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Monitoring the Status of Mink (*Mustela vison*) in Illinois

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ABSTRACT

Methods to census mink (*Mustela vison*) at large spatial scales are lacking. Therefore, we used museum records, trapper questionnaires, and sign surveys to determine their distribution in Illinois. We also evaluated the potential for using museum records and sign surveys to detect trends in relative abundance. From 1999 to 2005, biologists detected the presence of mink during 326 visits to 77 stations in 74 counties. Curators of 6 collections provided information about 166 specimens from 35 counties. Few (n = 17) were recent (1980-2004) records. A total of 293 trappers reported capturing 1,321 mink during the 2003-04 and 2004-05 trapping seasons. Altogether, we documented recent occurrences of mink in 92 of 102 counties. Harvest estimates and questionnaires are adequate for monitoring the status of mink; museum records are not. Sign surveys can be implemented at a cost of <$14,000 (US) annually to derive quantitative estimates of relative abundance from site occupancy data if status becomes a concern.

INTRODUCTION

Quantitative methods to determine absolute or relative abundance of mink (*Mustela vison*) at a large spatial scale are lacking (Eagle and Whitman 1987). Therefore, status assessments consist of expert opinion supported by data from harvest records (Forbes 1912, Soper and Payne 1997), museum voucher specimens (Hoffmeister 1989), and questionnaires returned by fur-takers (Mohr 1943), government officials (Wildhagen 1956, Bevanger and Ålbu 1986) or other authorities (Gerell 1967, Bevanger and Henriksen 1995). Such assessments are adequate for immediate conservation needs (Larivière 2003) but lack rigor required for direct comparisons at a later time.

We documented the current distribution of mink in Illinois to determine whether changes have occurred since Hoffmeister's (1989) assessment. Our sources of data included museum records and sign surveys. We evaluated suitability of these data for applying analytical innovations that allow detection of trends in relative abundance. We also provide costs for determining site occupancy so managers can decide if adequate resources are available to do so.

METHODS

Sign Surveys

Trained staff from the Illinois Department of Natural Resources (IDNR) conducted sign surveys at a sample of Basin Survey Sites established by the Illinois Environmental Protection Agency (1996) and IDNR to monitor surface water quality, diversity and abundance of fishes, and other indicators of the biotic integrity of riverine systems. We selected 75 of 102 counties for sampling based on the existence of Basin Survey Sites, delineations of watersheds [≥3 stations per population management unit as defined by Bluett et al. (1995)], and assigned work areas (typically, each biologist sampled 2 counties).

Practical considerations limited strict random selection of sites within counties. Sites that might have been difficult to locate or access (e.g., in the center of a large river with no corresponding landmarks on shore) were not considered. Those that were part of the Ambient Water Quality Monitoring Network (AWQM) were given preference. For example, if a county had 10 stations, 2 of which were part of the AWQM, we listed the 2 AWQM stations in random order followed by 2 standard Basin Survey Sites in random order. If no AWQM stations occurred in a county, 4 standard Basin Survey Sites were listed in random order.

We do not believe that our sampling strategy biased results because AWQM stations are considered representative of the stream reaches where they are located (Illinois Environmental Protection Agency 2002) and differ from standard Basin Survey Sites primarily because a greater number of chemical, physical, and biological characteristics are assessed at AWQM stations than standard Basin Survey Sites. Biologists evaluated sites in the order listed, selecting the first with conditions deemed suitable for detecting the presence of mink (e.g., waterways with rock or sod-bound shorelines were rejected). With a few exceptions, sites selected the first year were sampled during subsequent years.

Biologists conducted sign surveys once per year during 1 Feb through 31 Mar in the southern furbearer zone (i.e., south of U.S. Route 36) and 15 Feb through 15 Apr in the northern zone. Snow cover was not a prerequisite for conducting surveys and seldom existed during sampling. We avoided sampling shortly (<48 hrs) after rainfall that might obscure or eliminate sign and while rivers were rising quickly or at flood stage.

