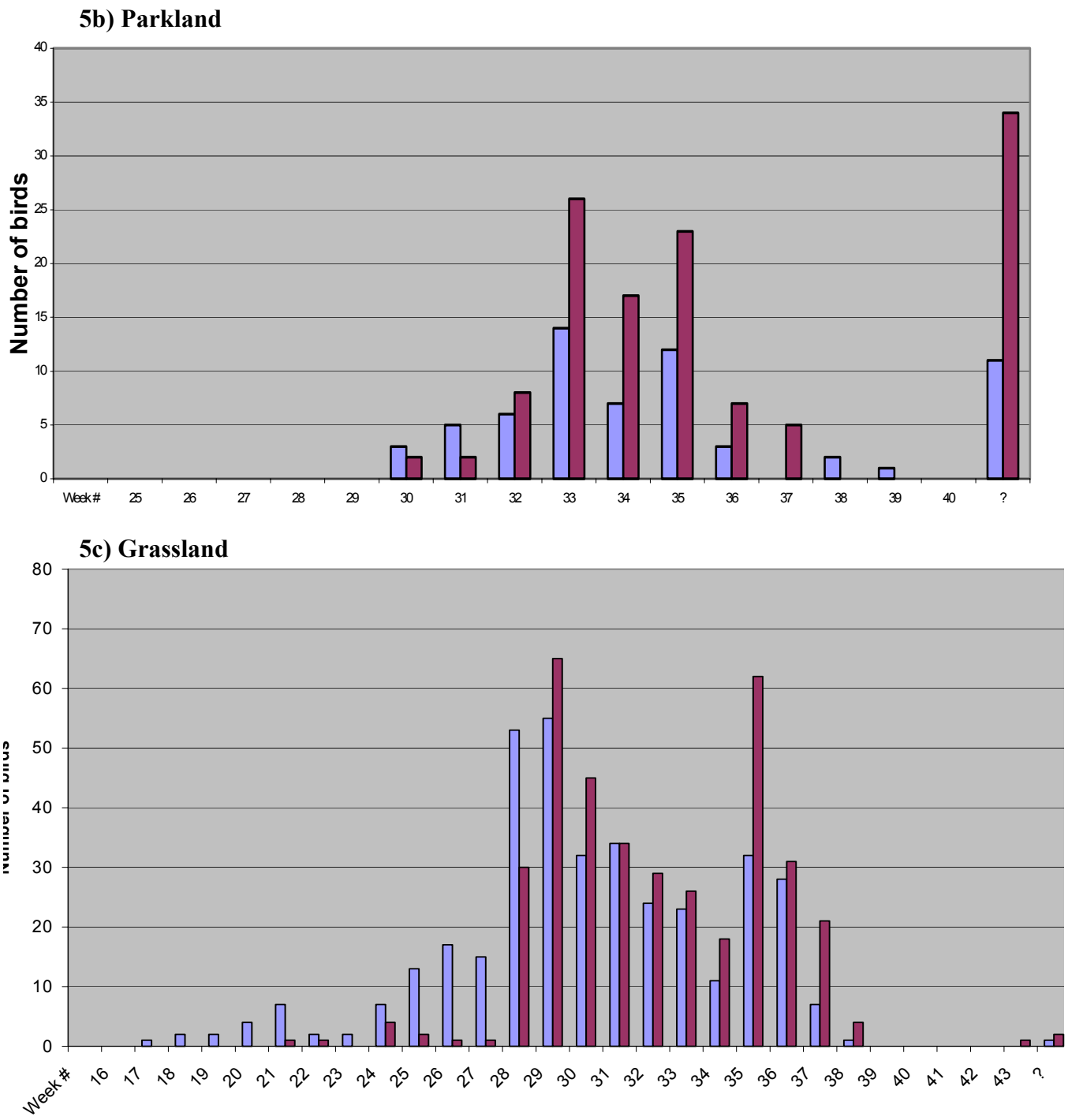
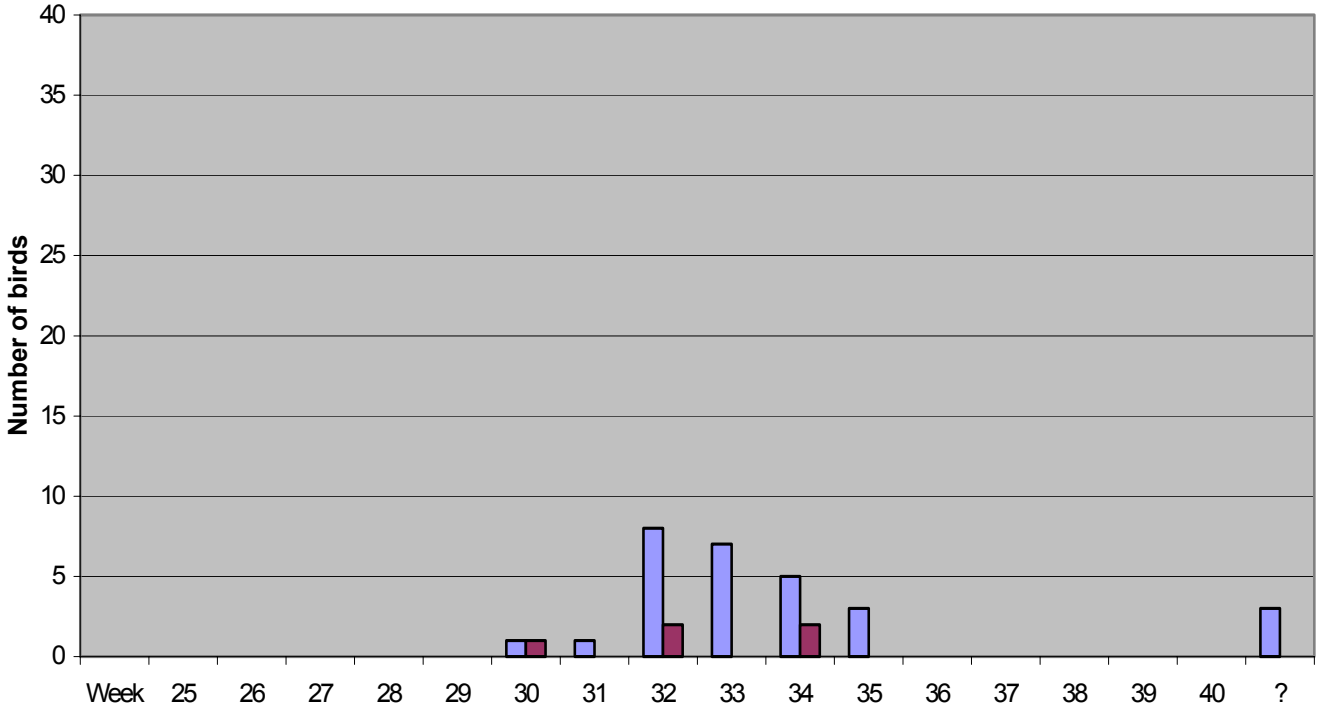
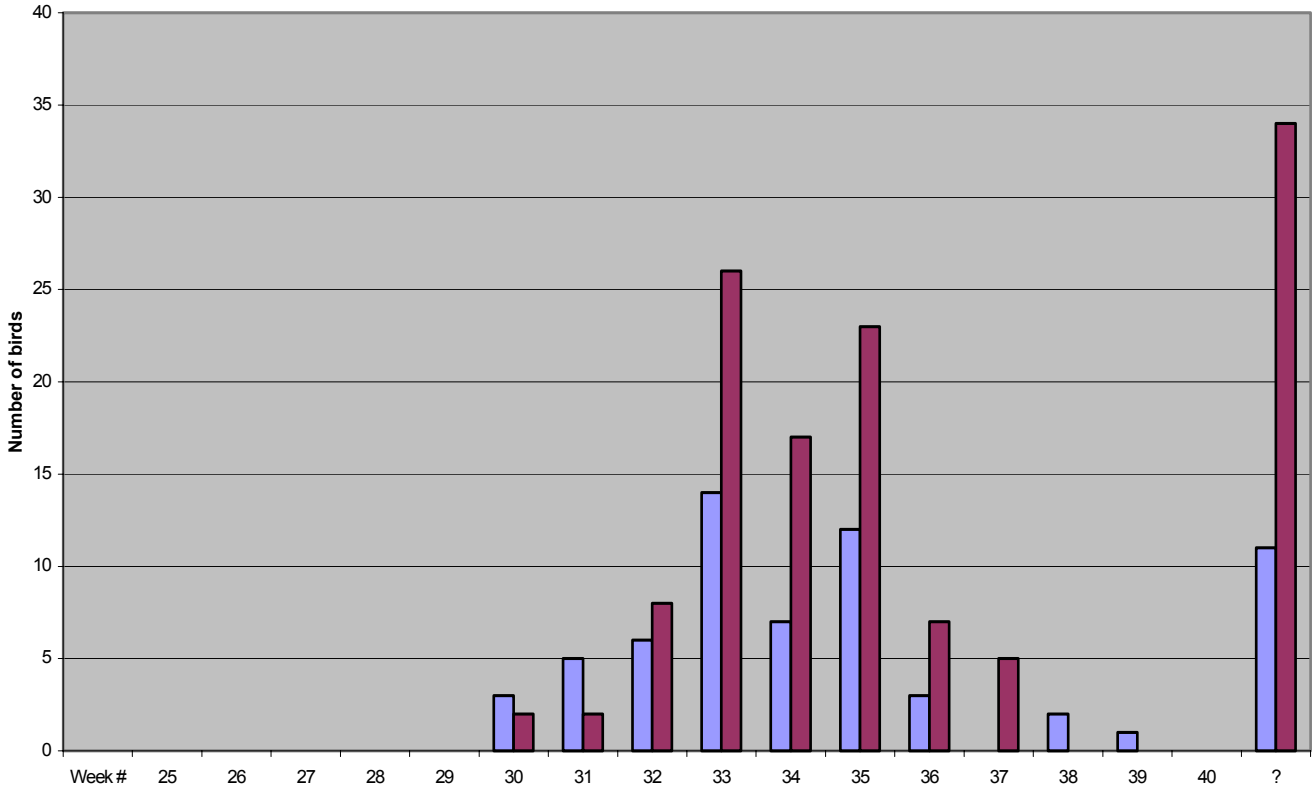


Figure 5. Weekly collection of crows ? and magpies ? in three natural regions of Alberta in 2003:
a) Boreal, b) Parkland, c) Grassland Natural Regions.

6a) Boreal



6b) Parkland



6c) Grassland

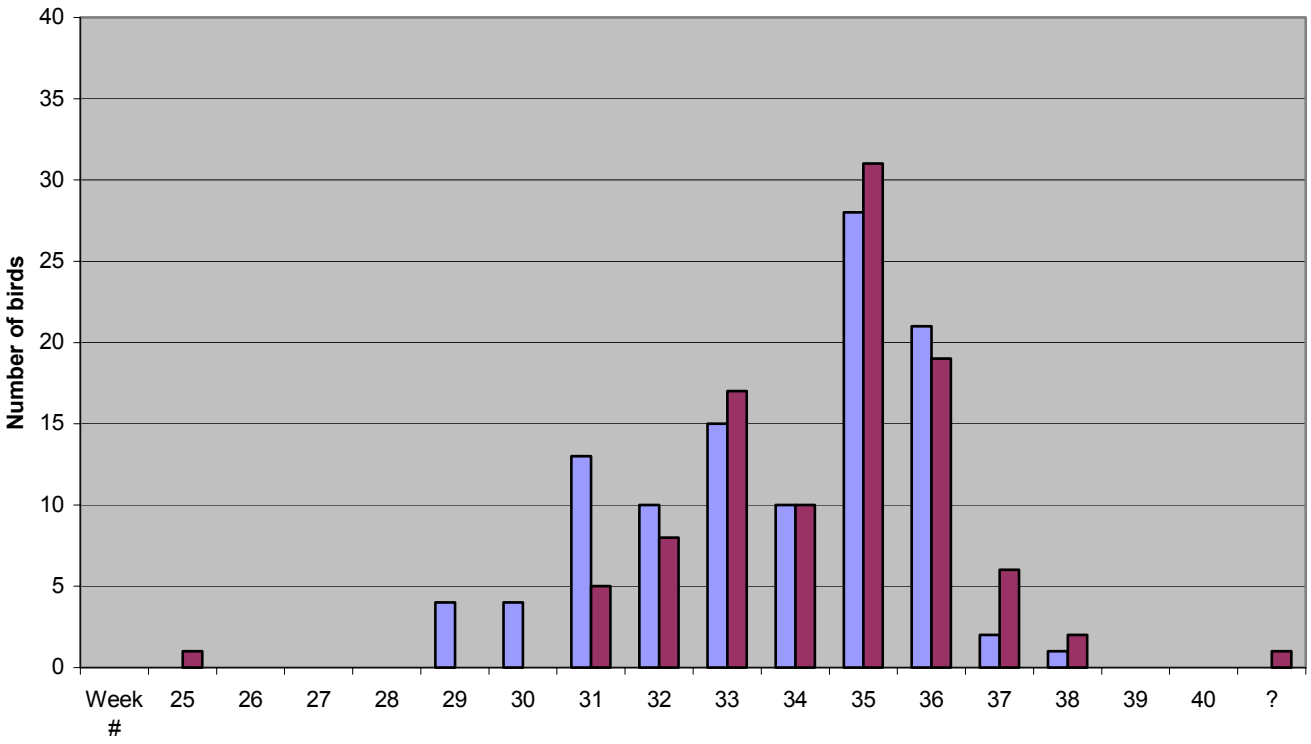


Figure 6. Weekly collection of WNv-positive crows ? and magpies ? in three natural regions of Alberta in 2003: a) Boreal, b) Parkland, c) Grassland Natural Regions.

For further information re WNv bird surveillance email Dr. Margo Pybus at margo.pybus@gov.ab.ca

III. *Horse Surveillance*

Introduction

West Nile virus (WNv) affects the central nervous system in humans, birds and horses, causing mild to severe illness and sometimes death. The virus is spread by mosquitoes that become infected by feeding on, infected birds. First reported in Uganda in 1937, WNv is widespread in most of Africa and Eurasia. In 1999 it was identified in North America for the first time and scientists believe that it is now here to stay. Alberta detected its first cases in humans, birds and horses in 2003. The *Culex tarsalis* species of mosquito is responsible for spreading the virus in Alberta.

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 rather eliminate the virus uneventfully. Symptoms of WNv can include weakness, fever, lack of co-ordination, 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.

In 2003, WNv in horses became a provincially reportable disease, under Alberta's *Livestock Diseases Act*. This requires all suspected or confirmed cases to be reported to the Chief Provincial Veterinarian (CPV). Private veterinary practitioners were asked to complete an initial survey when a case was suspected, and then a follow-up survey if the case was laboratory confirmed as positive. Questions focused on clinical signs, environment and whether preventive measures were in place, in hopes of providing some insight into the epidemiology of WNv in Alberta.

WNv in all species of animals is also Immediately Notifiable under Canada's *Health of Animals Act.*

Objectives

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

- determine the number of horses affected with WNv in Alberta in 2003,
- explore the distribution of risk factors involved, and
  determine the use and effectiveness of preventive measures.

Methods

As WNv is a reportable disease in horses in Alberta, all veterinary practitioners who examined a horse with suspicious clinical symptoms were required to report those findings to the Chief Provincial Veterinarian. Once a suspected case was laboratory confirmed as positive, a survey was sent to the practitioner to explore possible associated risk factors. If the case was laboratory negative, the survey was not sent out.

Results

The first suspected case of WNv in horses was reported in late July 2003, with reporting continuing until November 2003. During 2003, private veterinary practitioners reported 222 cases of possible WNv infection. Of the cases reported, 170 horses were laboratory confirmed (IgM Elisa serology) with WNv, 30 horses were laboratory negative, two were reported as suspicious and 20 owners declined further testing. Of the 170 horses laboratory confirmed with WNv, 111 recovered from the viral infection and 59 animals (34.7 percent) died or were euthanized due to complications associated with the disease. Of the 222 horses reported for possible WNv infection, 21 practitioners/owners reported that the horse had been vaccinated for WNv, although the details of the vaccination protocol were not provided. Of the horses vaccinated, 11 were laboratory confirmed with WNv and four (36 percent) died.

Clinical Findings

To assess the clinical findings of WNv infection, practitioners were asked if the horse demonstrated specific clinical signs (Figs. 1 to 3). Of the 163 completed or partially completed surveys with regards to clinical findings, 19 (12 percent) horses had an elevated body temperature. One hundred forty-two (88 percent) horses demonstrated signs of weakness with 74 (47 percent) unable to rise to a standing position. Eleven (7 percent) horses showed signs of head pressing and 37 (24 percent) horses were hypersensitive to sound. Muscle tremors were seen in 99 horses (62 percent), eight (5 percent) horses showed signs of blindness, and 13 (8 percent) horses had seizures. Loss of appetite was seen in 44 (28 percent) horses, with 102 (65 percent) reported cases of depression. Sixty-five (44 percent) cases reported paralysis of hind limbs and 86 (54 percent) horses demonstrated muzzle twitching. Signs of hyperexcitability were seen in 40 (26 percent) horses and 11 (7 percent) horses exhibited circling. Three (2 percent) horses were already comatose when examined. Any given animal may have exhibited numerous clinical signs, so the total percentage reported exceeds 100 percent.

Though actual numbers are too small for meaningful statistical comparison, the graphical comparison of animals that recovered to those that died, relative to their clinical signs (Fig. 3) reflects, not surprisingly, that those with more severe clinical symptoms were less likely to recover. Additional comparisons (for example, between vaccinates and non-vaccinates) included too few animals to suggest trends.

Risk Factors---Environmental

To determine possible risk factors associated with exposure to WNv in horses, the survey focused on environmental conditions, travel history and mosquito control measures (Figs. 4 to 6). Of the 157 surveys completed or partially completed with regards to possible exposure to risk factors, 76 horses had access to a natural water source such as a dugout, slough or creek and 64 horses had access to areas of bush. Both of these types of areas are expected to have higher concentrations of mosquitoes, thus increasing the possibility of exposure to WNv. Practitioners/owners were asked if there was any form of mosquito control in place and only three reported some sort of mosquito control used.

Practitioners/owners were asked if the affected horse had exposure to other horses in the area and if these horses had shown clinical signs of possible WNv infection. Of the 157 laboratory confirmed horses, 145 had contact with other horses and 12 other horses had shown clinical symptoms of infection.

Since wild birds such as crows, magpies and blue jays are quite susceptible to the effects of WNv infection, large numbers of deaths of these birds in an area may be an indication of the arrival of WNv. Thirty-five practitioners/owners reported dead wild birds in the area. Twenty-six practitioners/owners reported that the affected animal had traveled off the premise in the three weeks before clinical symptoms were noticed. Virtually everyone who completed the survey reported that the affected horse was housed outside during the day and in the early mornings/late evenings most of the time.

Risk Factors---Horse Age/Breed

When examining the range of age of laboratory confirmed horses, the greatest number of horses affected were those that were six to 10 years of age. Sixty-seven percent of these recovered from the infection (Figs. 7 and 8). While the age distribution of Alberta horses is not available for comparison, it is interesting to note that horses under 15 years of age had a better chance of recovery than those that were older. Quarter horses were the breed most affected by WNv in Alberta last summer (Fig. 9). When those affected were compared as a percentage of the approximate population by breed within Alberta (Agriculture Statistics Yearbook), the breed with the largest proportion affected was the Arabian, but there were minimal differences among the major breeds (Fig. 10).

