Spatial and Temporal Differences in Giant Kidney Worm, *Dictophyma renale*, Prevalence in Minnesota Mink, *Mustela vison*

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Examination of 110 Mink (*Mustela vison*) carcasses from 1998 through 2007 indicated that the giant kidney worm, *Dioctophyma renale*, occurred in Pine and Kanabec Counties of eastern Minnesota with annual prevalences of 0-92%. Worm prevalence increased from 20% in 1999 to 92% in 2001 and decreased to 6% in 2005. During 2000 to 2007, no worms were found in Mink from Anoka and Chisago Counties (n = 54), and in 2000, none in 107 Mink from LeSeur, Freeborn, Redwood, Brown and Watonwan Counties. Changes in kidney worm prevalence were positively related to trapping success, considered an index of Mink density.

Key Words: Mink, *Mustela vison*, giant kidney worm, *Dioctophyma renale, Lumbriculus variegatus*, Minnesota.

The giant kidney worm (*Dioctophyma renale*) infects several species of carnivores in many areas of the world including the Mink (*Mustela vison*). The worm inhabits the right kidney of the Mink and destroys it. Studies of captive Mink infected with *D. renale* document that the worm can cause morbidity or mortality in that host (Graves 1937; Meyer and Whitter 1950; Mace and Anderson 1975). Reported prevalences of *D. renale* in Mink vary from 1 to 48% (Woodhead and McNeil 1939; Sealander 1943; Hallberg 1953; Schacher and Faust 1956; Miller and Harkema 1964; Crichton and Urban 1970; Fyvie 1971; Mace and Anderson 1975; Jorde 1980; Mech and Tracy 2001).

However no information is available about local kidney worm distribution in an area or about temporal changes in prevalence. Herein I provide new information about *D. renale* prevalences in Mink in various parts of eastern Minnesota and about temporal changes in prevalence.

Methods

I trapped Mink during the legal fur trapping season in 1998 to 2007 (except 2003) in counties of eastern Minnesota (Pine and Kanabec) where *D. renale* was known to exist (Mech and Tracy 2001) and in 2000, 2001 and 2004 to 2007, in counties where it was not known to exist (Anoka and southwestern Chisago). I also obtained 107 carcasses from trappers in five southern and southeastern Minnesota counties (Le Seur, Freeborn, Redwood, Brown, Wantowan) during 2000 where *D. renale* was not known to exist. I examined the kidneys and peritoneal cavities of the Mink carcasses for *D. renale*. I also compared my Mink trapping success between counties where *D. renale* was found with my success in the counties where I trapped and found no *D. renale*. I used the same trapping methods throughout the study area (Figure 1). I compared *D. renale* prevalences in the two areas by chi-square analysis.

Results

I captured 110 Mink in 6195 trap nights in Pine and Kanabec counties and 54 Mink in Anoka and southwestern Chisago counties during 2696 trap nights in 2000 to 2007 (Table 1). Although overall success rate was higher in the worm-free area (Table 1), the difference between the two study areas was not significant (χ^2 = 0.54; P = 0.46; d.f. = 1). In the area known to harbor *D. renale* (Mech and Tracy 2001), annual *D. renale* prevalence varied from 0 to 92%, whereas in the area not known to harbor the parasite, the prevalence was 0% (Table 1). I found no *D. renale* in the 107 carcasses from the five southern and southeastern counties.

Annual kidney worm prevalence in Pine and Kanabec counties increased from 20% in 1999 to 92% in 2001 and then decreased to 6% in 2005 and remained low through 2007 (Figure 2). Trapping success was strongly correlated with worm prevalence in that study area (r^2 = 0.72, P < 0.01, Figure 3). Trapping success in the two study areas was weakly correlated (r^2 = 0.49, P = 0.12).

Discussion

My data indicate that the giant kidney worm (*D. renale*) did not exist or existed in very low prevalences in areas of eastern Minnesota south of about Wyoming, Minnesota (latitude 45°22'N.), in southwestern Chisago County during this study while its prevalence was high north of that area. These findings that *D. renale* range or prevalence in eastern Minnesota differs between north and south begs the question as to why this