Using hip chains to determine distances, biologists traveled ≤300 m upstream and downstream from survey mid-points (i.e., road bridges identified as Basin Survey Sites or AWQM stations), and searched both shorelines for tracks, scats, and other signs of the presence of mink, river otter (*Lontra canadensis*), and beaver (*Castor canadensis*; i.e., a total of 1200 m of shoreline unless the presence of all 3 species was documented in a shorter distance). Data collected by staff included the presence of target species and types of evidence encountered. They also reported the percentage of shoreline with conditions deemed suitable to detect an animal's presence. Suitable conditions consisted of a band of sand or mud substrate along the water's edge; width of the band varied from a few centimeters to approximately 2 meters from the water's edge depending on substrate, slope, presence of rank vegetation, and other attributes of the bank. We calculated detection rates by dividing the number of sites where mink were detected by the total number of sites sampled.

Costs, tracked by IDNR's Programmatic Accounting System for reimbursement under Federal Aid in Wildlife Restoration Project W-99-R, were based on man-hours coded to the project for all tasks (i.e., data collection, entry, and analyses; preparation of reports), included an indirect cost of 23.3%, and are reported in US dollars.

Museum Specimens

Hafner et al. (1997) identified mammal collections in the Western Hemisphere. Using this guide, we sent letters to curators of large collections (>500 specimens) located in Illinois to obtain information about dates and locations that mink were collected. An initial request was mailed during December 2004; non-respondents received a second request during October 2005. We also searched 7 on-line databases (Burke Museum of Natural History and Culture, Yale Peabody Museum, Florida Museum of Natural History, University of Massachusetts at Amherst Mammalogy Collection, University of Alaska Museum of the North, Harvard University Museum of Comparative Zoology, and University of California, Berkeley Museum of Vertebrate Zoology) for information about specimens housed at out-of-state institutions. We judged the relative value of our sample by comparing sizes of collections housed by respondents and on-line sources to collections documented by Hafner et al. (1997).

Trapper Questionnaires

Each year, the Illinois Natural History Survey sends questionnaires to a stratified random sample of licensed trappers to determine their harvest, harvest effort, and opinions about management programs. Most (78%) of the 665 trappers contacted after the 2003-04 season responded (Miller et al. 2004), as did most (79% of 684) contacted after the 2004-05 season (Hubert et al. 2005). Respondents comprised approximately 18% of all licensed trappers during the 2003-04 season and 17% during 2004-05 (Miller et al. 2004, Hubert et al. 2005). More detailed methods and summaries were described in unpublished reports to IDNR (Miller et al. 2004, Hubert et al. 2005). We used raw data to link captures by successful mink trappers to the inquiry, "In which county did you do most of your trapping?"

RESULTS

Sign Surveys

Biologists made 454 visits to 78 stations in 75 counties during 1999 through 2005. They detected mink during 326 visits (71.8%) to 77 stations in 74 counties during this period (Fig. 1). Mink were detected frequently (≥67% of visits) at 49 stations and infrequently (≤33% of visits) at 12 (Appendix I). Detection rates varied from 0.69 to 0.73 during 2000 through 2004, when 70-75 stations were visited annually. The greatest detection rate (0.85) occurred in 1999 when 41 stations were sampled; the least (0.64) occurred in 2005 ($n = 47$).

Costs were similar in 2003 (235.5 man-hours; $10,218.55; 73 survey locations) and 2004 (231.5 man-hours; $10,723.25; 70 survey locations). Scaled-back efforts in 2005 (47 survey locations) cost $7,388.10 for 164 man-hours. During 2003 through 2005, the average cost per survey location per year was 3.32 man-hours valued at $149.10, including indirect costs.

Museum Specimens

Curators of 6 collections in Illinois (Field Museum of Natural History, Illinois Natural History Survey, Illinois State Museum, Illinois State University, Southern Illinois University at Carbondale, and University of Illinois Museum of Natural History) provided information about 166 specimens of mink with associated dates and/or locations of collection. Our on-line search yielded information about 2 additional specimens. Based on a recent assessment of mammal collections (Hafner et al. 1997), institutions in our sample housed approximately 96% of specimens kept in Illinois and 19% of those in North America.