Geographic Distribution

The geographic distribution of suspected WNv cases according to the health authority region and laboratory confirmation is shown in Figure 11. Figure 12 maps the location of laboratory confirmed positive cases in Alberta in 2003 according to health region. Most horses suspected of having WNv in Alberta were located in the East Central (34), Calgary (29) and Capital (29) health regions. This distribution reflects the owner's address, which may not have been the same as the location of the affected animals. While a legal land description was provided, it was not translated into regional health authority distribution.

Conclusion

In 2003, there were 222 horses suspected of having WNv in Alberta. Of these, 170 were laboratory confirmed as positive for the disease and 59 (34.7 percent) of these died.

The 2003 study of WNv in horses was an initial attempt to describe the disease in Alberta horses once it had been detected in the province and will provide the basis for future investigations. A second study will be conducted in 2004 to add to the knowledge learned from the results obtained in 2003.

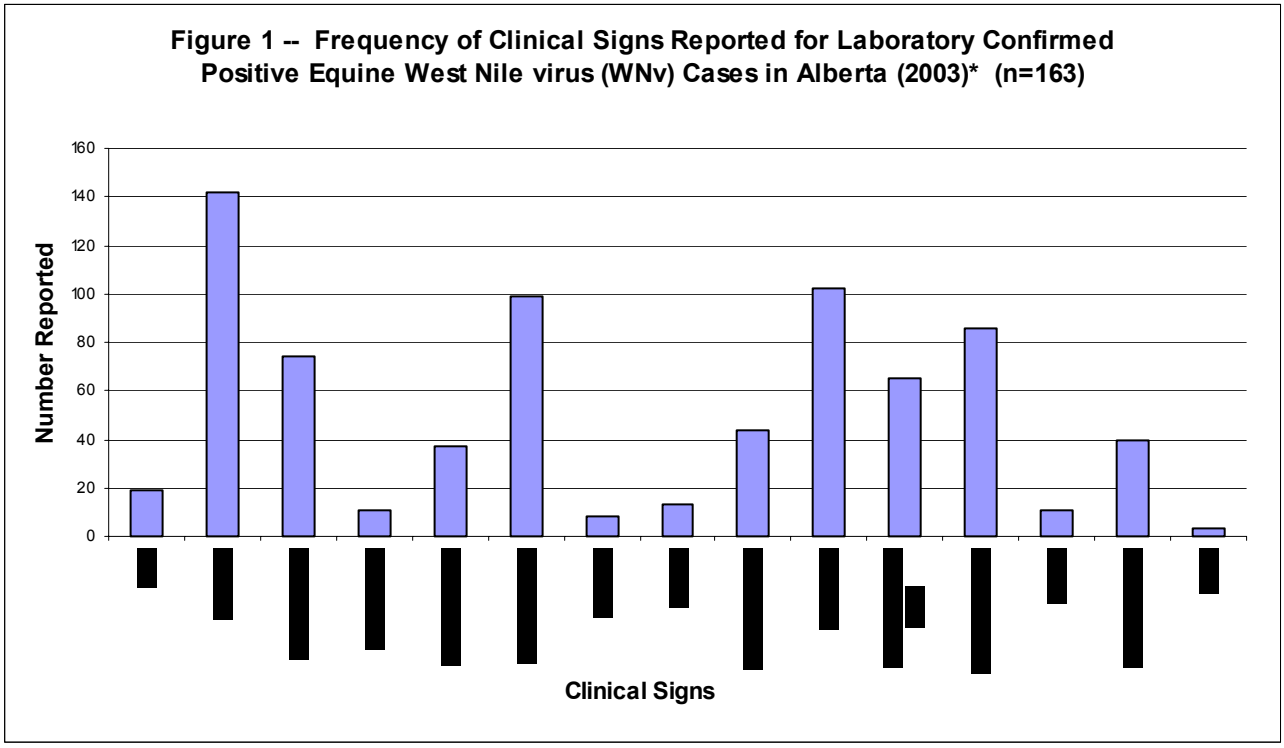
Acknowledgements

The Chief Provincial Veterinarian's Office would like to thank the veterinary practitioners of Alberta who took the time to complete surveys and submit them to our office, the horse owners for their cooperation and the Alberta Veterinary Medical Association (AVMA) for their assistance in publicizing and distributing the 2003 survey.

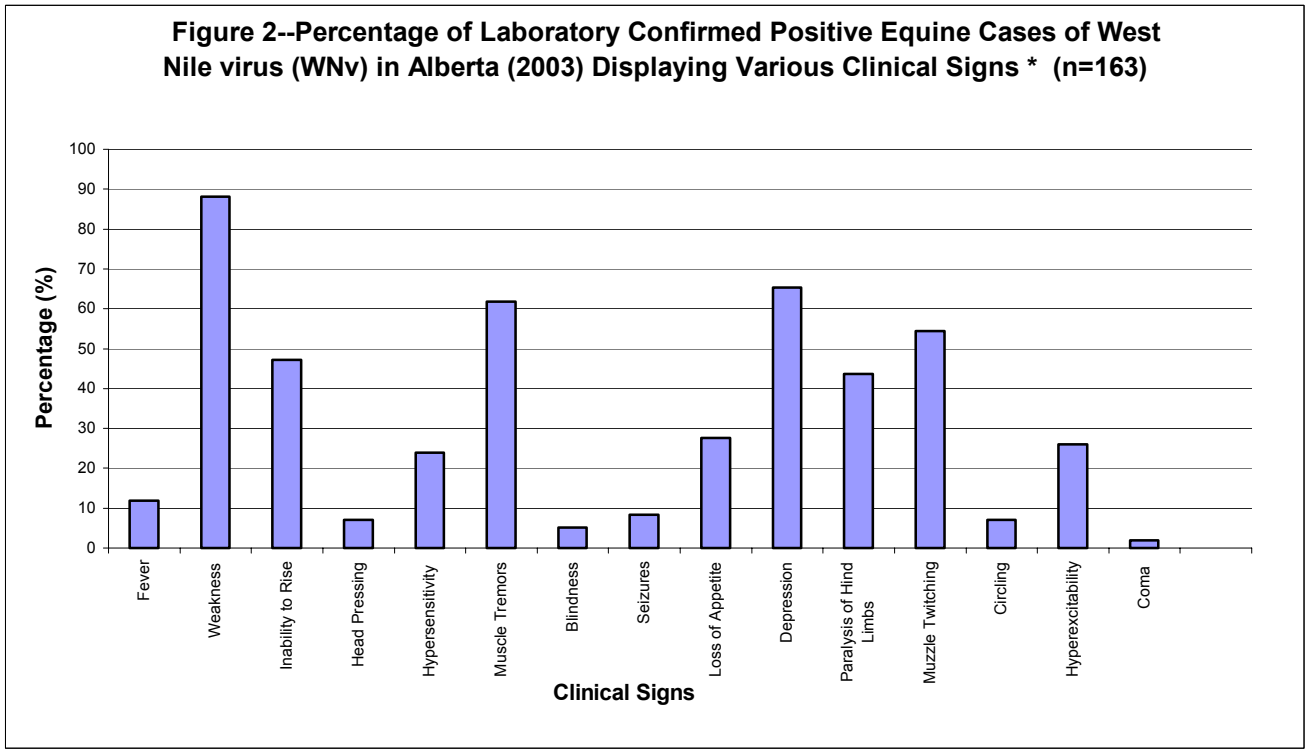
We are also grateful to Dr. Mary VanderKop, Annette Visser and Chris Duffy, all of AAFRD, for their assistance in preparing this report, including data entry, graphical analysis and mapping.

Thanks is also extended to Laura Plant-Edmonds and Melissa MacLean, both of the CPV Office, for helping to develop the 2003 survey and for following-up with veterinarians, horse owners and private diagnostic laboratories to gather missing information.

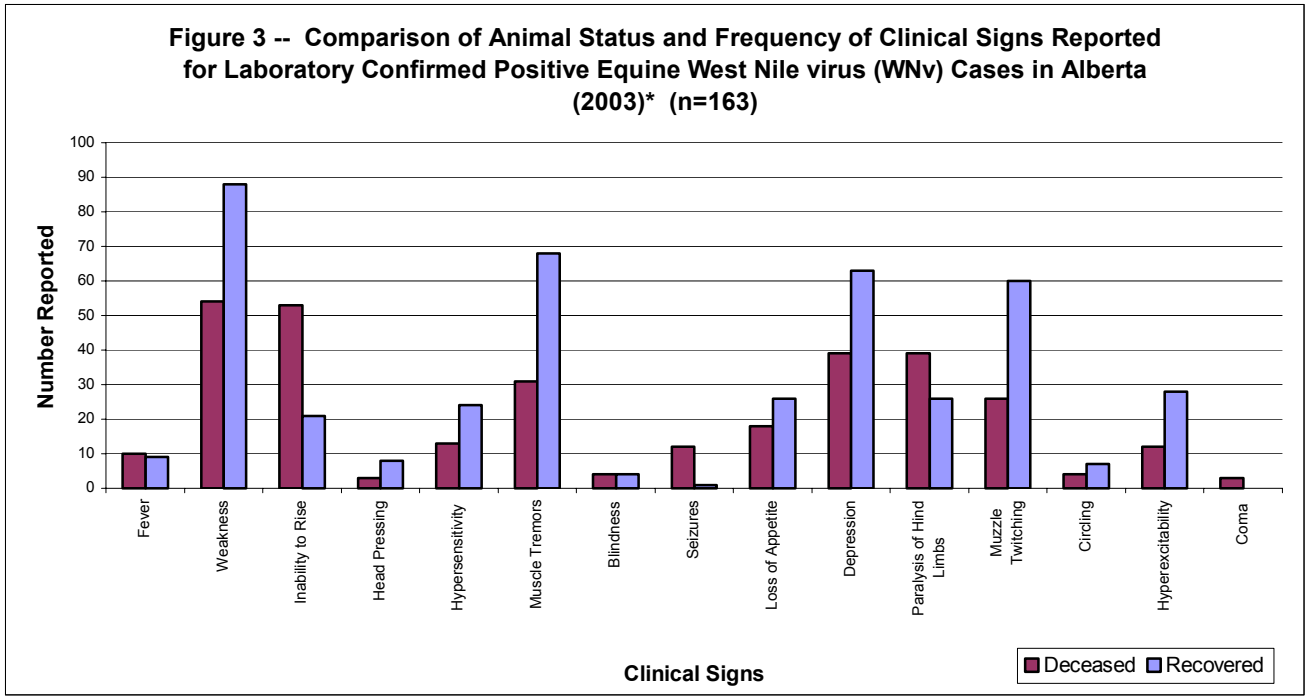
For further information re WNv horse surveillance email Dr. Gerald Ollis at gerald.ollis@gov.ab.ca



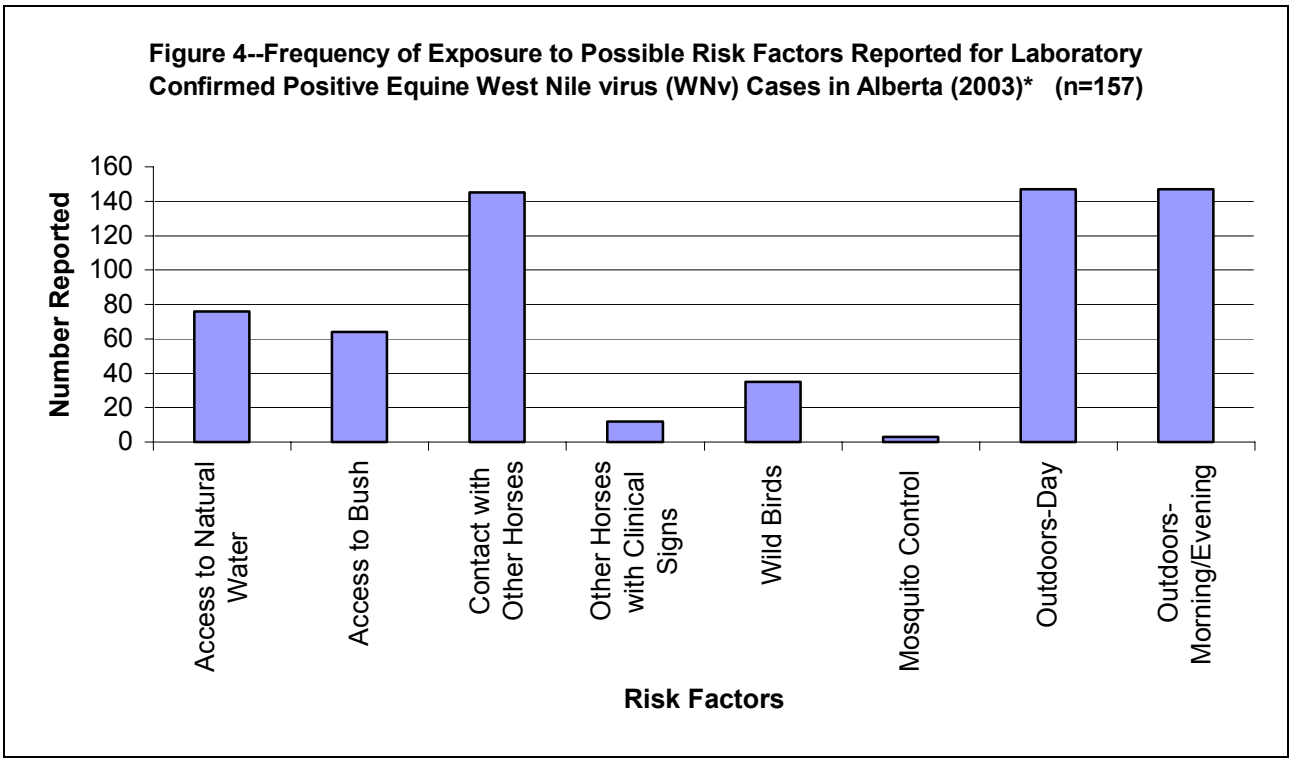
* Total exceeds 163, as any given animal could have displayed more than one clinical sign



* Percentages exceed 100%, as any given animal could have displayed more than one clinical sign

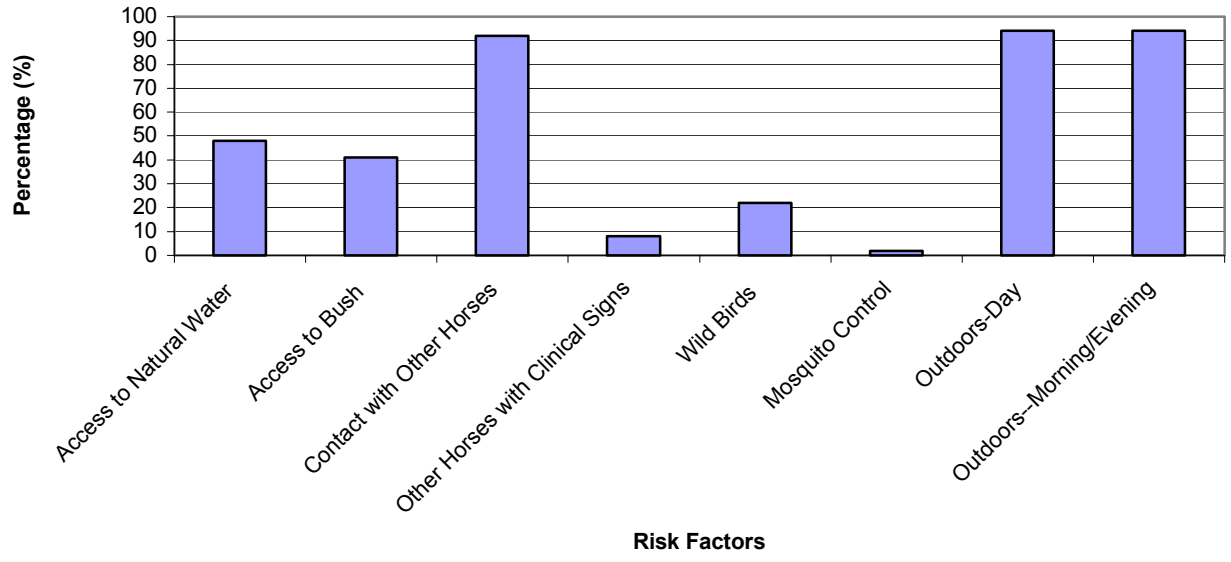


* Total exceeds 163, as any given animal could have displayed more than one clinical sign



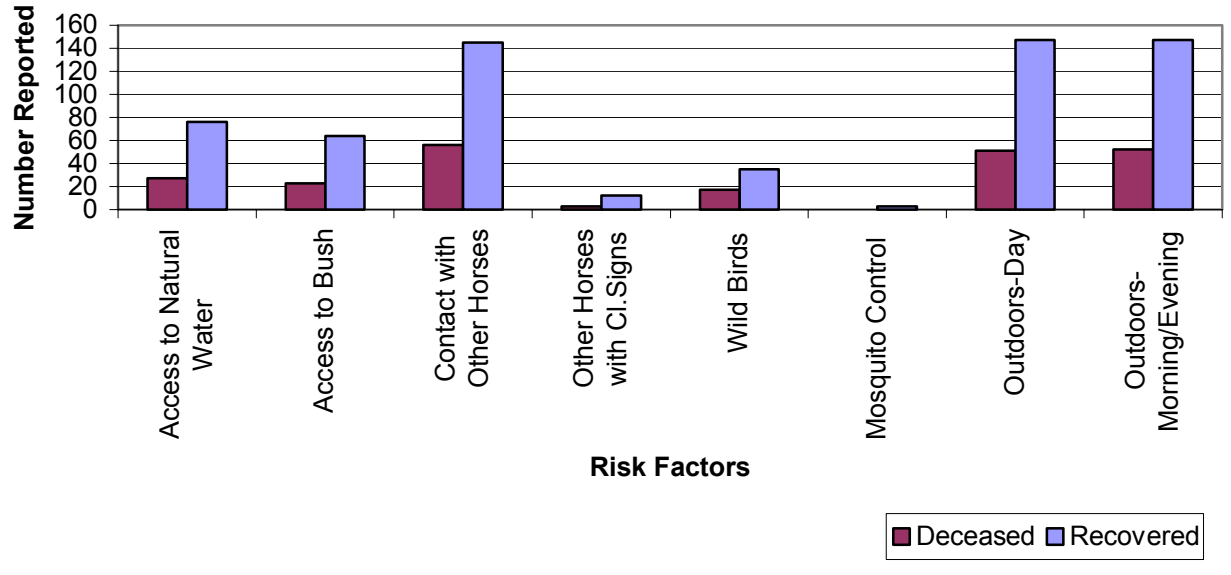
* Total exceeds 157, as any given animal may have been exposed to more than one risk factor

Figure 5--Percentage of Laboratory Confirmed Positive Cases of Equine West Nile virus (WNv) Exposed to Various Possible Risk Factors in Alberta (2003)* (n=157)



* Percentages exceed 100%, as any given horse may have been exposed to more than one risk factor

Figure 6--Comparison of Animal Status and Frequency of Exposure to Possible Risk Factors in Laboratory Confirmed Positive Equine West Nile virus (WNv) Cases in Alberta (2003)* (n=157)