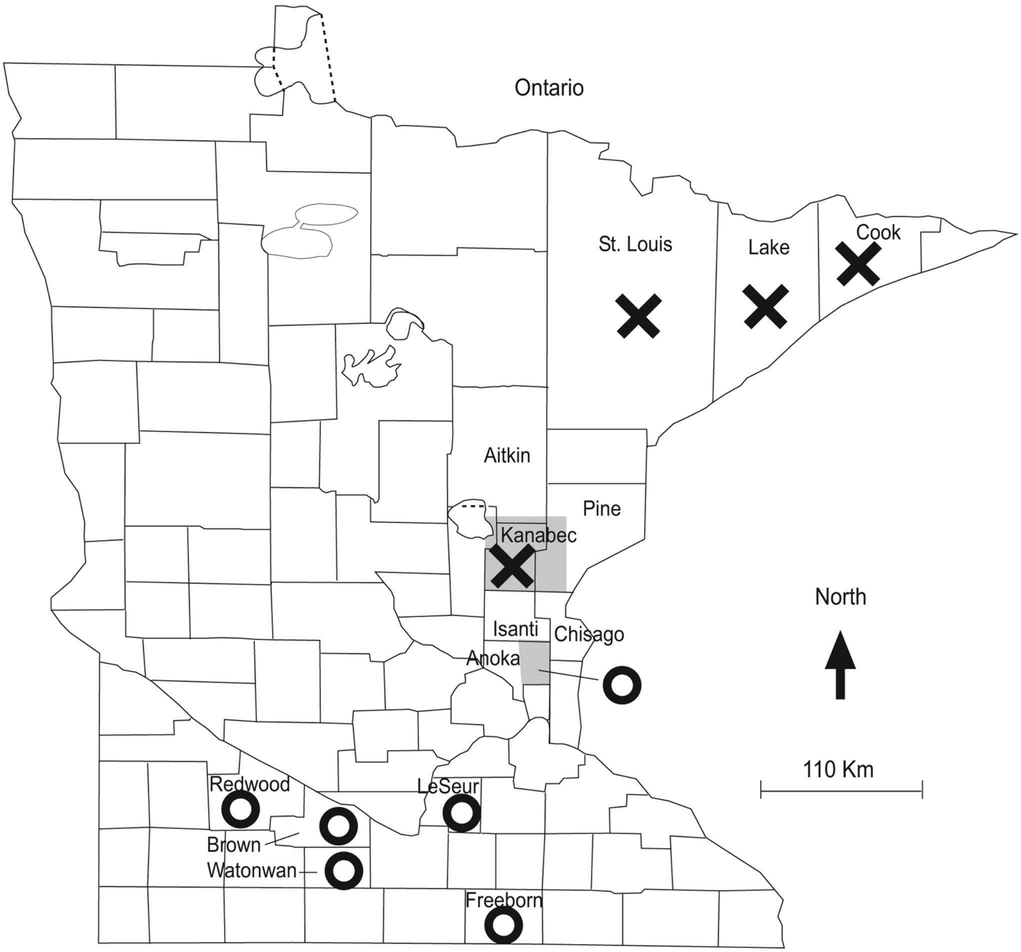

FIGURE 1. Areas where temporal prevalence and distribution of giant kidney worm in Mink were studied (shaded). Counties where worms were known to occur (X) or where not found (O) by this study or by Mech and Tracy (2000).

TABLE 1. Prevalence of giant kidney worm (*Dioctophyme renale)* in eastern Minnesota Mink and capture success.[1]

	Kanabec and Pine counties				Anoka County[2]		
Year	Mink Caught	Trap Nights	Capture Success (%)	Worm prevalence (%)	Mink Caught	Trap Nights	Capture Success (%)
1998	18	1116	1.61	35			
1999	10	740	1.35	20			
2000	6	310	1.94	50	11	347	3.17
2001	24	960	2.50	92	11	319	3.45
2002	11	363	3.03	82			
2004	14	574	2.44	43	13	624	2.08
2005	16	944	1.69	6	4	348	1.15
2006	6	618	0.97	0	7	546	1.28
2007	5	570	0.88	20	8	512	1.56
Total	110	6195	1.78[3]	35	54	2696	2.00[3]

[1] Considered an index of Mink density

[2] No worms found in Anoka County Mink and no trapping in Anoka County in 1998, 1999, 2002, or 2003.

[3] Average annual success not significant.