Locations were available for 146 specimens from 35 counties. Dates were available for 145 specimens; the most recent was collected in 2002. Seventeen specimens were collected during 1980-2004, 71 during 1955-1979, 36 during 1930-1954, 17 during 1905-1929, and 4 during 1899-1904. Runs of years (≥2) without collections were more common from 1980-2004 (n = 6) than 1955-1979 (n = 1), 1930-1954 (n = 2), and 1905-1929 (n = 2). The longest run (16 yrs) occurred from 1909-1924.

Trapper Questionnaires

Questionnaires distributed after the 2003-2004 trapping season resulted in 517 usable responses from trappers residing in 85 of 102 counties; these included responses from 140 successful mink trappers who reportedly captured 695 mink. Questionnaires distributed after the 2004-2005 season resulted in 535 useable responses from trappers residing in 77 counties; these included responses from 153 successful mink trappers who captured 626 mink. Data from both years suggested captures occurred in 74 of 93 counties where respondents (including those who did not capture mink) did most of their trapping. Reports for most of the 74 counties included responses from multiple successful mink trappers (58 counties) during multiple years (36 counties) and were confirmed by detection of mink during sign surveys (56 counties).

DISCUSSION

Our findings indicated a statewide distribution of mink. This result is not surprising given past assessments in Illinois (Forbes 1912, Mohr 1943, Hoffmeister 1989) and the species' widespread range elsewhere in North America (Larivière 1999). However, our work provides a more contemporary and complete reference than Hoffmeister (1989), who documented 62 museum specimens and 2 published reports from 24 counties. It also provides an opportunity to examine the relative value of available sources of data. For example, lack of recent (1980-2004) museum specimens limited usefulness of these data for determining distribution. Questionnaires provided results similar to but less precise and accurate than sign surveys. If necessary, we could obtain more detailed information about locations by modifying the survey instrument, as was the case for long-tailed weasels (*Mustela frenata*) in Illinois (Richter 2005).

Mink, considered common to abundant in most of their range (Larivière 2003), are harvested legally in nearly all states and provinces where they occur (Novak et al. 1987). Managers often rely on harvest records to infer status because direct methods to census or monitor populations at large spatial scales are lacking (Ray 2000, Larivière 2003). The secure status of mink suggests this approach is adequate (Larivière 2003). However, other methods are desirable (Linscombe et al. 1982, Ray 2000, Larivière 2003) because changes in capture effort caused by varying pelt values (Clark et al. 1985), numbers of trappers, and other factors (Bluett 1992) sometimes mask underlying relationships between population and harvest levels (Erickson and Sampson 1978, Erickson 1981).

Various forms of sign surveys (e.g., track-boards, sand-transects, searches of natural substrates along shorelines) have been used to monitor occurrence, habitat use, and activity of mink at relatively small spatial scales such as a site or watershed (e.g., Burgess and Bider 1980, Humphrey and Zinn 1982, Mason and MacDonald 1983, Loukmas and Halbrook 2001). Our use of this method to determine distribution at a statewide scale is the first we are aware of. We observed high detection rates with little variation among years when we conducted sign surveys at >70 sites. These characteristics suggest sign surveys would have been well suited for calculating trend and possibly relative abundance if we had used multiple sampling to estimate detection error, a requisite for applying recent innovations for analyses of presence-absence data (e.g., Strayer 1999, Royle and Nichols 2003, MacKenzie 2005, Stanley and Royle 2005). We believe this approach would be useful in jurisdictions where the status of mink is a concern.