*** Total exceeds 157, as any given animal may have been exposed to more than one risk factor**

Figure 7 -- Age Distribution for Equine Laboratory Confirmed Positive Cases of West Nile virus (WNv) in Alberta (2003) (n=157)

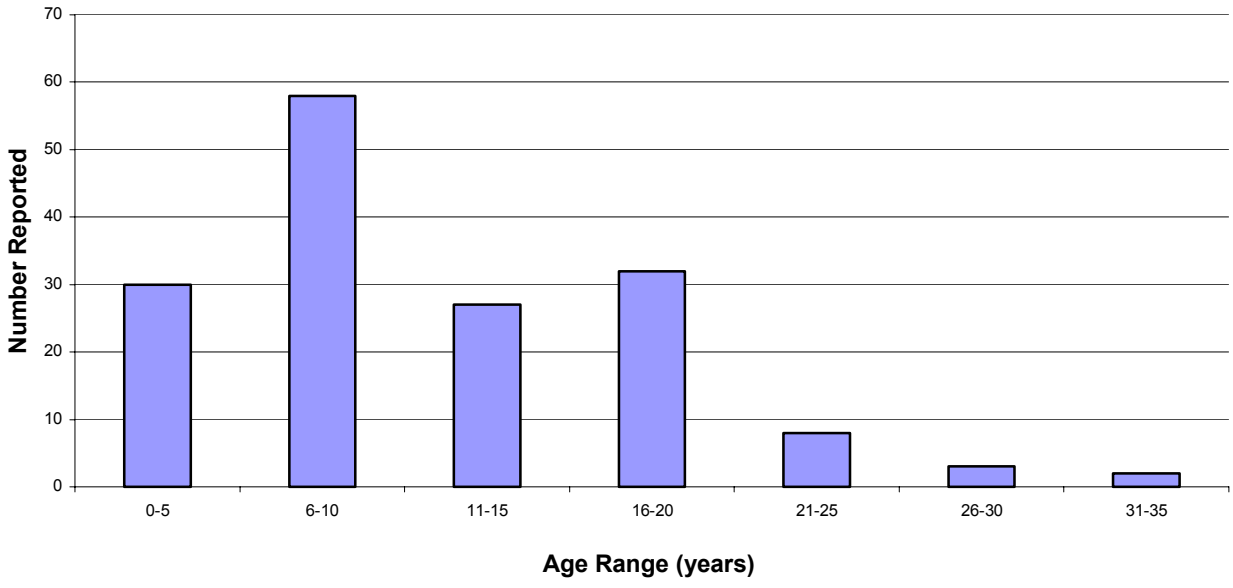


Figure 8 -- Comparison of Animal Status and Age Distribution of Laboratory Confirmed Positive Equine Cases of West Nile virus (WNv) in Alberta (2003) (n=157)

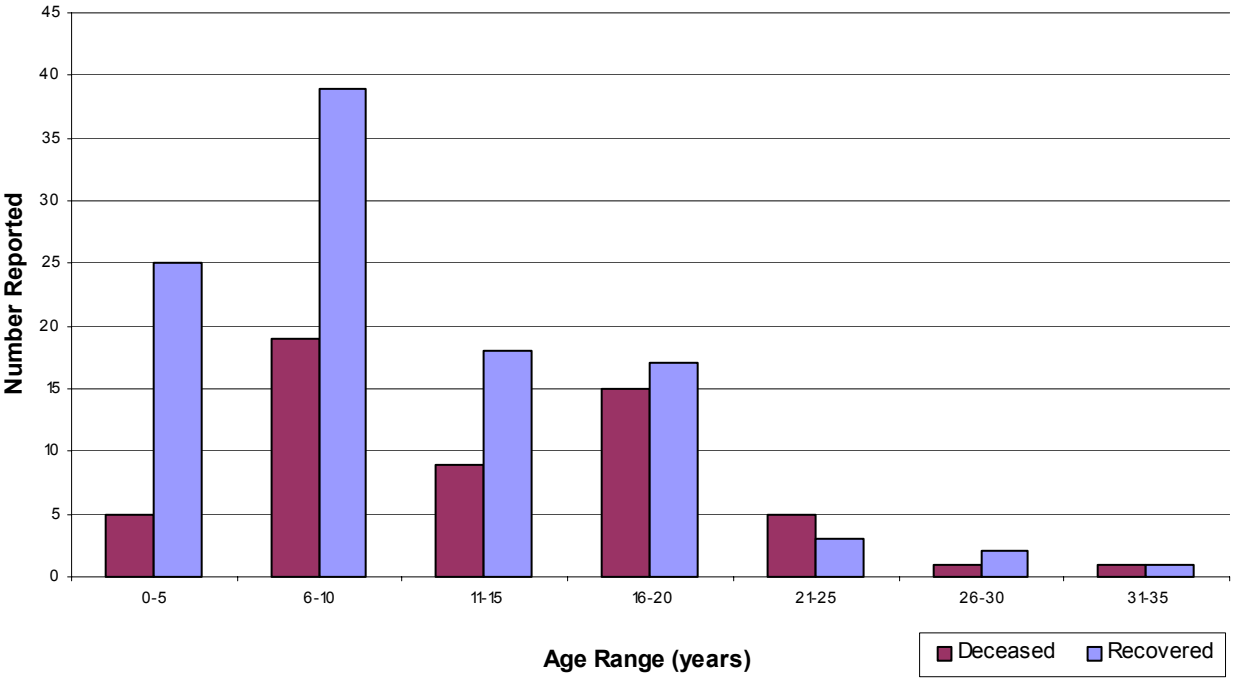


Figure 9--Frequency of Laboratory Confirmed Positive and Negative Equine West Nile virus (WNv) Cases Distributed Among Breeds in Alberta (2003) (n= 222)

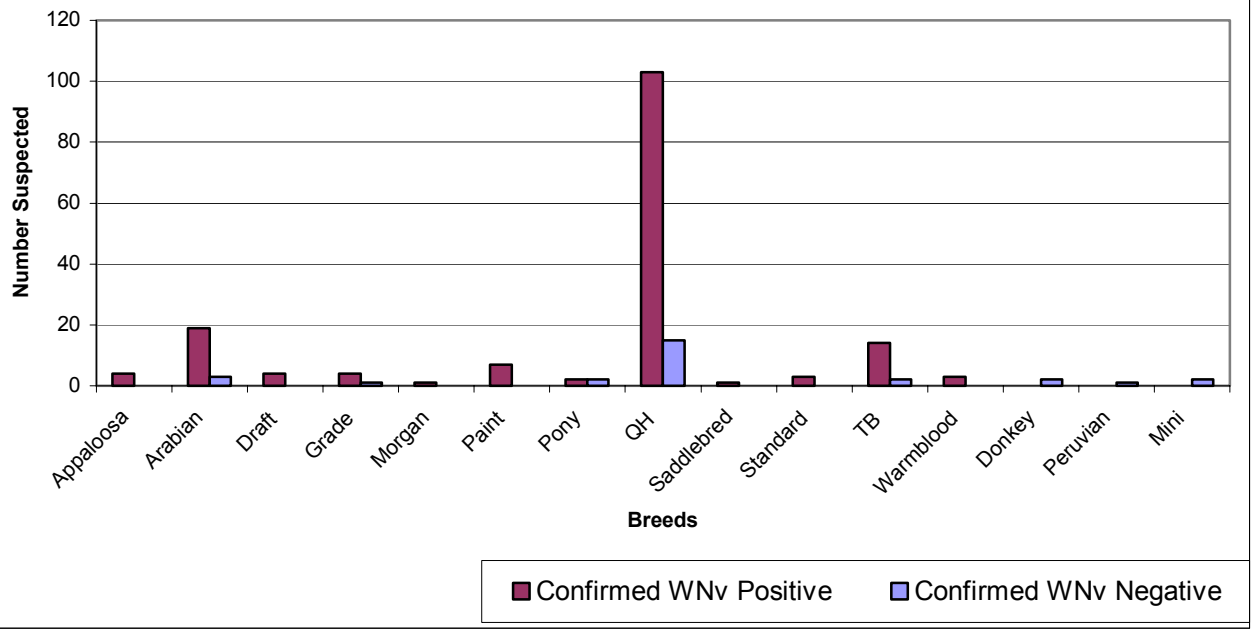


Figure 10 -- Comparison of Horses Laboratory Confirmed Positive for West Nile virus (WNv) as a Percentage of the Approximate Population by Breed Within Alberta (2003) (n=157)

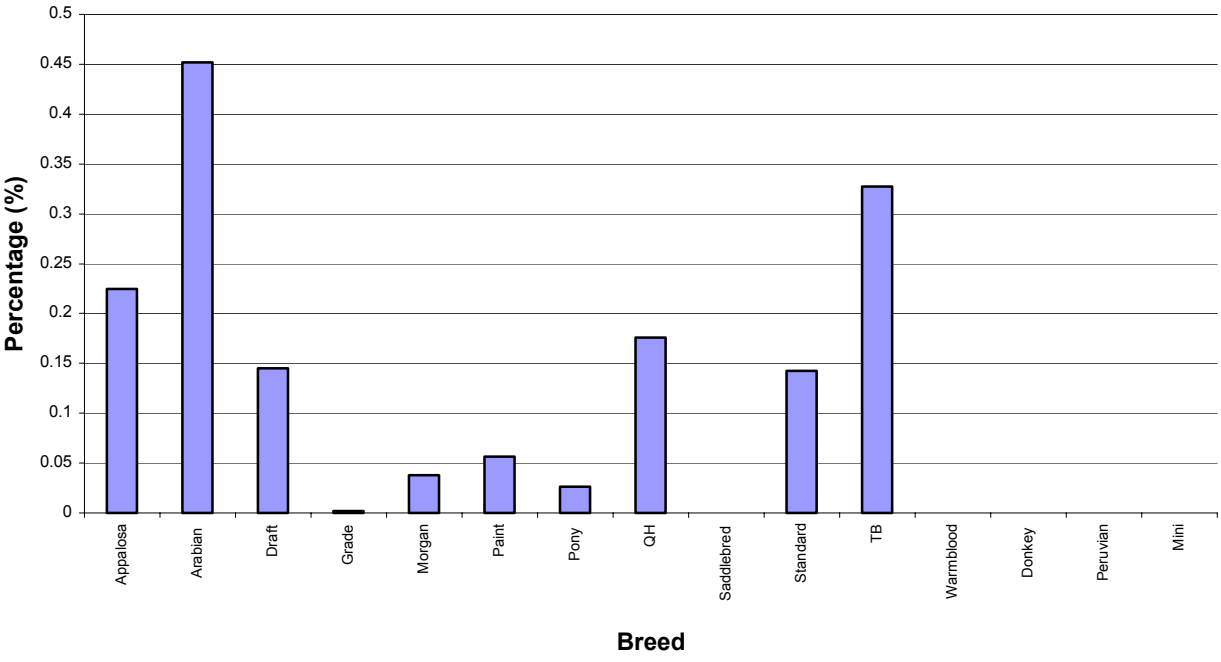


Figure 11 -- Frequency of Suspected Cases of Equine West Nile virus (WNv) Infection Distributed Among Regional Health Authorities in Alberta (2003) (n=222)

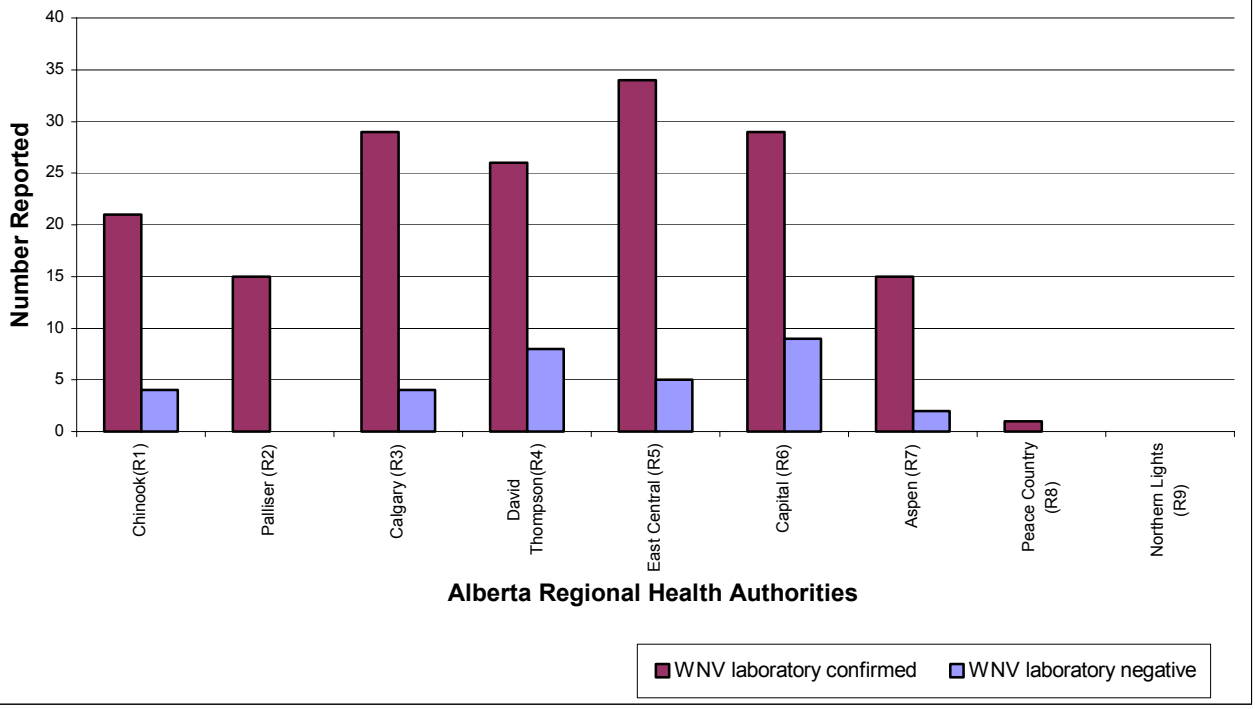
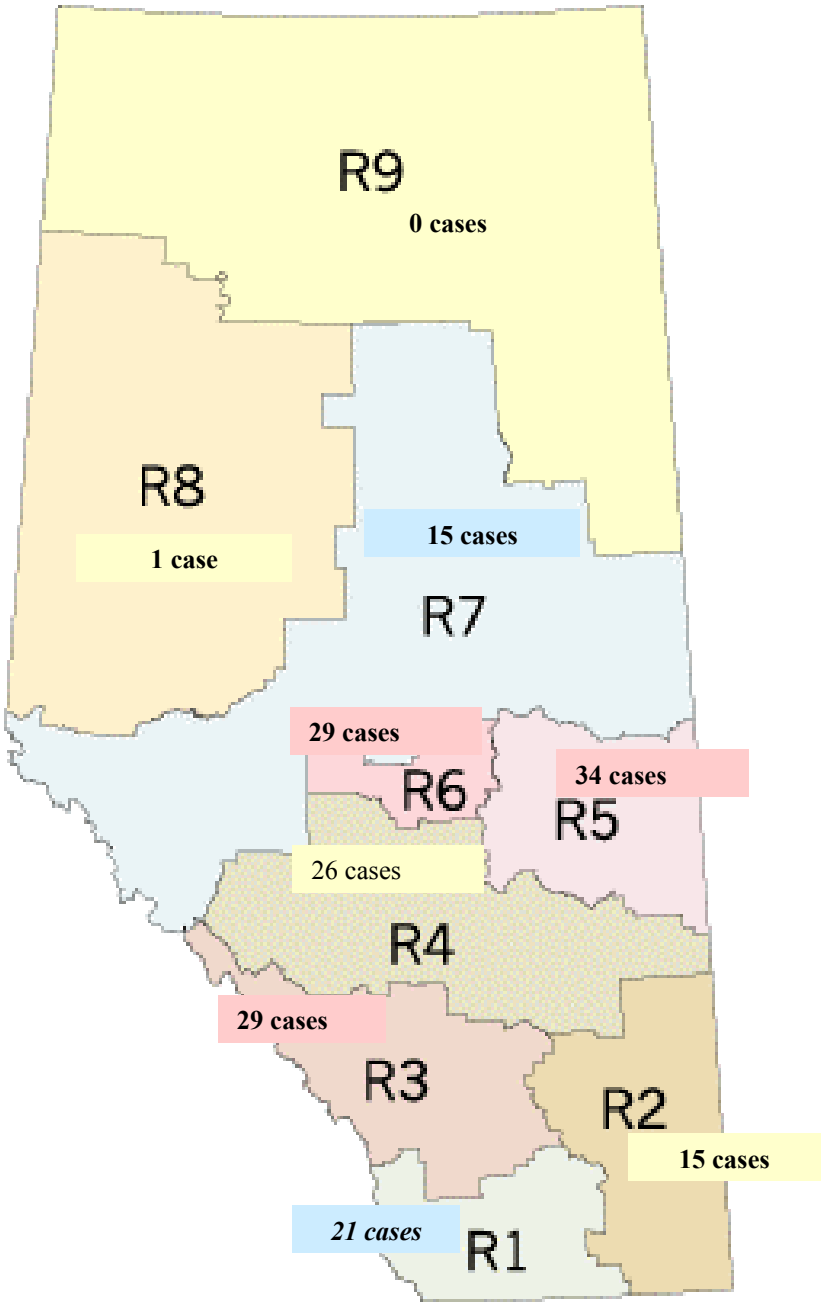


Figure 12. Geographic Distribution of Equine Laboratory Confirmed Positive Cases of West Nile virus (WNv) by Regional Health Authorities in Alberta (2003)
(n =170)



IV. *Human Surveillance*

Introduction

Locally-acquired human cases of West Nile virus (WNv) were first identified in Alberta in 2003. The following report outlines the epidemiological findings of human surveillance for West Nile virus.

Objectives
This report provides information on three main objectives of the WNv surveillance in humans in 2003:

1) The timely identification of human cases in a geographical area due to endemically acquired infection as well as importation;
2) To identify WNv infection in blood and tissue/organ donors and recipients;
3) To monitor the epidemiology (i.e., age distribution, gender, clinical presentation, risk factors, outcomes) of WNv in human cases.

The findings from the 2003 season will be used to inform public health activities for 2004.

Methods of Human Surveillance
In addition to standard reporting requirements for Notifiable Diseases in Alberta, Regional Health Authority (RHA) public health staff were asked to complete Health Canada's Human Case Investigation Report Short Form on all WNv cases. This 9-page form contains additional questions for determining the possible source of infection, risk factors, symptomology, the presence of underlying conditions, travel history, protective behaviors, blood donor/recipient history, and other WNv-related details. The form submission rate was 92%.