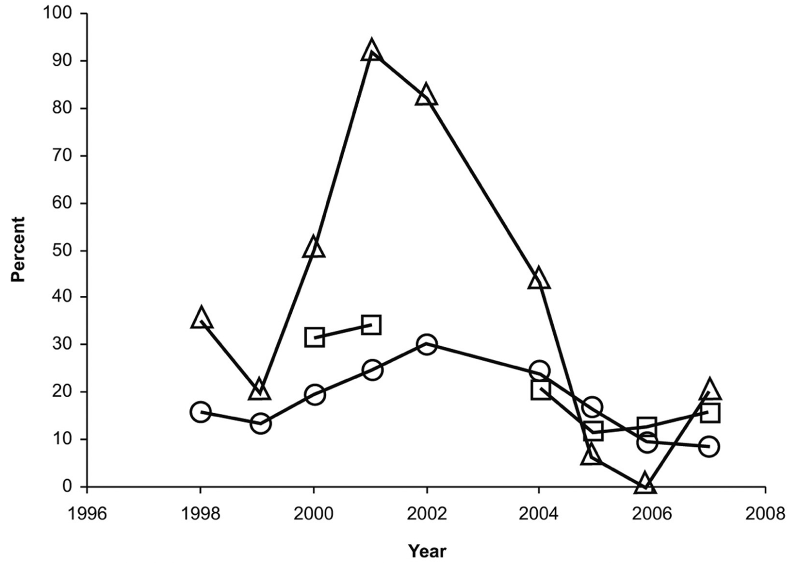

FIGURE 2. Prevalence of giant kidney worms in Mink of east-central Minnesota (triangles), Mink-trapping success rate in worm area (circles) and in worm-free area (squares).

is so. Mink inhabit all types of waterways and feed on a variety of fish, frogs, birds, and mammals, so it is difficult to compare Mink habitat suitability among various areas. The intermediate host of *D. renale* is the water worm (*Lumbriculus variegatus*), and various fish and frogs are paratenic hosts. Because fish and frogs are widespread throughout eastern Minnesota, this strongly implicates the distribution of *Lumbriculus variegatus* as the prime factor causing the difference in the *D. renale* distribution or prevalence. *Lumbriculus variegatus* depends on passive means such as stream flow or perhaps incidental carry by animals in Mink, to increase its distribution (Timm 1980). Therefore, it is understandable how it may live in one watershed but not in another that may be close but across a divide. Thus future research into this subject should include an assessment of *Lumbriculus variegatus* distribution.

My findings that *D. renale* increased and then decreased over a five-year period, peaking at the highest prevalence ever reported in Mink, suggest that prevalence may show cyclicity. The correlation between *D. renale* prevalence and trapping success may indicate that prevalence fluctuates with Mink density. This interpretation assumes that non-infested Mink are just as trappable as infected Mink, an assumption justified by the similarity in trapping success between both study areas, one with *D. renale* and the other without. I had > 20 years' experience trapping Mink with the same methods before the study began, so differences in annual trapping success probably reflect actual differences in Mink density.

The effect of *D. renale* on Mink density is difficult to gauge. The correlation between trapping success in both study areas might suggest that in general *D. renale* has little population effect. However, the fact that the lowest success rates (2006 and 2007) in the *D. renale* area were considerably lower than those in the worm-free area offer some evidence that after Mink reach high densities in the *D. renale* area, and thus high worm prevalence, they might drop to lower density than in the worm-free area. Further research might elucidate this question.

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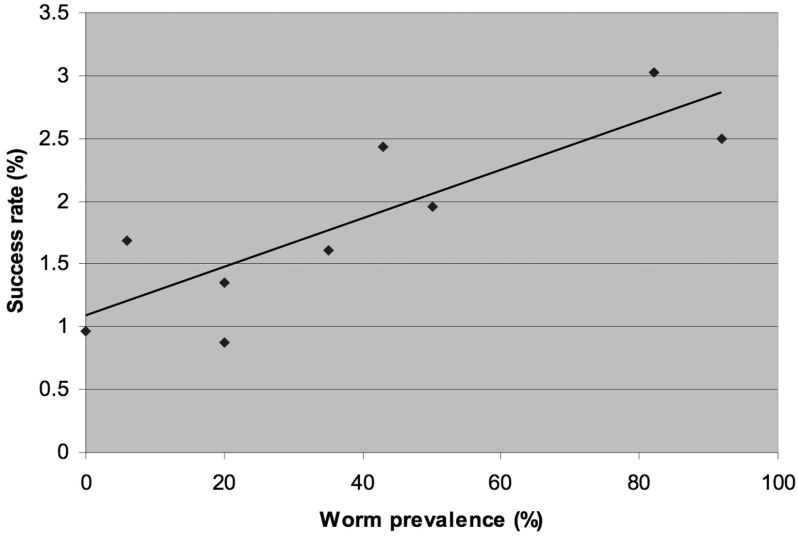

FIGURE 3. Relationship between Mink-trapping success and kidney worm prevalence in Mink; $r^2 = 0.72$; $P < 0.01$; $y = 0.0193x + 1.0782$.

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