Costs are an important consideration for resource managers seeking to implement monitoring programs (Field et al. 2005). Based on our experience, sampling 70 sites annually would cost 232.4 man-hours valued at $10,437, including indirect costs. Re-sampling one-third of these sites each spring to estimate detection error would add 77 man-hours valued at $3,429. These costs are greater than those for detecting only mink (i.e., our protocol required biologists to sample a total of 1200 m of shoreline unless the presence of mink, river otter, and beaver was documented in a shorter distance). Detection rates for river otter (26.8–35.7%; Bluett et al. 2004) were lower than those for mink. Therefore, the maximum distance was sampled at most sites. Distance or time elapsed from the beginning of the survey route until evidence of mink is first encountered might be useful metrics that would incur few if any additional costs (E.C. Hellgren, Cooperative Wildlife Research Laboratory at Southern Illinois University, personal communication).

Fewer sites were sampled during 1999, when sign surveys were initiated in southern Illinois, and 2005, when they were phased-out by eliminating sites where evidence of river otters had been observed ≥3 times. Detection rates observed during 1999 and 2005 were not anomalous, per se, but it seems improbable that the greatest and least values occurred during these years by chance alone. Possible explanations include differences among observers, sample sizes, populations, site characteristics, or a combination of factors. Our experience supports the notion that design is an important consideration for monitoring wildlife at large geographic scales (Pollock et al. 2002, Stanley and Royle 2005) and suggests some approaches might be less effective than others for monitoring mink, especially if the number of sites sampled annually is small (e.g., <70).

Several researchers have developed statistical approaches for inferring threat or decline from museum records (e.g., Solow 1993, Burgman et al. 1995, McCarthy 1998). In general, these methods assume a relationship between relative abundance and accessions, are most meaningful when used with information from other sources, and are best suited for comparisons within taxa or other aggregations of species (Burgman et al. 1995). Some approaches assume that collection effort is relatively constant over time; others allow for differences that might occur because of changes in policies, funding levels, restrictions, or other abiotic influences on numbers of accessions of a particular species (McCarthy 1998).

We do not advocate use of these methods for monitoring the status of mink in Illinois because collection records do not appear to reflect relative abundance. For example, the number of collection records we documented from 1980–2004 (n = 17) was small compared to the estimated harvest of mink by trappers during that period (n = 199,966; Illinois Department of Natural Resources, unpublished data). Museums' efforts to collect mink probably declined during 1980-2004, as evidenced by more runs of absences and fewer specimens than the quarter-century preceding this period. The total number of mammal specimens housed by respondents increased approximately 21% from 1983-1995 (Yates et al. 1987, Hafner et al. 1997), indicating that collection of mink deviated from this trend.

The mink's status appears secure in Illinois. Given limited resources, we believe harvest records and trapper questionnaires provide adequate monitoring tools. If these sources of data indicate cause for concern, sign surveys, which were discontinued in 2006, could be re-instituted with multiple sampling efforts at a subset of locations to estimate detection error, trend, and relative abundance. Our data provide a baseline for future comparisons of the distribution of mink in Illinois and possibly a means of identifying underlying causes of decline linked to water quality, abundance of prey, or other metrics associated with Basin Survey Sites.