Results

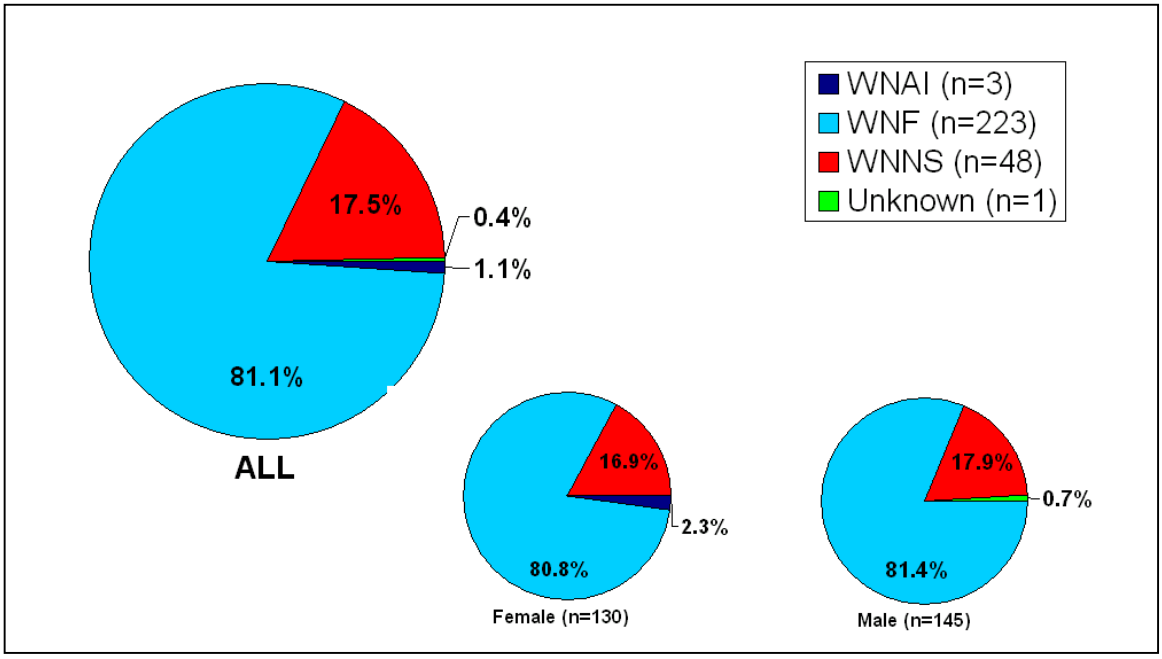
Number of Cases by Clinical Classification

In 2003, there were 275 cases of WNv reported in humans in Alberta. Of these, 17.5% (n=48) were West Nile Neurological Syndrome (WNNS) cases, 81.1% (n=223) were West Nile Fever (WNF) cases, 1.1% (n=3) were West Nile Asymptomatic Infection (WNAI) cases, and in one case the clinical categorization was unknown[1].

Sex

As shown in Figure 1, there was no difference in reported incidence of WNv infection or WNv clinical classification by sex.

Figure 1: Clinical Manifestation of Human West Nile Virus Cases in Alberta by Sex, 2003 (n=275)



[1] It is important to note that the true number of WNv infections in 2003 was likely under-reported since previous reports suggest that a large proportion of WNv infected individuals are asymptomatic. Further, many of the milder symptomatic cases likely had non-specific presentations with symptoms that overlapped with other viral syndromes (e.g., enterovirus). Owing to mild or absent symptoms, these individuals may not have presented for clinical care and/or may not have been tested by clinicians if WNv was not suspected. These individuals were therefore not counted as cases and are not included in this data. The true prevalence of WNv infection will be assessed in a sero-prevalence study planned for March 2004.

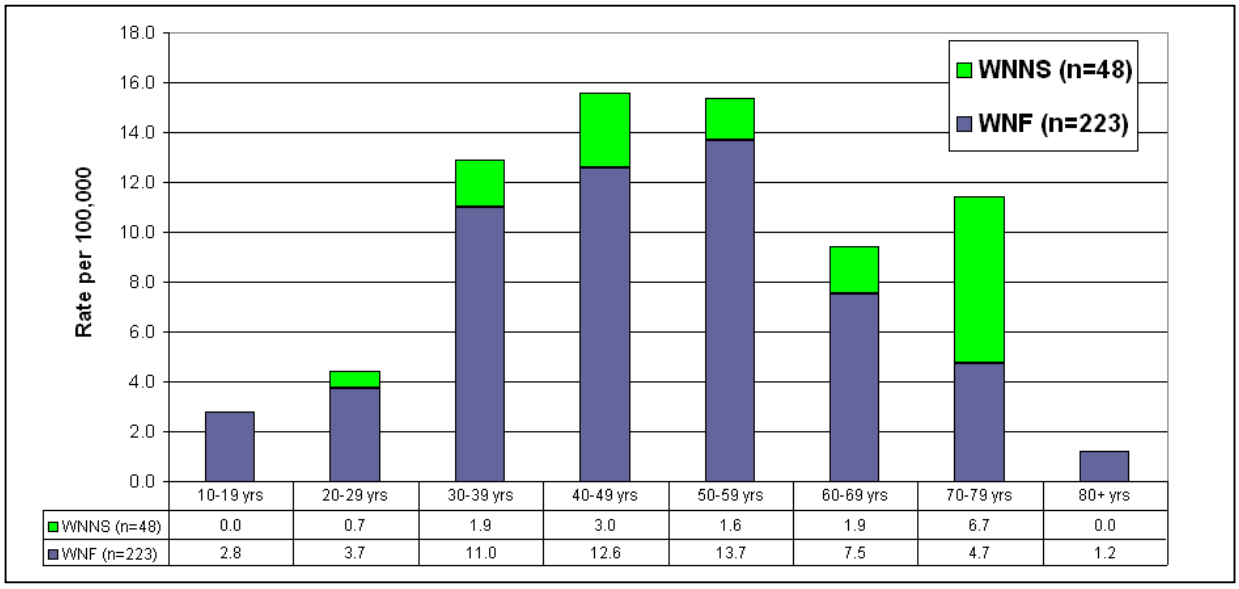
Age Distribution

The age-specific rates of WNv cases are shown in Figure 2. The mean age of all WNv cases was 44.7 years [SD=14.5 years] with a range from 11 to 80 years. Individuals aged 30-59 years accounted for over 70% of WNv cases overall.

On average, WNNS cases were significantly older than WNF cases (Mean age WNNS=50.3 yrs; Mean age WNF=43.5 yrs; $p<0.05$).

Only in the 70-79 year age group are there more cases of WNNS than WNF.

Figure 2: Age-Specific Rate of Human West Nile Virus Cases in Alberta by Clinical Classification, 2003 (Mean Age WNF = 43.5 years; Mean Age WNNS = 50.3 years; $p<0.05$)

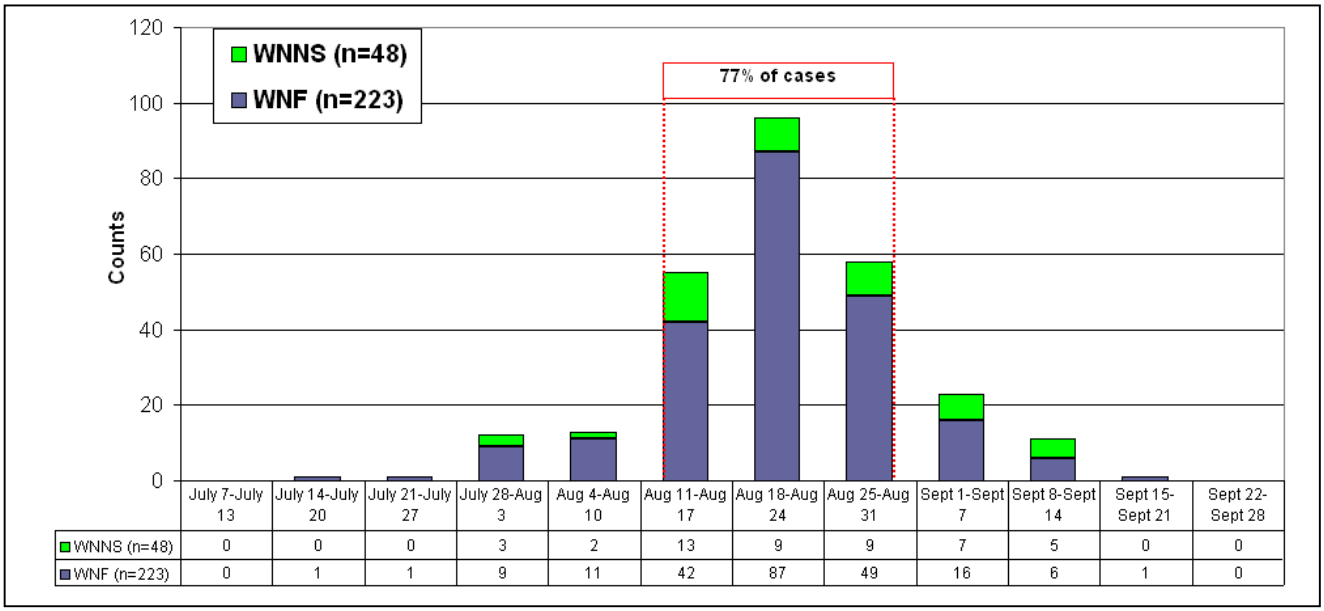


	10-19 yrs	20-29 yrs	30-39 yrs	40-49 yrs	50-59 yrs	60-69 yrs	70-79 yrs	80+ yrs
WNNS (n=48)	0.0	0.7	1.9	3.0	1.6	1.9	6.7	0.0
WNF (n=223)	2.8	3.7	11.0	12.6	13.7	7.5	4.7	1.2

EpiCurve by Date of Symptom Onset

As shown in Figure 3, dates of reported symptom onset ranged from July 18th to September 20th, 2003 (or Week 29 to Week 38). Over three-quarters (77%) of cases had onset of symptoms in the last 3 weeks of August. There were no apparent differences between reported dates of symptom onset for WNF and WNNS cases.

Figure 3: Human West Nile Virus Cases in Alberta by Reported Date of Symptom Onset, July 18 - September 20, 2003 (n=271; excludes 3 asymptomatic cases and 1 case of unknown manifestation)



	July 7-July 13	July 14-July 20	July 21-July 27	July 28-Aug 3	Aug 4-Aug 10	Aug 11-Aug 17	Aug 18-Aug 24	Aug 25-Aug 31	Sept 1-Sept 7	Sept 8-Sept 14	Sept 15-Sept 21	Sept 22-Sept 28
WNNS (n=48)	0	0	0	3	2	13	9	9	7	5	0	0
WNF (n=223)	0	1	1	9	11	42	87	49	16	6	1	0

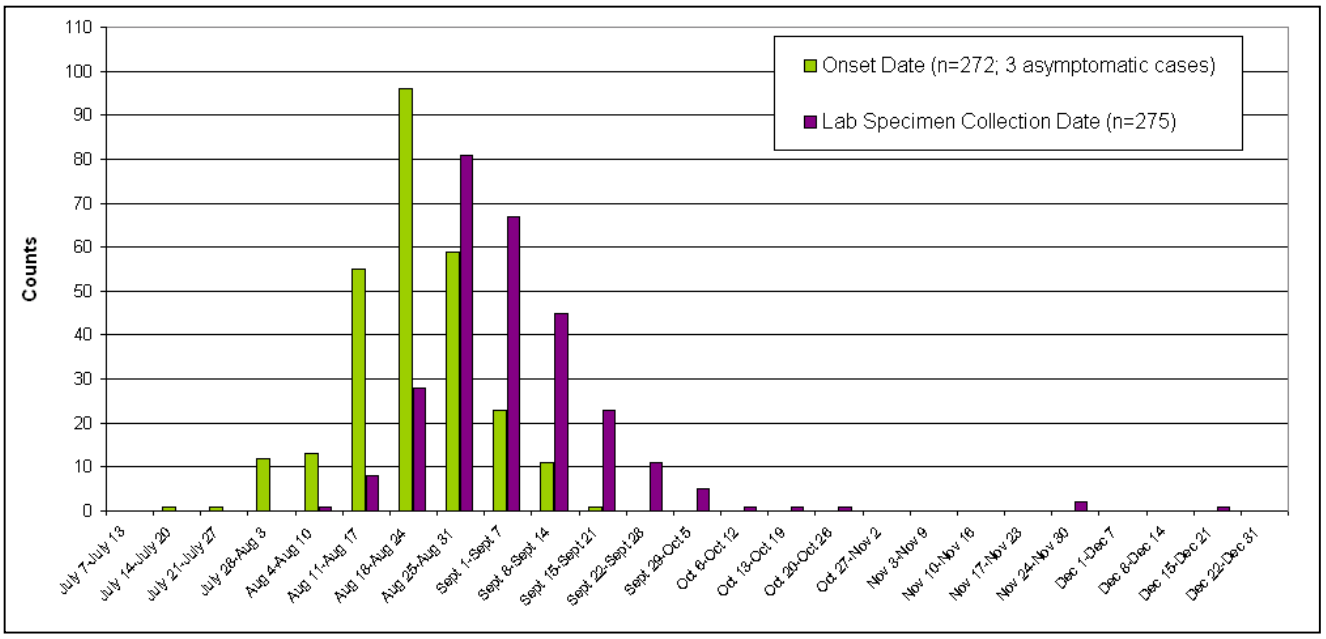
EpiCurve by Lab Specimen Collection Date

As shown in Figure 4, the distribution of cases by Lab Specimen Collection date shows that the range was August 8th to December 17th with 70% of cases occurring between August 25th and September 14th, 2003. The case with the earliest lab specimen collection date (August 8th) was asymptomatic.

The curve for Lab Specimen Collection date is skewed highly to the right. Anecdotal evidence suggests that, primarily out of curiosity, a few individuals presented for testing of WNv long after their symptoms had resolved, which is thought to explain the cases tested for WNv in October, November, and December 2003.

As shown, there was an approximate 4-week lag between the earliest date of reported symptom onset and the lab specimen collection date. The lag between subsequent dates decreases as the epidemic peaks and wanes. The exact causes of the delay between reported symptom onset and lab specimen collection are not entirely clear. The lag may be due to recall bias on the part of the individual affected, or testing bias on behalf of physicians (i.e., physicians may not have started looking and testing for the virus until later in the summer), or treatment seeking bias on behalf of Albertans (i.e., as public awareness of WNv increased, individuals with related symptoms may have been more likely to seek testing and treatment sooner).

Figure 4: Human West Nile virus Cases in Alberta by Date of Symptom Onset and Lab Specimen Collection Date, July 18 - December 17, 2003



Geographical Distribution

In Figure 5, human cases of WNv are plotted by place of residence to the nearest town. As shown, cases were predominantly in the Parkland and Grassland natural regions of the province, and mirrored the distribution of infected mosquitoes and birds. Those cases who live outside the Parkland and Grassland regions were found to be more likely related to travel than locally-acquired infection.

Figure 6 shows the crude rate and case counts of WNv by Regional Health Authority (RHA). As shown, rates of reported infections were generally higher in the south of the province than in the north. Palliser RHA reported the highest number and rate of human WNv cases. Palliser is the only RHA that is entirely within the Parkland and Grassland regions.

Figure 5: Human Cases of West Nile Virus in Alberta by Community, Onset Dates: July 18 – September 20, 2003 (n=272)

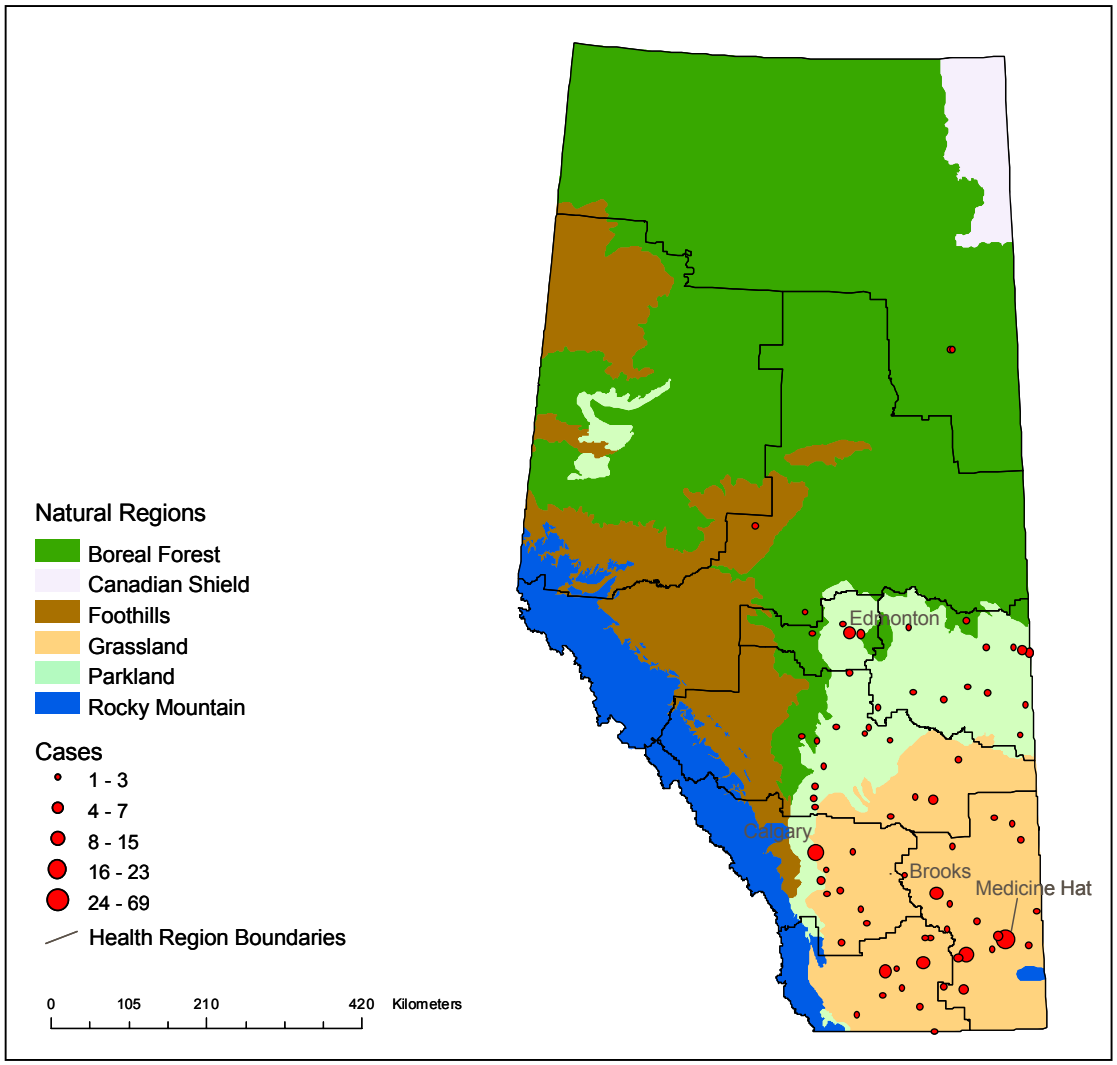
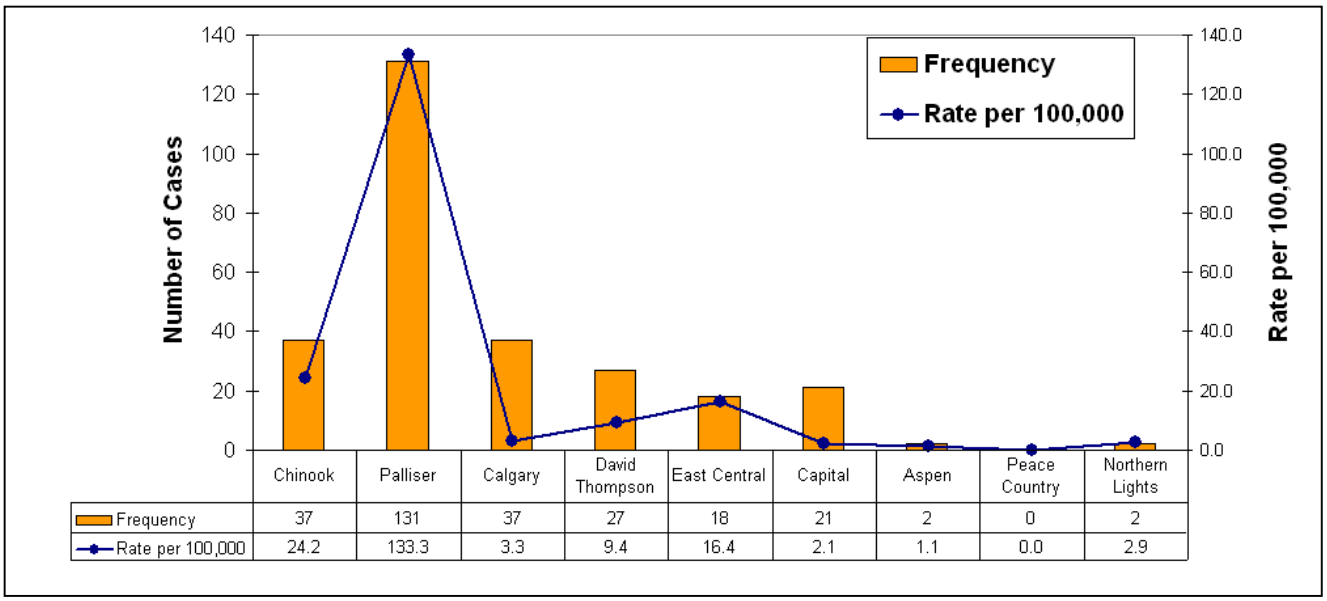


Figure 6: Crude Rate (per 100,000) and Case Counts of Human West Nile Virus Cases in Alberta by Regional Health Authority, July 18 – Sept 20, 2003 (n=275)

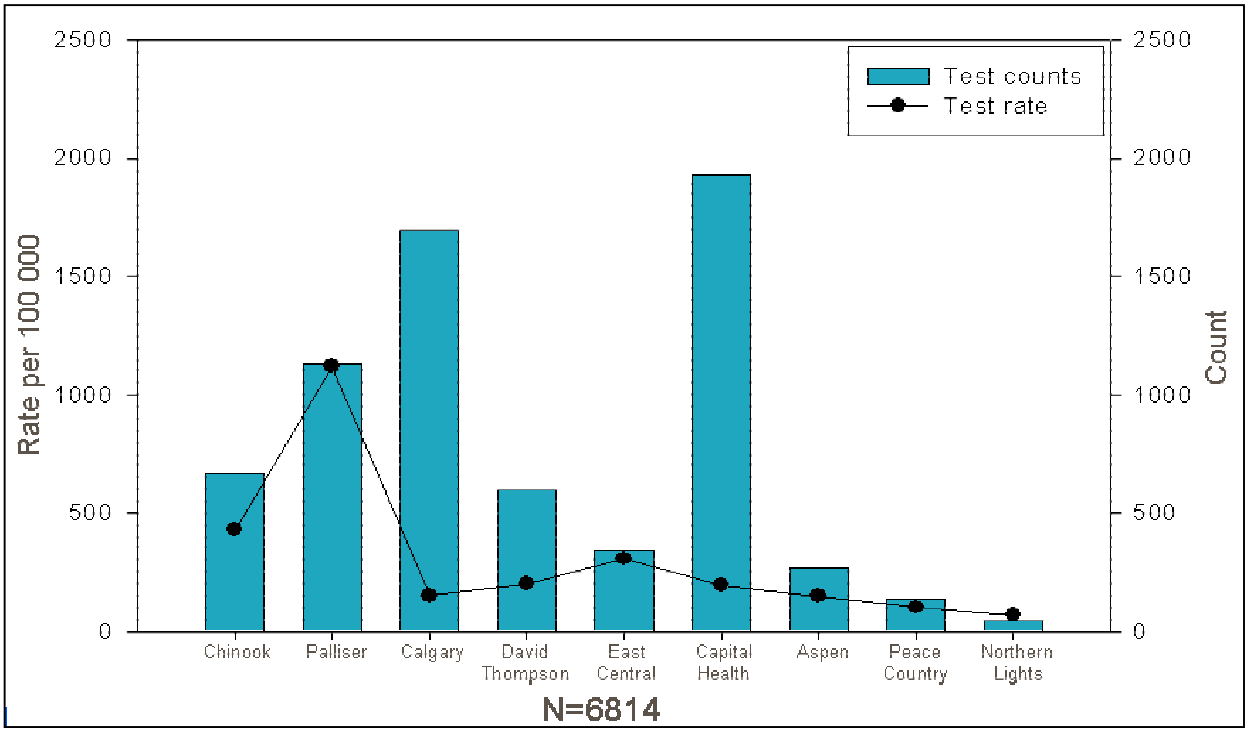


	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights
Frequency	37	131	37	27	18	21	2	0	2
Rate per 100,000	24.2	133.3	3.3	9.4	16.4	2.1	1.1	0.0	2.9

Lab Testing

The number and rate of lab tests by RHA is shown in Figure 7 below.

Figure 7: Crude Testing Rate (per 100,000) and Testing Counts of West Nile Virus in Alberta by Regional Health Authority (July 7-September 20, 2003)



As shown in Figure 7, although southern RHAs had the highest testing rates in the province, increased testing alone does not account for the higher rate of reported cases in southern areas.

Table 1 below provides a provincial lab-testing summary for WNv in 2003. As shown, the provincial lab tested 3,490 specimens from 2,916 patients for WNv. The number of specimens submitted to the lab for WNv testing was over 10 times greater than the number of positive results (n=275).

Table 1: Provincial Lab Testing Summary (May 1 – November 12, 2003)

	# of SPECIMENS	# of PATIENTS
Organ/tissue	440	393
Serology (Non-Transplant)	3,050	2,523
TOTAL	3,490	2,916

Symptomology

As shown in Table 2, WNv infection can be associated with very non-specific symptoms. Over 90% of cases reported 'Fatigue/Sleepiness' while over 80% reported 'Headache' and 'Weakness'.

Table 2: Signs and Symptoms Reported by Human Cases of West Nile Virus in Alberta, 2003

SIGNS AND SYMPTOMS[3]	WNF (n=221)[1]		WNNS (n=48)		Total (n=269)[2]		Odds Ratio[4]	95% CI
	% Yes	n Yes	% Yes	n Yes	% Yes	n Yes		
Fatigue/Sleepiness	91.9%	203	95.8%	46	92.6%	249	2.04	0.46-9.10
Headache	84.2%	186	85.4%	41	84.4%	227	1.10	0.46-2.66
Rash	82.4%	183	60.4%	29	78.5%	212	0.33	0.17-0.64
Weakness	81.4%	180	93.8%	45	83.6%	225	3.42	1.01-11.5
Muscle Pain	79.2%	175	68.8%	33	77.3%	208	0.58	0.29-1.15
Fever	67.0%	148	87.5%	42	70.6%	190	3.45	1.40-8.49
Joint Pain	60.6%	134	45.8%	22	58.0%	156	0.55	0.29-1.03
Stiff Neck	60.6%	134	64.6%	31	61.3%	165	1.18	0.62-2.69
Eyes Sensitive to Light	39.4%	87	60.4%	29	43.1%	116	2.35	1.24-4.45
Other Symptoms	38.5%	85	43.8%	21	39.4%	106	1.24	0.66-2.34
Enlarged Glands	36.2%	80	31.3%	15	35.3%	95	0.80	0.41-1.56
Confusion or Forgetfulness	30.8%	68	41.7%	20	32.7%	88	1.61	0.85-3.05
Blurred Vision or Deterioration in Eyesight	27.1%	60	47.9%	23	30.9%	83	2.47	1.30-4.68

Table Notes:

[1, 2] Two WNF cases were missing information on symptoms and were excluded from the denominator.

[3] Options for recording the presence of a sign or symptom included 'Yes', 'No', or 'Don't Know/Unsure'. Between 10-13% of cases reported 'Don't Know/Unsure for the following symptoms: Fever, Confusion or Forgefulness, Enlarged Glands.

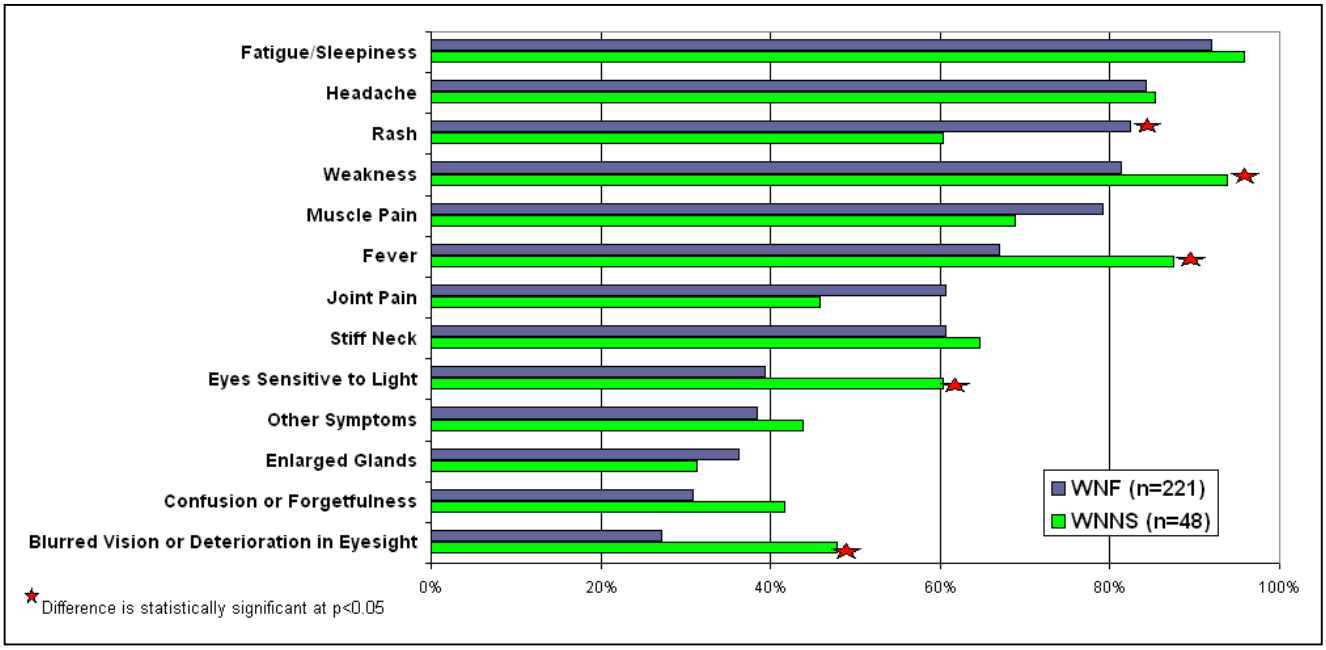
[4] To calculate the Odds Ratio, 'No' and 'Don't Know/Unsure' responses were combined.

Both Table 2 and Figure 8 reveal that there was considerable overlap between the symptoms reported by WNF and WNNS cases. There was a statistically significant difference in reporting between WNF and WNNS cases for five symptoms. 'Weakness', 'Fever', 'Eyes Sensitive to Light', and 'Blurred Vision or Deterioration in Eyesight' were reported more often by WNNS cases compared to WNF cases. Presence of a 'Rash' was more commonly reported by WNF cases. These symptoms were so common in both clinical presentations, however, that the difference may not be clinically helpful in discriminating between the two.

Interestingly, although presence of a 'Fever' is a key clinical criterion for diagnosis of infection by WNv, only 67% of confirmed WNF cases and 88% of WNNS reported presence of a fever. This finding may not be unique to Alberta since early analyses from Saskatchewan and British Columbia suggest similar results. This is an important finding with implications for the case definition of WNv infection for 2004.

The most common 'Other symptoms' reported by WNF and WNNS cases included gastro-intestinal symptoms (e.g., diarrhea, nausea, and vomiting), dizziness and balance problems, hypersensitivity, tingling/numbness, and back pain.

Figure 8: Signs and Symptoms reported by Human West Nile Virus Cases in Alberta in 2003, by Clinical Manifestation

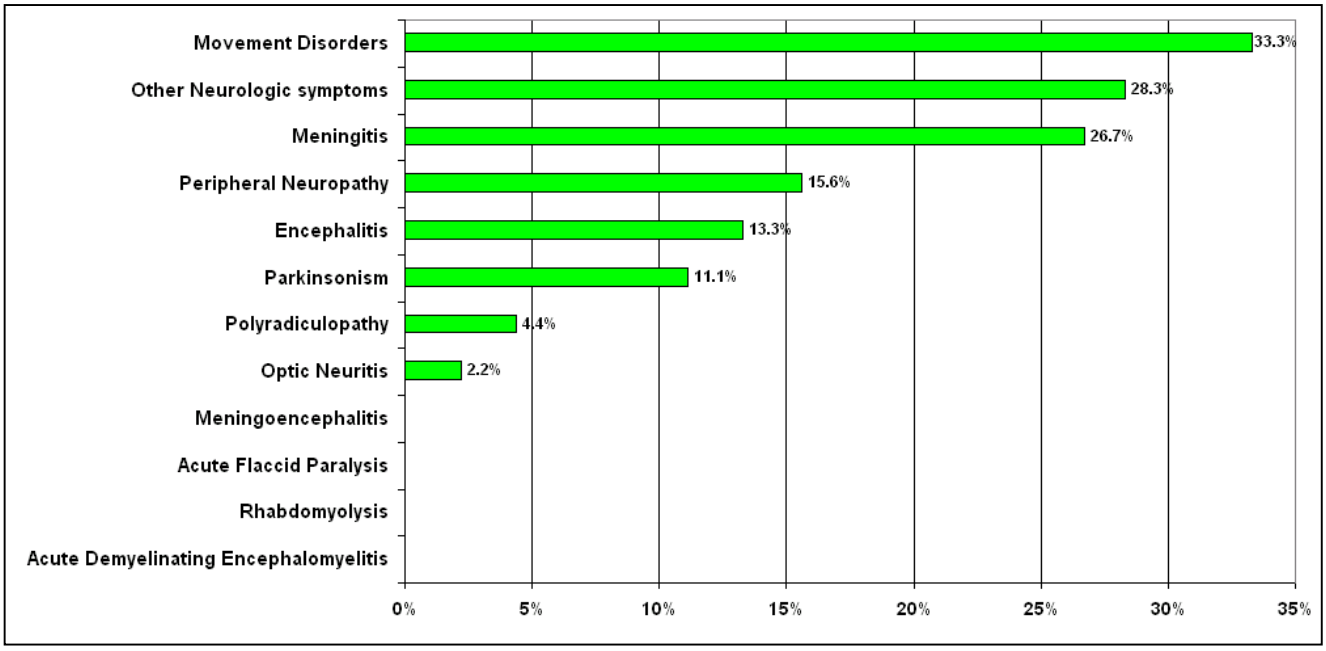


Severity of Neurological Syndrome

There were 48 WNNS cases, which accounted for 17% of all WNv cases in Alberta in 2003. Of these 48 cases, 3 were missing details about the presence or absence of neurological syndromes. Of the remaining 45 cases, 40% presented with severe neurological syndromes (i.e., meningitis and/or encephalitis) while 56% presented with milder symptoms (e.g., movement disorders including tremors, peripheral neuropathy, and 'other neurological symptoms'), and 4% reported no neurological syndromes.

Figure 9 shows the types of neurological syndromes reported by the WNNS cases. In this figure, each case is classified into as many clinical categories as applied to him/her (i.e., some patients had more than one neurological syndrome). WNNS cases in 2003 included a broad spectrum of clinical presentations including milder cases than first expected based on information from previous years in other sites. The most common presentation in Alberta in 2003 was that of various movement disorders (this group may overlap with those reported as Parkinsonism), followed by 'other neurological symptoms', and meningitis. The most common 'Other neurological symptoms' reported by WNNS cases included 'balance, gait, and dizziness', 'confusion and decreased mental status', and 'weakness, not otherwise specified'.

Figure 9: Types of Neurological Syndromes reported by Human West Nile Neurological Syndrome (WNNS) cases in Alberta, 2003 (n=45; 3 cases missing information on neurological



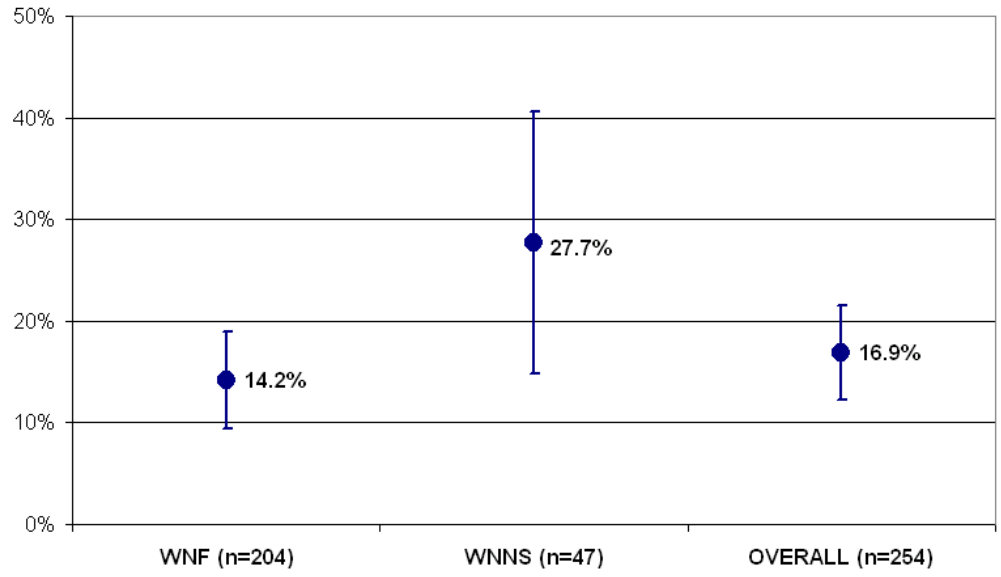
syndromes)

Underlying Chronic Health Conditions

Overall, 17% of all WNv cases reported an underlying condition. As shown in Figure 10, a higher proportion of WNNS patients reported an underlying chronic medical condition compared to WNF patients (28% and 14%, respectively). Underlying chronic medical conditions considered included: Cancer, Heart Disease, Diabetes, Alcoholism, Cerebro-vascular Disease, Liver Disease, Lung Disease, Renal Disease, and Other Autoimmune Diseases. Conditions such as Asthma, Hypertension, and Osteo-arthritis were not considered 'underlying medical conditions' for this analysis since these patients would not be considered immuno-compromised.

WNNS patients are significantly older than WNF patients, which may partly explain the higher proportion of WNNS cases with underlying conditions.