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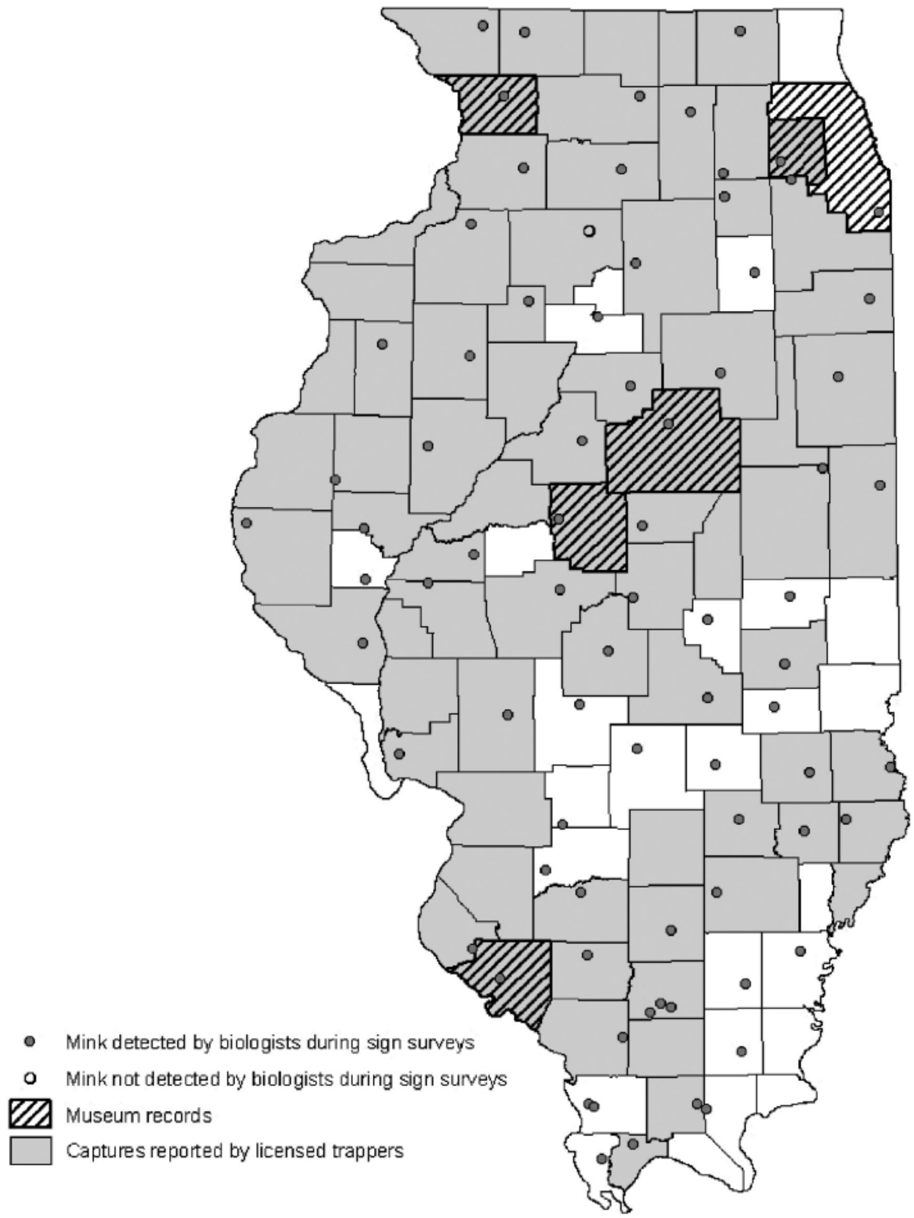
Figure 1. Distribution of mink in Illinois from recent sign surveys (1999-2005), museum records (1980-2004) and captures reported by random samples of licensed trappers (2003-2005).



Appendix I. Basin Survey Sites where biologists searched for evidence of mink (*Mustela vison*) in Illinois, 1999-2005.