Figure 10: Proportion of WNNS cases and WNF cases with Underlying Chronic Medical Conditions in Alberta, 2003

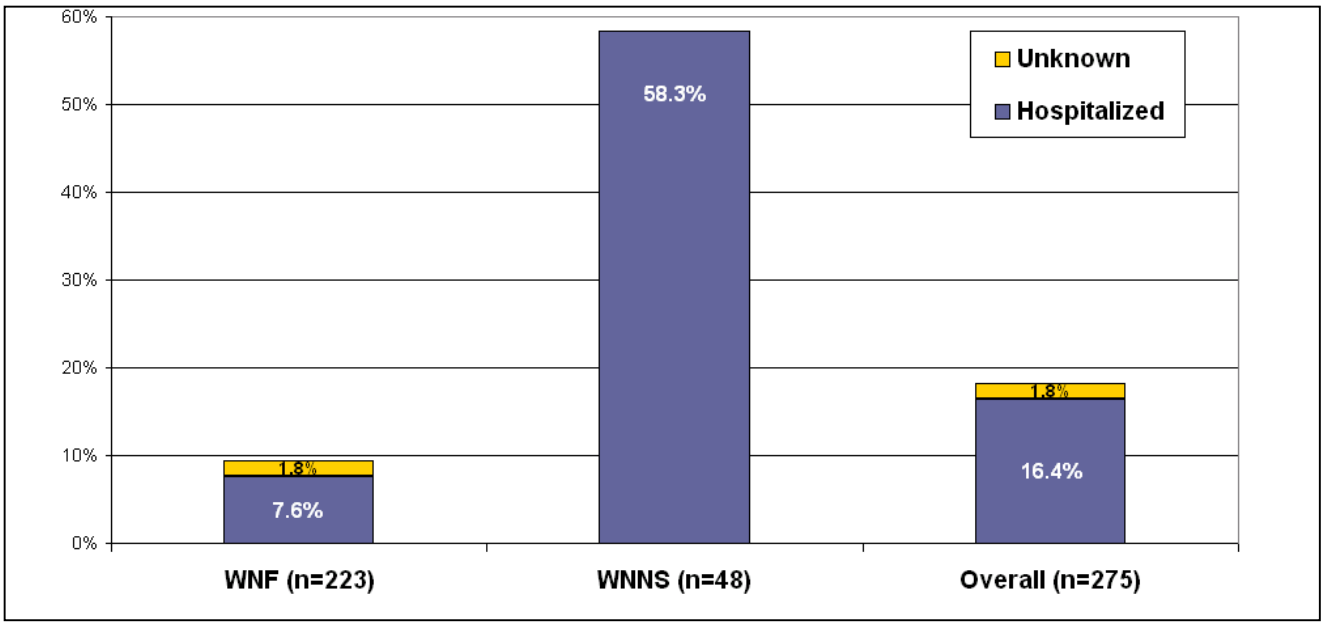


Hospitalization

Overall, 16% of Human West Nile virus cases in Alberta in 2003 were hospitalized. This compares with a 51% hospitalization rate in Ontario during the 2002 West Nile season.

As shown in Figure 11, a significantly higher proportion of WNNS patients were hospitalized than WNF patients (58% and 8%, respectively). Length of stay in hospital cannot be reliably reported owing to a large number of missing discharge dates in both groups.

Figure 11: Proportion of WNF and WNNS Cases Hospitalized in Alberta in 2003



WNv Outcomes

Table 3 provides a summary of outcomes for 269 WNv cases in Alberta in 2003 (6 cases were excluded from this analysis because 3 cases were asymptomatic, 1 case had unknown WNv infection, and 2 cases were missing data on outcome). WNNS cases were less likely than WNF cases to be 'Fully Recovered' at the time of interview by the RHA public health staff member (19% and 39% respectively). One WNNS patient died but WNv infection was not the primary cause of death.

The analysis of outcomes is limited by timing of RHA follow-up since follow-up is done at only one point in time for each case and the timing of follow-up varies from case to case. Owing to a one-time follow-up, outcome status of those initially classified as 'Not Fully Recovered' remains unknown. Further, for those who reported being 'Not Fully Recovered', information on persisting symptoms was not collected.

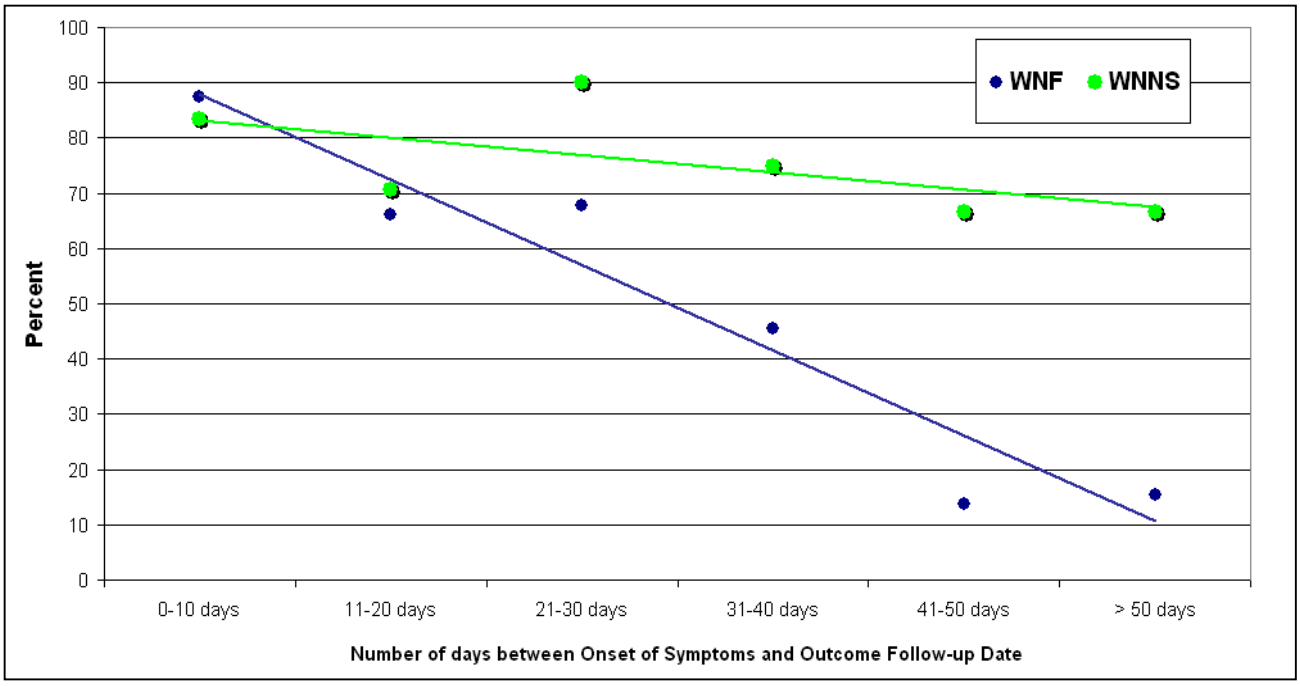
Table 3: Outcomes of Human WNv Cases in Alberta, 2003 (n=269)

	Fully Recovered	Not Fully Recovered	Died	Unknown
WNF (n=221)	38.5%	57.9%	0%	3.6%
WNNS (n=48)	18.8%	77.1%	2.1%*	2.1%

* Primary cause of death was not WNv

Figure 12 shows the proportion of WNNS and WNF cases that were 'Not Fully Recovered' by Number of Days between Onset of Symptoms and Outcome Follow-up Date. The figure shows that WNNS cases appear to take longer to recover, although the relationship has not been tested for statistical significance.

Figure 12: Proportion of Human West Nile Virus cases 'Not Fully Recovered' by Number of Days between Onset of Symptoms and Outcome Follow-up Date



Sources of Infection

Mosquito exposure was the most likely mode of transmission for virtually all WNv cases. Two-thirds (66%) of cases recalled being bitten by a mosquito in the 3 weeks prior to symptom onset. Another 15% of cases were unsure if they had been bitten. Of the 66% of cases who recalled being bitten, 5% also had direct contact with sick or dead birds. Only one case had mucous membrane contact with body fluids of a WNv infected bird.

There were no cases attributable to vertical transmission or breastfeeding, receipt of blood products, or receipt of organ/tissue transplant.

Blood Donors and Recipients

Regional Health Authorities (RHAs), Alberta Health and Wellness (AHW), and Canadian Blood Services (CBS) worked together to ensure that WNv infection in blood donors and recipients was thoroughly investigated.

In Alberta between July 21st, 2003 and September 7th, 2003, CBS tested 20,124 blood donations for WNv RNA using the Roche test. Of these, 3 donations were positive for WNv RNA, yielding a rate of 1 positive per 6,708 donations. The rate in Saskatchewan was 1 positive per 748 donations.

Of the three CBS-identified blood donors with West Nile virus, two were eventually classified as WNF cases and the other as WNAI. Regional Health Authorities identified four additional West Nile virus cases who had donated blood in the 8 weeks prior to onset of symptoms. In these 4 cases, infection likely was far enough before the donation that they were not viremic at the time of donation and therefore were not picked up by the CBS blood-screening test (a molecular method that detects viral RNA). After viremia is past, risk of transmission by blood transfusion is thought to be negligible.

No cases of transfusion–acquired cases of West Nile virus were identified in Alberta or Canada in 2003. One case of WNv infection was, however, reported in an individual two days after having received a transfusion of red blood cells. It was felt that this interval was too short to explain the presence of IgM and infection was due to exposure to WNv prior to receiving the transfusion.

Tissue/Organ Donors and Recipients

The Provincial Lab tests all donated organs and tissues in Alberta for pathogens, according to defined protocols. Testing for West Nile virus was instituted on July 7th, 2003. Of the 440 organ/tissue specimens tested, none were found to contain West Nile virus.

Vaccination

Less than 5 WNv cases had been vaccinated against Yellow Fever, Japanese Encephalitis, or Other Arboviruses. Over two-thirds of cases were, however, missing information on vaccination history.

Protective Behaviour

As shown in Table 4, most WNv cases reported ‘Never’ (24%) or only ‘Sometimes’ (47%) using insect repellent when outside. Owing to a lack of a comparison group, it is not possible to determine whether or not these levels of protective behaviour are typical of all Albertans.

Table 4: Reported Use of Insect Repellant by Human WNv Cases in Alberta in 2003 (n=242)

Do you use personal insect repellant(s) when outside/outdoors?	Percent
Never	24%
Sometimes	47%
Most of the time	26%
Always	3%

Travel History

Approximately two-thirds (67%) of WNv infected individuals reported traveling more than 100 km from their place of residence in the three weeks prior to symptom onset. This finding may have implications for our ability to attribute infections to exposures by geographic location.

Key Findings

- Locally-acquired human cases of West Nile virus were first identified in Alberta in 2003.
- The two southernmost Regional Health Authorities, Chinook and Palliser, had the highest rates of human cases in the province.
- Geographic distribution of human cases mirrored that of WNv positive birds, horses and mosquito pools. Cases were found predominately in the Parkland and Grassland eco-regions of the province.
- There was no difference in incidence of WNv infection by sex.
- Individuals aged 30-59 years of age accounted for over 70% of WNv cases overall.
- Symptom onset dates ranged from July 18th to September 20th, 2003, however, 77% of cases reported symptom onset in the last three weeks of August (August 11th to 31st).
- The exposure period of the first human cases coincides with the first identification of positive *Culex tarsalis* mosquitoes in the province.
- Those with WNv infections did not consistently practice personal protection measures.
- WNNS is a more severe disease than WNF as indicated by the significantly higher proportion of cases who were hospitalized (58% and 8%, respectively).
- Compared to WNF cases, those with WNNS were older, were more likely to be hospitalized, and may have had longer duration of symptoms. A higher proportion of WNNS cases had underlying chronic medical conditions but this was closely related to age.
- WNv infection can be associated with very non-specific symptoms such as 'fatigue/sleepiness' and 'weakness'.
- There is considerable overlap between symptoms reported by WNNS and WNF cases. Many symptoms were so common in both clinical presentations that any differences may not be clinically helpful in discriminating between the two.
- Although presence of a 'Fever' is a key clinical criterion for diagnosis of infection by WNv, only 67% of confirmed WNF cases and 88% of WNNS reported presence of a fever.

For further information re WNv human surveillance email Angela Kaida at angela.kaida@gov.ab.ca

V. *Mosquito Surveillance*

Introduction

Mosquitoes have been identified as the major contributing factor in the build-up and spread of West Nile virus (WNv). In the United States and Canada the virus is being shown to be dependent on:

1) the movement of birds as hosts,
2) populations of the mosquito genus *Culex* as the primary vector, and
3) weather associated with drought-like conditions.

The Alberta Government anticipated that birds using the Central Migratory Bird Flyway through the Prairie Provinces of Canada could introduce the virus to Alberta. A surveillance program for mosquitoes was developed and implemented for the 2003 season in conjunction with surveillance programs for birds, horses and humans.

Objectives

The specific objectives of the 2003 Mosquito Surveillance Program were:

1) to identify and map larval habitats in selected municipalities through the season,
2) to study how climate and environmental factors in Alberta influence mosquito activity,
3) to determine WNv in mosquito populations by testing selected mosquito pools in different geographical areas of the province, and
4) to use the information for a better understanding of the role of the mosquito in WNv transmission in Alberta.

Methods of Mosquito Surveillance

Surveillance Centres

Several Alberta municipalities volunteered to undertake the task of monitoring mosquito larvae and adult populations and trapping mosquitoes for virus analysis. By mid-May 2003, guidelines for mosquito surveillance were developed and mosquito surveillance centres were established in each of the nine regional health authorities. In total, 12 municipalities including Grande Prairie, Fort McMurray, Fort Kent, Edmonton, Camrose, Red Deer, Drumheller, Calgary, Brooks, Oyen, Medicine Hat, and Lethbridge served as primary surveillance centres. Satellite trapping sites were established at Strathmore, Indus, High River, Vulcan, Coaldale, Raymond and Magrath. Six (6) municipalities already had mosquito abatement programs in place (Grande Prairie, Edmonton, Calgary, Red Deer, Drumheller, and Medicine Hat). Collectively, these six municipalities comprise over 60 % of Alberta's population. An additional six municipalities had previous mosquito abatement program experience (Fort McMurray, Camrose, Brooks, Oyen, Raymond, and Magrath). Agricultural Research Association staff operated two of the surveillance centres (Fort Kent and Oyen).

Operational Procedure and Testing

Municipalities with existing mosquito abatement programs were relied on to identify samples of mosquito larvae and adults and to monitor mosquito development through the season. All mosquito surveillance centres were provided with a copy of mosquito identification keys[2]. Depending on their level of expertise, municipal personnel were able to at least separate all *Culex* species from other mosquito species.

Traps used to capture mosquitoes were the standard CDC (Centre for Disease Control) model[3] used for monitoring diseases in insects. At least two traps were issued to all centres. Traps were baited with carbon dioxide (in the form of dry ice) and operated without lights (in accordance with the West Nile virus National Steering Committee Guidelines). Traps were operated from July 8 (immediately following confirmation of the first positive WNv positive bird on July 7) until the last week in September. A total of 50 CDC traps were operated one night per week (usually Tuesday evenings) over the surveillance period. Live adult female mosquitoes were collected, killed by freezing, identified to species and sorted into pools of no more than 50 (usually each Wednesday). Pools were then packaged in vials and shipped to the Provincial Laboratory in Calgary (on Thursdays and Fridays). Analysis of the mosquitoes for presence of the West Nile virus was conducted using Nucleic Acid Sequence Based Amplification (NASBA) and Reverse-transcripterase Polymerase Chain Reaction (RT-PCR) methods. Results of analysis were provided to Alberta Environment on a weekly basis (the Monday following the Tuesday collection event) and, in turn, forwarded to the respective surveillance centres.

Mosquito Species Background and Determination

The Government of Alberta had previously surveyed and documented the mosquito species that inhabit the province (1974 to 1993). Most of Alberta's 44 species of mosquitoes are considered to be 'nuisance' mosquitoes and are not generally known to contribute significantly to transmission of West Nile virus or other diseases previously tracked in Alberta[4]. These mosquito species overwinter as eggs and require snowmelt and significant rainfall events to hatch from eggs and develop in standing water as larvae. This process typically begins in early spring and the emergence of adult mosquitoes occurs in 6 to 8 weeks. Throughout the remainder of the season annoyance levels will fluctuate in response to significant rainfall events that cause flooding where eggs have been laid on the dry margins of standing water bodies. Once egg hatching occurs, adults will begin emerging in approximately 5 to 14 days depending on such factors as weather conditions and water temperatures.

In Alberta, there are approximately 10 mosquito species that overwinter in the adult stage and 3 of these are in the genus *Culex* (*Culex territans*, *Culex restuans* and *Culex tarsalis*). These species are common to all the Prairie Provinces. In Alberta, *Culex tarsalis* is prevalent in the southern half of the province and has been determined to be very common in irrigated areas. *Culex tarsalis* is also widely distributed throughout most of western North America. *Culex restuans* has been found more common through east-central Alberta and *Culex territans*

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[2] *The Insects and Arachnids of Canada Part 6: The Mosquitoes of Canada* by Wood, Dang and Ellis, 1979. Identification keys developed for mosquito species of Alberta were also provided to assist in mosquito adult and larvae identification.

[3] BioQuip Products, Inc., California

[4] Western Equine Encephalitis and Dog Heartworm

throughout Alberta in small numbers. *Culex territans* primarily obtains blood from reptiles and amphibians, while *Culex tarsalis* and *Culex restuans* prefer to obtain blood from birds for the successful maturation of their eggs. Later in the season, *Culex tarsalis* is more likely to switch feeding to other animals and humans.

Culex species are not usually targeted in municipal mosquito control programs as their numbers are not significant and many of their habitats are difficult to locate/access. During 2003, many of the participating municipalities focused attention on finding the source of development and habitat preferred by *Culex* species and taking appropriate control measures to reduce *Culex* populations.

Results

Season Synopsis

In 2003, notably annoying numbers of adult mosquitoes were common throughout much of Alberta during mid to late May. This occurrence is generally attributed to increased egg hatch triggered by a significant snowmelt and early precipitation not seen in Alberta for the last few years. Mosquito numbers declined during the month of June and no subsequent egg hatches of any significance occurred in most areas due largely to drier than average weather conditions during the June to September period. Consequently, mosquito annoyance levels were moderately low during the balance of the summer season.

During 2003, the first *Culex tarsalis* larvae were found in southern Alberta during the second week of June. This is quite typical for this mosquito species, thus indicating that the first seasonal cohort of overwintered adults had begun to blood feed and lay eggs in late May/early June. The CDC traps were placed at the surveillance centres throughout the province in the second week of June. These traps, baited with carbon dioxide in the form of dry ice, are designed to attract female mosquitoes seeking blood meals. The second cohort of adults was observed in the CDC traps in early July, followed by a third cohort in early August. As expected, trap collections of *Culex tarsalis* dropped off significantly around the third week of August when adult females normally cease blood feeding in preparation for winter (diapause). Although *Culex tarsalis* became undetectable in CDC traps by the first week in September, some municipal mosquito abatement program personnel continued to check for *Culex tarsalis* development in water and used New Jersey Light Traps to continue trapping adult mosquitoes (the mosquitoes are attracted to light in these traps). In southeastern areas of the province, significant numbers of *Culex tarsalis* were found to develop to a fourth adult cohort that emerged in late September. It is assumed that these adults would then seek out suitable overwinter sites as opposed to seeking a blood meal for further egg production.

The mosquito sorting and identification conducted by the municipalities provided an indication of the abundance and distribution of the most common mosquito species found in the province during 2003 (see *Table 1: Abundance (Percent) of Mosquito Species Captured in Alberta Municipality CDC Trapping Stations from July 8 to September 27, 2003*). Overall the numbers captured were relatively low. In centres such as Edmonton and Calgary the higher numbers are a reflection of more traps being operated. The greater number of species identified in some centres is also reflective of mosquito identification experience (Edmonton, Calgary, Grande Prairie, Red Deer, Camrose, Medicine Hat). Although identification resources and expertise were limited in other centres, all were proficient in separating the *Culex* species. The lower

abundance and type of species found in some of the satellite centres (High River, Strathmore, Indus, Vulcan and Coaldale) is a reflection of a shorter time period that those traps were in operation.

Results confirmed the distribution of *Culex tarsalis* to the southern half of Alberta (as was the case in previous assessments). *Aedes vexans*, the most common nuisance species, continues to be found throughout the province and the collections were higher in late summer and appeared from precipitation records to be associated more with the influence of irrigation practices in the southern portion of the province rather than localized rainfall events.

One disadvantage of using CDC traps is that they do not attract, in an equal fashion, all species of mosquito in an area. As with most other types of traps, attraction is conditional on the type of bait, time of operation, geographical location, proximity of the trap to interferences such as light and other attractants (e.g. livestock yards, human settlements), the species of mosquito present, and other such factors. As a result, the above list cannot be considered a complete reflection of all the species that may be common to an area. However, it does provide a good representation of most mosquito species within the area. It is further acknowledged that the lack of precipitation in most areas likely had a major influence on the reduced presence and abundance of more typical nuisance mosquito species in the surveillance areas.

Trap Operation for Virus Analysis

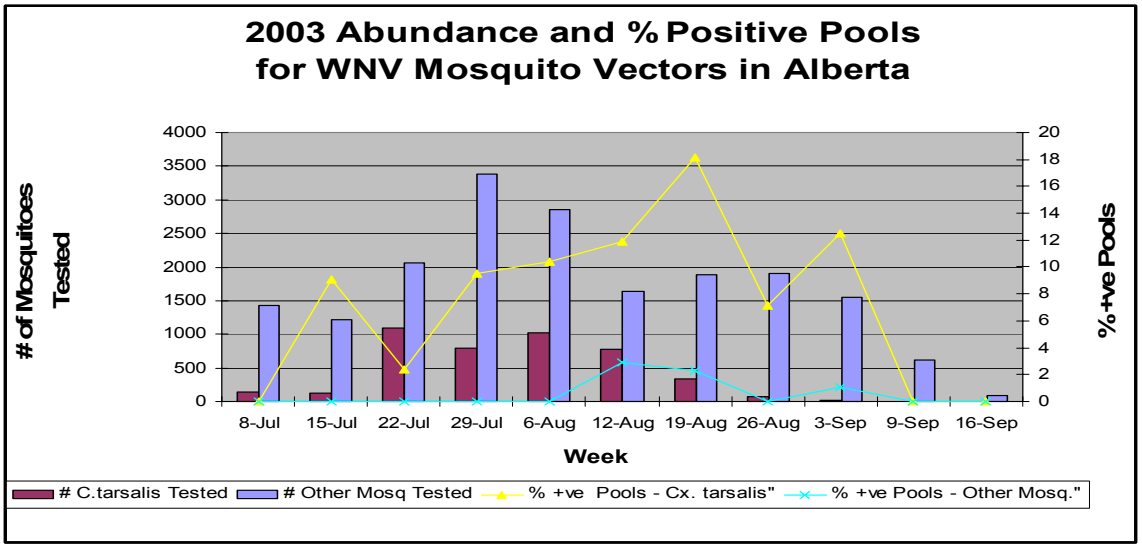
Mosquitoes collected over the 11 weeks of the Mosquito Surveillance Program (July 8 to September 27) were sorted, in most cases into *Culex* species (16% of the total provincial catch) and "Other" species. A cumulative total of 1,417 pools of mosquitoes (comprised of 23,072 female mosquitoes) were tested over this period. Thirty-one pools were found to be positive for the West Nile virus (see *Table 2: Province of Alberta 2003 Summary of Mosquito Surveillance Program for West Nile virus*).

Culex species made up the major portion of the pools that were confirmed positive for West Nile virus (25 of the 31 pools). One of the 31 positive pools was *Aedes vexans*, and 5 of the 31 were "other" species.

It is suspected that through the sorting and identification process that contamination of "other" species pools of mosquitoes through broken mosquito body parts may have lead to cross contamination of samples. This may account for the positive WNv readings in pooled species identified as other than *Culex tarsalis*.

The measured period of adult *Culex tarsalis* biting activity occurred during the period July 6 (Week 28) to August 24 (Week 35) (see Figure 1). Maximum population peaks were reached the week of July 20 (Week 30) and again in the second week of August (Week 32). This observation strongly supports the general understanding that generations of this species tend to occur about 35 to 40 days apart. *Culex tarsalis* populations began to decline in the traps the third week in August (Week 34). This finding coincides with previous reports indicating that *Culex tarsalis* populations enter diapause and cease blood feeding when day-length becomes less than 16 hours.

Figure 1:



Other species may play a role in build-up and spread of the virus in birds and other animals, acting as "bridging vectors". However, the replication of the virus is thought to be more successful in *Culex* species, thus making this species a better transmitter of the virus. Due largely to the dry conditions, there were few numbers of other species collected in 2003, so it is difficult to draw any conclusions in this regard in the absence of supporting data. There is some anecdotal evidence that can be drawn from the human-virus surveillance program data, which suggests that the highest incidence of human cases appears to be associated with the areas of highest *Culex* activity.

Geographical Location and Natural Regions

Comparisons of the information collected from participating municipalities as shown in the following charts, indicate the activity of *Culex tarsalis* and the detection of the virus in mosquitoes was more significant in the Grassland Natural Region than the Parkland Natural Region.

Figure 2:

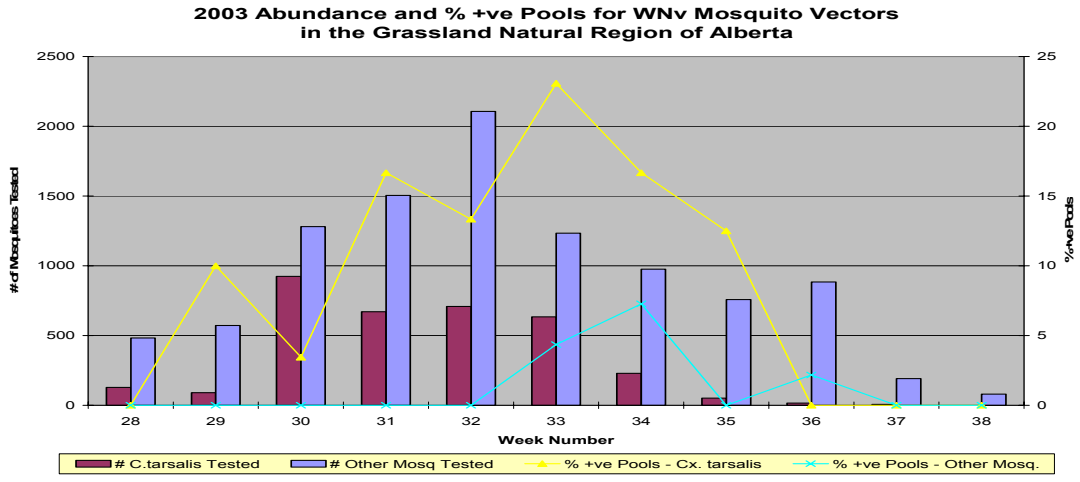
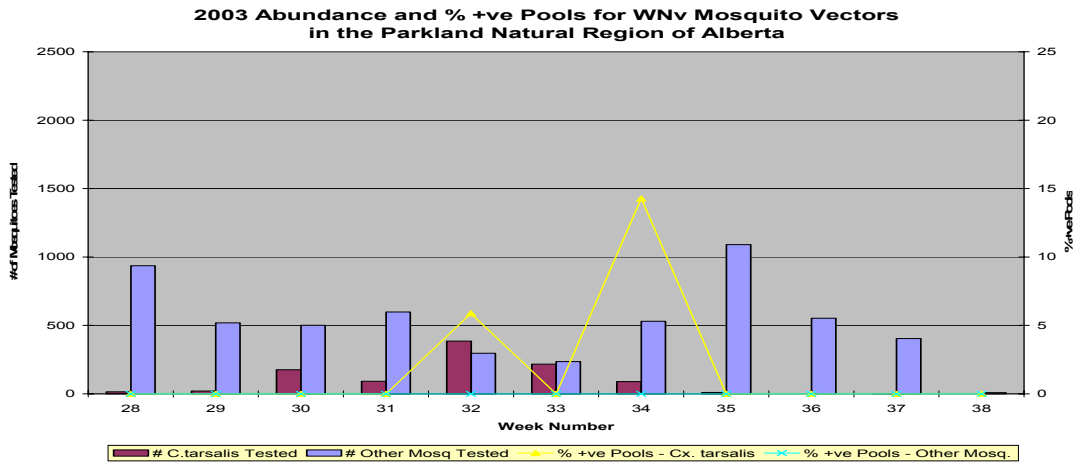


Figure 3:



Habitat Types

Many of the municipalities that conduct mosquito abatement programs, and some of the others that participated in the surveillance program made a concerted effort to determine the source of development for *Culex tarsalis*. It is 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.

Eggs can be deposited in open permanent water, however the eggs and larvae can be subject to extensive predation by other aquatic organisms. The success of this species appears to be related to its ability to find shallow, warm water that is not subject to physical disturbance or aquatic predators. Consequently, some of the significant developmental aquatic habitats where *Culex tarsalis* were found in August included:

a) abandoned sewage lagoons (particularly those that supported marginal vegetation that hung over the water providing protection from disturbance),
b) compost areas associated with mushroom farms and other compost storing facilities,
c) stored tires that were undisturbed for more than one season or that were partially covered in grasses or other vegetation,
d) tree plantations where planting holes had been left for more than one season, and
e) small pools of water from declining water levels surrounding large sloughs and rivers.

Other known habitats found in Alberta include seepage from irrigation canals, roadside ditches, livestock hoof prints that hold water/urine in pastures, non-flushed livestock and pet drinking containers, rain barrels, plugged eaves troughs on buildings, wet areas on over watered lawns, stagnant bird baths, shaded and litter covered woodland pools, etc.

Temperature Records and Influences

Temperature records were obtained for most of the participating municipalities in the surveillance program. The objective was to correlate temperature and precipitation with the development of *Culex* species and the potential activity of the West Nile virus. Rainfall events are not known to contribute significantly to the population peaks in *Culex tarsalis*, which can lay their eggs on the surface of any standing and protected water. Scientific studies have previously identified that a trigger temperature for potential mosquito-virus activity (Western Equine Encephalitis) may be in the order of 16ºC.

Environment Canada reports show consistent average daily (mean) temperatures in the majority of Grassland and much of the Parkland Natural region to be above 16ºC for seven weeks between July 6 (Week 28) and August 24 (Week 35). This may have contributed to the amplitude of virus transmission during this time period of the 2003 season.

Infection Rates

Infection rates of the mosquito pools were calculated using a standard Maximum Likelihood Estimate method[5] for infection rates of arbo-viruses. This method was chosen for the Alberta data, as total capture numbers of adult female mosquitoes were low (below 1000 per night) for the majority of the trapping period.

Infection rates in the *Culex tarsalis* populations commenced with the first positive WNv mosquito pool on July 15 (Week 29) and remained low through to the second week of August (Week 33). They then rose significantly to a peak in the first week in September (Week 36), dropping to zero the following week (Week 37). This three-week period of increased infection rates can possibly be attributed to the declining population of adult females, many of which are assumed to have lost interest in finding a blood meal and therefore are not being attracted to the traps. The very few mosquitoes that were attracted to the traps (2 to 6 specimens per pool) did show a proportionally high incidence of WNv infection. The significance of this finding cannot be determined without further investigation.

Conclusions

The compilation of all 2003 data obtained from participating mosquito surveillance centres in Alberta confirms the role of *Culex tarsalis* as the primary vector of WNv in this province.

The operation of traps in participating municipalities confirmed the presence of *Culex tarsalis* and prompted municipal personnel to locate and identify aquatic habitats where *Culex* larvae develop. Familiarity with *Culex* habitats will greatly assist mosquito control program personnel in preparing future control strategies to reduce populations of the primary West Nile virus vector species.

Examination of precipitation records for trapping locations demonstrated that rainfall events through the summer are not a significant contributing factor to population peaks of *Culex tarsalis*. This species commences development in late May when ambient temperatures reach a

[5] *Statistical Estimation of Infection Rates of West Nile Virus in Mosquito Populations*, Illinois Natural History Survey, Gu, W.; Lampmann,R; and Novak,R.J.

threshold (about 10ºC) and then increases its rate of development through the season until short day-length in mid to late August triggers diapause and they cease blood feeding. *Culex tarsalis* continues to lay eggs and develop through their life cycle until average air temperatures fall below 12ºC[6]. Their adaptation to these environmental conditions coupled with consistent warm weather above a threshold temperature (16°C), may be the determining factor for the amplitude of virus transmission.

Above average air temperatures continued in southeast Alberta until late summer and resulted in an emergence of a fourth cohort of adults late in September. It is presumed that the fourth cohort of adults will have the potential to overwinter, however it is not known what level of overwintering mortality will occur or whether successful overwintering by a high number of adults will increase the vector capacity for the 2004 season. Any evaluation of overwintering associated with increased populations would have to be evaluated against influence of additional virus loading from migrating birds. Successful overwintering is expected to be significant if a mild Alberta winter contributes to *Culex tarsalis* survival.

Across Canada the influence of non-*Culex* species as potential transmitters of the virus (bridging vector) is being examined. There was one positive pool of *Aedes vexans* species captured from a trapping site outside the City of Calgary Mosquito Abatement Program boundaries (Indus, Alberta) on August 19. Although high numbers of these species can develop after significant rainfall or irrigation events, their role as an effective transmitter of the virus (bridging vector) remains in question and is thought to be far less significant than that of *Culex tarsalis* and other *Culex* species.

The 2003 surveillance program confirms that the activity of West Nile virus in *Culex tarsalis* is of greater significance in the southern half of the province, and in particular in the Grassland Natural Region. Information gained during 2003 will assist in developing mosquito abatement strategies that can target this species at the most effective stages of its development.

For further information re WNv mosquito surveillance email Jock McIntosh at jock.mcintosh@gov.ab.ca

[6] *Oviposition Behavior of Natural Populations of Culex tarsalis and Culex restuans (Diptera: Culicidae) in Artificial Pools*, Journal of Medical Entomology, Vol 27, No. 2; Brust, R.A., March 1990

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- Jason Boarse and Jay Byer, Lakeland Agricultural Research Association, Fort Kent
- Trevor Wallace and Jacqueline Hawes, Chinook Applied Research Association, Oyen

Table 1: Abundance (Percent) of Mosquito Species Captured in Alberta Municipality CDC Trapping Stations from July 8 to September 27, 2003																				
STATION	***CUX***	***TER***	***RES***	***TAR***	***VEX***	***EXC***	***CSS***	***INO***	***OTS***	***FLA***	***DOR***	***SPE***	***CAM***	***CAN***	***STI***	***FIT***	***FLA***	***EUD***	***EAR***	***ALC***	**TOTAL**
Grande Prairie		4			9	13	9		3	20		20			16	5			1		883
Fort McMurray																				100	286
Fort Kent	2						4		94										<1		1390
Edmonton				13	46	9	<1	7	7	1	5	2	1	3		<1	1	1	3		5146
Camrose		<1	2	14	20	25			36		<1		<1	1	<1				<1		573
Red Deer				57	5	2	<1	2	7	3	1	<1							2	19	421
Drumheller				29	2			2	6											61	701
Strathmore				68	23			1												8	349
Calgary				18	6			1	74	<1	<1	<1							<1		6094
Indus				7	58			1												34	539
High River				80	2				17										1		294
Vulcan																				100	124
Brooks				20																80	2949
Oyen				44																56	237
Medicine Hat				22	10			12		<1	17	<1	<1							38	803
Lethbridge				26																74	401
Coaldale				8																92	560
Raymond				15																85	2405
Magrath				16																84	769
SPECIES CODE:																					

CUX = Culex species	VEX = *Aedes vexans*	OTS = *Ochlerotatus* species	CAM = *Ochlerotatus spencerii*	FLA = *Ochlerotatus flavescens*
TER = *Culex territans*	EXC = *Aedes excrucians*	FLA = *Ochlerotatus flavescens*	CAN = *Ochlerotatus canadensis*	EUD = *Ochlerotatus eudes*
RES = *Culex restuans*	CSS = *Culiseta* species	DOR = *Ochlerotatus dorsalis*	STI = *Ochlerotatus sticticus*	EAR = *Anopheles earleii*
TAR = *Culex tarsalis*	INO = *Culiseta inornata*	SPE = *Ochlerotatus spencerii*	FIT = *Ochlerotatus fitchii*	ALC = all species except *Culex*

Table 2: Province of Alberta 2003 Summary of Mosquito Surveillance Program for West Nile virus.

Surveillance initiated following confirmation of the first West Nile virus positive crow on July 4, 2003. There were 16 trapping centres located throughout the 9 Regional Health Authorities operating a total of 50 CDC Mosquito Traps baited with carbon dioxide. Traps were operated one night per week for a period of 11 weeks (8 July to 23 September, 2003).

CUM # of + POOLS	*+ POOLS FOR WEEK*	*WEEK*	*TOTAL # OF POOLS TESTED*	*CUM TOTAL# OF POOLS TESTED*	% of + POOLS FOR WEEK	LOCATIONS OF CONFIRMED + POOLS	+ MOSQUITO POOL SPECIES TYPE *
0	0	**28 (6 Jul – 12 Jul)**	96	96	0%		
1	1	**29 (13 Jul – 19 Jul)**	108	204	< 1%	Brooks	***Culex tarsalis (1)***
2	1	**30 (20 Jul – 26 Jul)**	156	360	< 1%	Brooks	*Culex tarsalis (1)*
6	4	**31 (27 Jul – 02 Aug)**	226	586	~ 2%	Brooks, Drumheller, Oyen, Strathmore	*Culex tarsalis (4)*
11	5	**32 (03 Aug – 09 Aug)**	194	780	~ 3%	Edmonton, Calgary, High River, Brooks, Raymond	*Culex tarsalis (5)*
19	8	**33 (10 Aug – 16 Aug)**	145	925	~ 6%	Drumheller (2), Calgary (2), Brooks (3), Oyen	*Culex tarsalis (6)* Other *(2)*
27	8	**34 (17 Aug – 23 Aug)**	165	1090	~ 5%	Edmonton (2), Calgary*, Strathmore, Coaldale (2), Raymond (2)	*Culex tarsalis (5)* *Aedes vexans (1)** Other *(2)*
29	2	**35 (24 Aug – 30 Aug)**	138	1228	~ 1%	Medicine Hat, Drumheller	*Culex tarsalis (2)*
31	2	**36 (31 Aug – 06 Sep)**	106	1334	~ 2%	Lethbridge, Raymond*	*Culex tarsalis* (1) Other (1)*

CUM # of + POOLS	*+ POOLS FOR WEEK*	*WEEK*	*TOTAL # OF POOLS TESTED*	*CUM TOTAL# OF POOLS TESTED*	% of + POOLS FOR WEEK	LOCATIONS OF CONFIRMED + POOLS	+ MOSQUITO POOL SPECIES TYPE *
31	0	**37 (07 Sep – 13 Sep)**	53	1387	0	None	None
31	0	**38 (14 Sep – 20 Sep)**	15	1402	0	None	None
31	0	**39 (21 Sep – 27 Sep)**	15	1417	0	None	None

* Of the positive pools tested 25/31 (81%) were *Culex tarsalis*; 1/31 (3%) was *Aedes vexans*; and 5/31 (16%) were other unidentified species.