County	Identification code for Basin Survey Site	Location (decimal degree)		No. years surveyed	No. years mink detected
Adams	KI04	40.12685	-91.41717	6	4
Alexander	IXD01	37.21490	-89.30025	7	4
Bond	OIC02	38.75368	-89.52894	7	7
Brown	DE03	39.87834	-90.70076	7	7
Bureau	DQ05	41.48644	-89.36876	5	0
Carroll	NONE	42.10000	-89.89000	6	4
Cass	EEA01	39.99824	-90.05745	4	2
Champaign	BPK13	40.38508	-87.96425	6	5
Christian	EOH01	39.55256	-89.25351	5	5
Clay	C19	38.77568	-88.49086	7	3
Clinton	OH01	38.54148	-89.62663	6	3
Coles	BENC01	39.48776	-88.20940	7	6
Cook	HBDA01	41.55686	-87.59577	5	1
Crawford	BF01	39.00460	-87.59748	7	6
Cumberland	BEJH01	39.28721	-88.27617	6	6
DeKalb	PQC05	42.02802	-88.73879	3	3
DeWitt	EIH01	40.12950	-89.04760	6	6
Douglas	BE14	39.79973	-88.17041	7	1
DuPage	GBK12	41.79593	-88.18713	6	6
Effingham	C28	39.02838	-88.62317	7	2
Fayette	OO01	39.10201	-89.08863	7	5
Franklin	NH26	37.92798	-88.96067	3	1
Franklin	N11	37.89145	-89.01973	2	1
Franklin	NHB34	37.91061	-88.89636	2	2
Fulton	DJ08	40.49019	-90.34025	5	5
Grundy	DV04	41.28619	-88.36025	6	2
Hamilton	ATF07	38.01640	-88.46142	7	4
Henry	PBG12	41.51209	-90.08642	5	1
Iroquois	FLH02	40.80503	-87.86387	6	3
Jackson	ND01	37.77245	-89.17885	6	2
Jasper	BEG01	38.98528	-88.07517	7	7
Jefferson	NJ07	38.26935	-88.89863	7	6
Jersey	DZA02	39.07298	-90.49277	6	6
JoDaviess	MNI12	42.42453	-90.02321	5	5
Johnson	AJF16	37.46593	-88.75239	7	4
Kane	DTC03	41.74376	-88.54088	6	3
Kankakee	F02	41.16016	-87.66260	5	3
Kendall	DTCA01	41.63568	-88.54116	6	6
Knox	DJ02	40.90750	-90.08680	6	6
LaSalle	DR01	41.33326	-89.08116	4	3
Lawrence	BEAB01	38.76931	-87.86595	7	7
Lee	PBU10	41.76540	-89.16838	6	6
Livingston	DS06	40.83055	-88.57514	5	4
Logan	EID07	40.16032	-89.55138	5	5
Macon	E05	39.79667	-89.10430	6	6
Macoupin	DA05	39.25952	-89.84929	6	1
Marshall	DP02	41.08938	-89.31288	6	5
McDonough	DG04	40.33088	-90.89613	5	4
McHenry	DTK06	42.39957	-88.43074	6	3

Appendix I. continued

County	Identification code for Basin Survey Site	Location (decimal degree)		No. years surveyed	No. years mink detected
McLean	DKP02	40.59410	-88.88875	5	4
Monroe	OB04	38.18347	-90.05458	7	7
Montgomery	OIL01	39.30486	-89.42974	6	1
Morgan	DF05	39.86001	-90.33243	6	3
Moultrie	OT01	39.69520	-88.66193	6	6
Ogle	PQB04	42.10030	-89.05348	5	5
Perry	NCK01	38.15374	-89.38608	6	2
Pike	KCA03	39.58500	-90.71303	7	4
Pope	AJG18	37.44274	-88.70065	6	5
Pulaski	IX11	37.28450	-89.11803	7	4
Randolph	OA01	38.04624	-89.89245	7	7
Richland	CH01	38.71411	-88.11254	7	7
Saline	ATG03	37.70778	-88.49194	6	4
Sangamon	E26	39.83704	-89.54592	6	4
Schuyler	DGD01	40.11056	-90.71917	6	6
Shelby	OR02	39.33128	-88.67086	7	5
Stark	DJN02	41.16085	-89.73506	6	6
Stephenson	PWQ04	42.39909	-89.76280	5	3
Tazewell	DKG01	40.51833	-89.41395	5	5
Union	IC04	37.47117	-89.37677	3	3
Union	ICD02	37.45725	-89.34714	6	5
Vermilion	BPG11	40.30374	-87.62211	6	3
Warren	LDD20	40.95726	-90.62089	6	5
Washington	OJA01	38.44139	-89.41702	6	4
Wayne	CA07	38.43937	-88.62636	7	4
White	C32	38.16324	-88.14668	6	5
Whiteside	PH01	41.77219	-89.77211	6	4
Will	GBL02	41.71111	-88.12797	6	6
Woodford	DKKB01	40.77327	-89.11856	6	2