UPDATED: 20 OCT 2003

VI. *Provincial Laboratory for Public Health (Microbiology)*

Laboratory Surveillance

Human Testing

Serology

Antibody testing for West Nile virus (WNV) was implemented in the Provincial Laboratory and was offered provincially on May 1st, 2003. The only available test, the Hemagglutination Inhibition Assay (HAI), was used. From May 1st until July 28th, this was the primary diagnostic test. No cases were detected, but some cross-reactivity was noted due to previous dengue infections.

In late July, commercial WNV IgM assays became available. Since there was no published experience with these assays, both available kits were run in parallel on all specimens. Confirmatory HAI titres, and neutralization titres performed at the National Laboratory in Winnipeg, confirmed that positive tests were accurate. It was noted that specimens collected in the first week of illness were IgM-negative in 50% of cases, indicating that a follow-up test is essential. WNV IgM will continue to be the primary WNV test for 2004.

Nucleic Acid Amplification Tests (NAAT)

Both polymerase chain reaction (PCR) and NASBA were implemented for WNV diagnosis in 2003, using commercial or published methods. All positive samples were confirmed by a second, different assay to ensure accuracy. Stat testing on CSF specimens was offered starting June 3rd. Only one patient in 270 was positive, (although only 11 specimens were submitted from patients with West Nile Neurological Syndromes). This test will continue to be offered stat in 2004.

NAAT testing on plasma was examined retrospectively as a potential supplementary diagnostic test. This test was much more successful than previous published reports suggested. Of 1128 specimens tested, 91 were positive. For WNV cases tested during the first week of illness, approximately 50% were positive, and were almost invariably those patients who had not yet developed IgM antibody. Thus, NAAT testing on plasma offers an extremely useful supplement to IgM testing for severe or transplant/transfusion-related cases. These results are being published, and the test will be offered in 2004.

Transplantation

NAAT testing on plasma specimens was implemented in June for organ donor screening. Special requisitions were devised, and turnaround times were set up according to the individual transplant program needs, with many tests performed stat. All transplant screens were negative in 2003.

Mosquito Testing

In collaboration with Alberta Environment, NAAT testing was implemented for mosquito pools June 10th using protocols adapted from the National Laboratory in Winnipeg. This program was successful in detecting infected mosquitoes before human cases were identified (first positive mosquito pool July 15th), mainly in the SE corner of the province. Almost all positive pools were *Culex tarsalis* or *Culex spp*.

WNV Testing Summary

Test	Population	Specimens tested	Patients tested	Positive patients
IgM	human diagnostic	3050	2353	246
CSF NAAT	human diagnostic	287	270	1
Plasma NAAT	human diagnostic	1169	1128	89
Plasma NAAT	transplant screen	330	288	0
Mosquito pool NAAT	Mosquito pools	1652 pools	n/a	31 pools

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

For more information regarding this data, please contact Dr. Peter Tilley by email at: peter.tilley@provlab.ab.ca

VII. *Communications*

Other than two travel-related cases in 2002, there had been no evidence of West Nile virus in the province as Alberta approached the spring of 2003. The virus was expected to arrive that year, but when and where could not be predicted.

Based on the experiences of other jurisdictions in the U.S. and Canada, it was clear that the risk of infection if and when the virus arrived in Alberta would be quite low. But, the growing evidence of potential consequences of a case of the more serious neurological syndrome made providing Albertans with reliable information on the virus an imperative.

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 2003 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

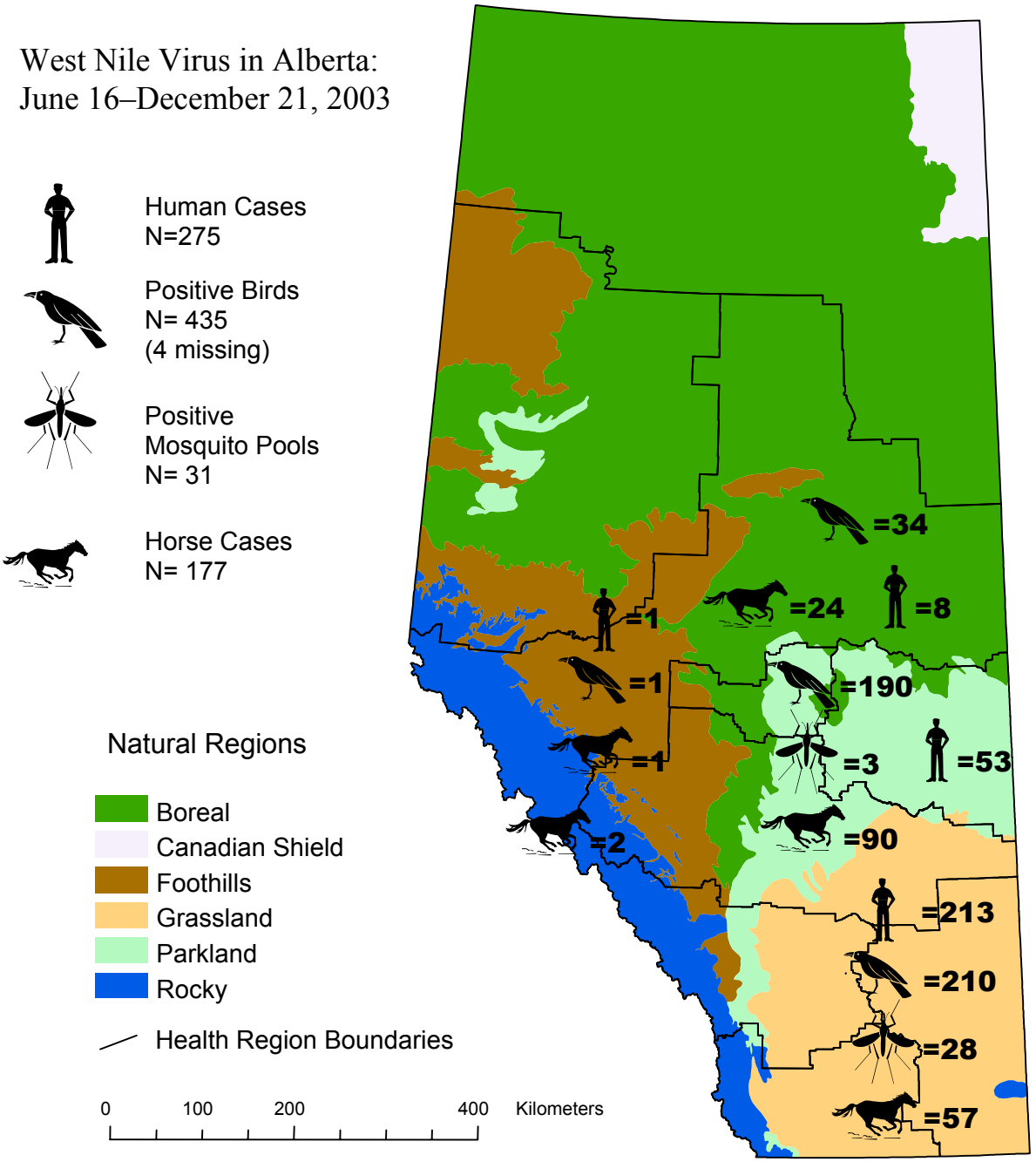
A variety of informal measures were used to evaluate the information campaign for 2003. We monitored:

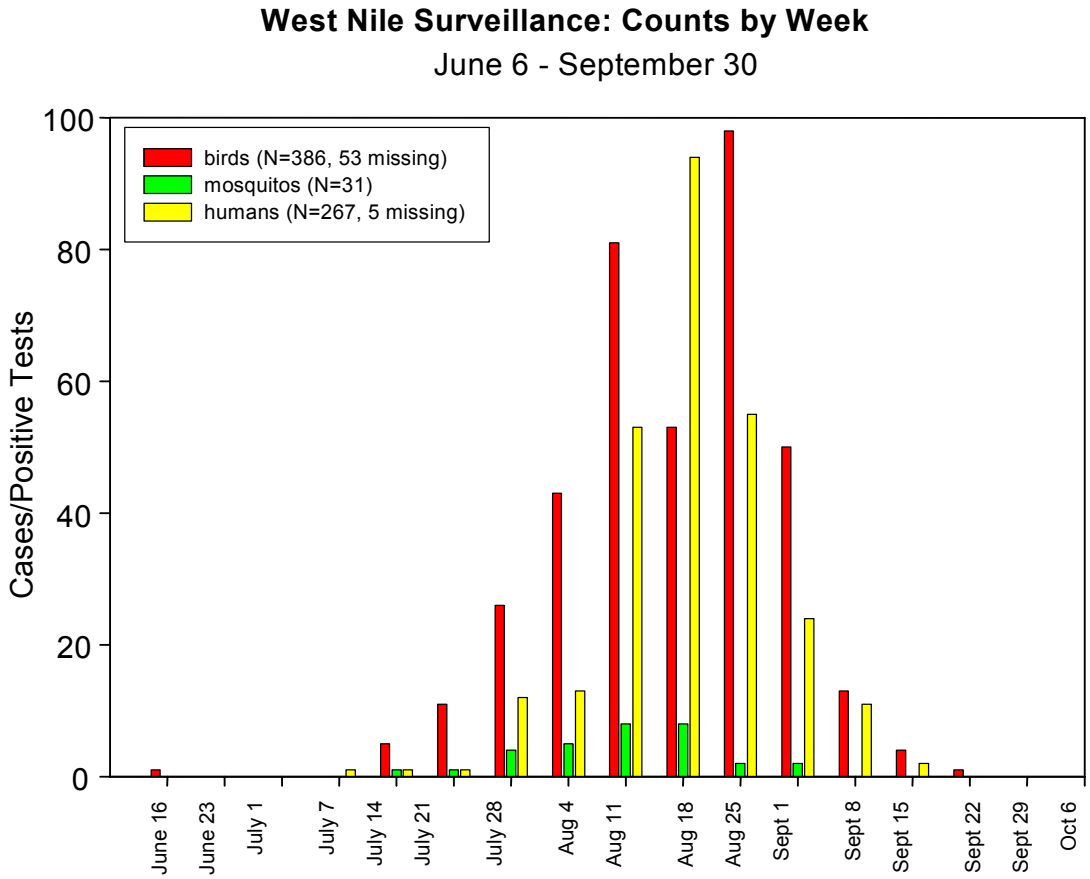
- Media coverage
- Web site visits
    - roughly 30,000 hits to our West Nile virus pages
- Phone calls to the provincial Health Link information line
- Public inquires to our ministry – letters, emails, phone calls, requests for materials
    - we had requests for over 50,000 additional direct mail brochures from major employers, schools and other jurisdictions
- We are planning to include some questions to determine knowledge, attitudes and behaviours around personal protection measures when we conduct a serosurvey later this month.

For further information contact: John Tuckwell at john.tuckwell@gov.ab.ca

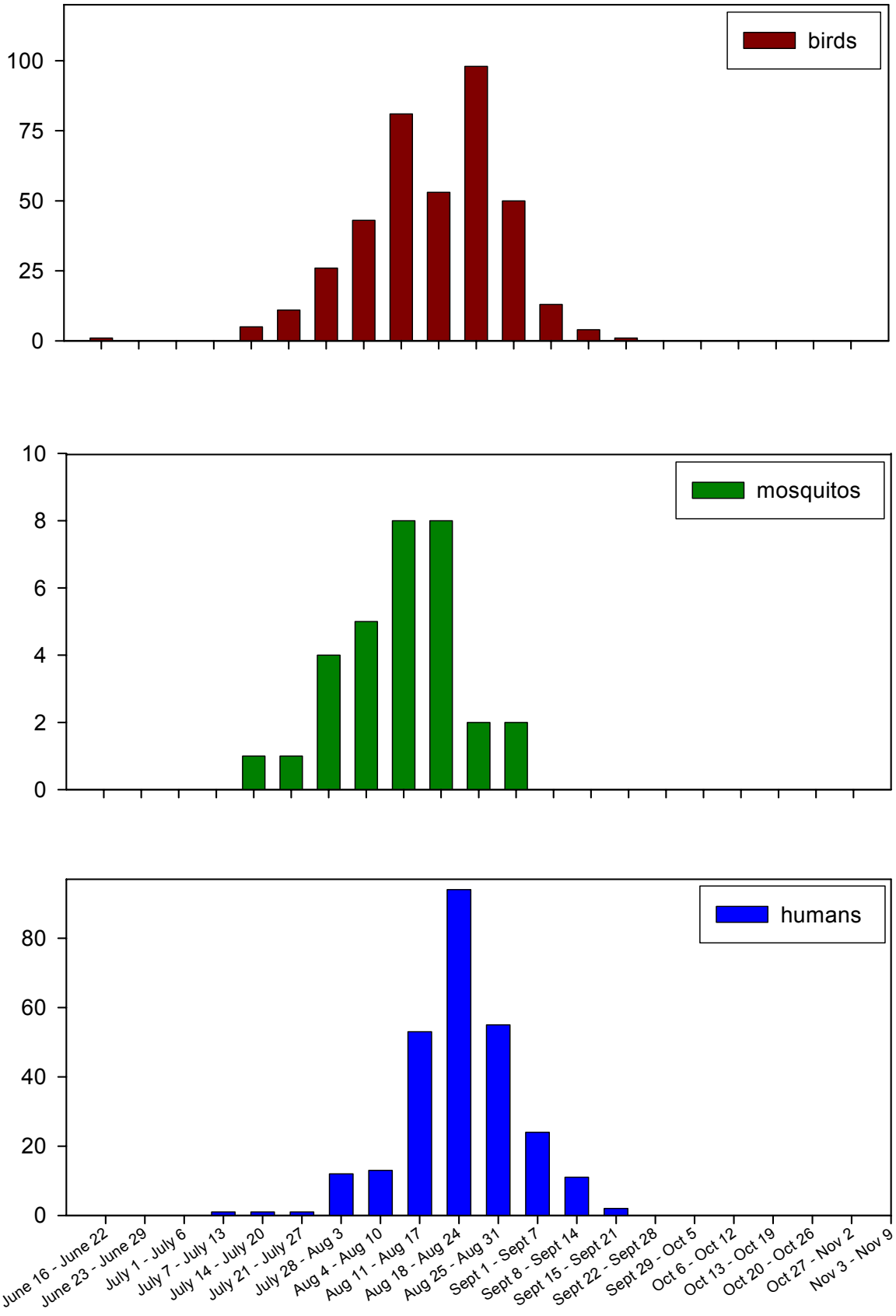
VIII. *Summary of Surveillance Across Species*

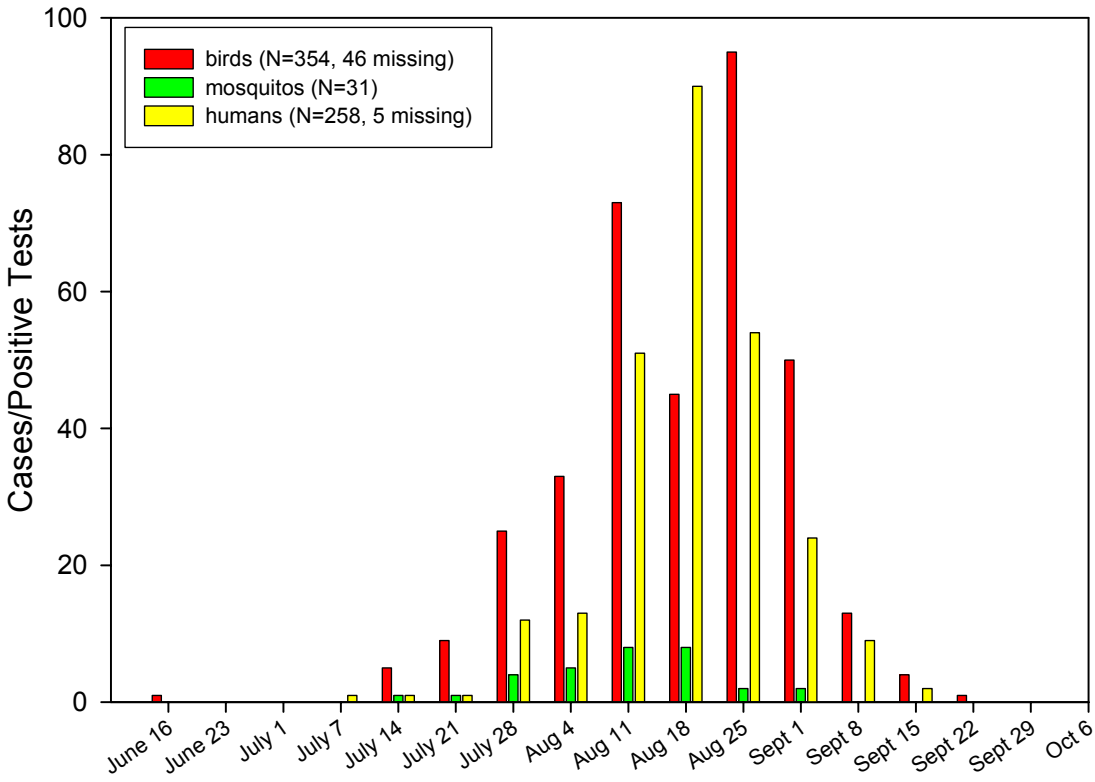
In 2003, the Interdepartmental West Nile virus Working Committee developed a series of objectives to undertake the collection, analysis and communication of information regarding WNv in humans, birds, mosquitoes and horses. This final chapter provides an overview of data from all species over time and place.




West Nile Surveillance: Counts by Week
June 6 - September 30
birds (N=386, 53 missing)
mosquitos (N=31)
humans (N=267, 5 missing)
Cases/Positive Tests
100
80
60
40
20
0
June 16
June 23
July 1
July 7
July 14
July 21
July 28
Aug 4
Aug 11
Aug 18
Aug 25
Sept 1
Sept 8
Sept 15
Sept 22
Sept 29
Oct 6

West Nile Virus Surveillance
in Alberta
Weekly counts: June 6 – September 30, 2003




West Nile Surveillance in Parkland and Grassland:
Counts by Week
June 6 - September 30
birds (N=354, 46 missing)
mosquitos (N=31)
humans (N=258, 5 missing)
Cases/Positive Tests
0
20
40
60
80
100
June 16
June 23
July 1
July 7
July 14
July 21
July 28
Aug 4
Aug 11
Aug 18
Aug 25
Sept 1
Sept 8
Sept 15
Sept 22
Sept 29
Oct 6

Key Findings

- West Nile virus was well documented in birds, horses, humans, and mosquitoes in the southeast of the province and as far north as Grand Cache.
- The highest prevalence of WNv in all species was in the Grassland natural region where the mosquito vector, *Culex tarsalis* was infected with the virus and the climate is dry and warm.
- The geographic distribution of WNv positive horses, birds and mosquito pools mirrored that of human cases.
- The distribution of cases in all species in the natural regions matches with the results from Saskatchewan and Manitoba.
- Birds were the best sentinel for human cases however the results do not provide significant lead time to implement increased prevention measures.

Acknowledgements

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Dr. Gerald Ollis – Alberta Agriculture, Food and Rural Development
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