Reproductive Success and Banding Returns of American Kestrels in Agroecosystems in the Southern Ontario Landscape

Kimberly O'Hare, Pamela Martin, Glenn Barrett*

* Corresponding author

Figure 1. Recently hatched American kestrel chicks with adult female. *Photo: EC/Glenn Barrett*

Introduction

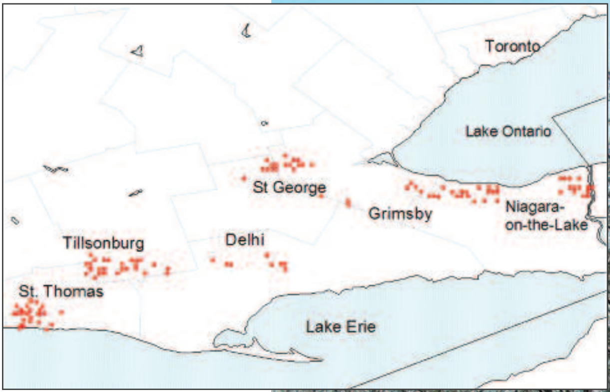
American Kestrels (*Falco sparverius*) are a common sight in southern Ontario, perched on wires and trees along roads in agricultural areas. About the size of a Blue Jay (*Cyanocitta cristata*), they prefer open habitats with scattered trees in cultivated and urban areas. Males establish a nesting territory and the female joins later, after moving among several territorial males before making a choice. They hunt small mammals, birds and invertebrates, with males delivering prey to the female during incubation and later, to the nestlings. Males also incubate the eggs while the female hunts. They nest almost exclusively in natural cavities in banks or cliffs or woodpecker holes in trees, and will readily compete with European Starlings (*Sturnus vulgaris*) for nest boxes (Smallwood and Bird 2002). Although their status is considered "very common", a long term decline of American Kestrel populations in southern Ontario is evident in the Canada Bird Trends Database of the North American Breeding Birds Survey (http://www. cws-scf.ec.gc.ca/mgbc/ trends). Being at the top of the food web, they are in a position to bioaccumlate persistent environmental contaminants and can be considered as bioindicators of environmental conditions. Their use of agricultural fields for foraging and their propensity to accumulate contaminants suggest they may be sensitive to agricultural impacts. Most persistent organochlorine pesticides including DDT, were banned from use in the 1970s and 1980s; nevertheless, the toxic breakdown product of DDT is still prevalent in the soil in many agricultural regions in Ontario (Crowe and Smith 2007, Bishop *et al.* 2000a, 2000b) and has been found in the eggs of American Kestrels and other agriculturally nesting birds (Hebert *et al.* 1994). In particular, areas of tobacco production and fruit orchards were heavily sprayed with DDT in the past and continue to receive high usage of the more modern pesticides.

We suggest that kestrels breeding in areas specializing in certain crop types (agroecosystems), are at greatest risk of exposure to both historically-applied persistent contaminants and current-use pesticides, which may impact their reproductive success. We investigated American Kestrel reproductive success from 2002 to 2005 in three different agroecosystems that we classified as having high, moderate and low pesticide use. American Kestrel adults and nestlings were banded from 2001-2008. Band recapture data may provide some insight on survival, nest re-occupancy and dispersal of kestrels in agricultural regions of Ontario.

Kestrel nest boxes were located along trails in the Great Lakes basin in southern Ontario. Nestbox trails were named for proximity to a primary town in the area. Two trails (Grimsby and Niagara-on-the-Lake) were on the Niagara Peninsula, where stone fruit orchards and vineyards predominated. Two other trails (Delhi and Tillsonburg) were located in areas in which tobacco was

Figure 2. Map of American Kestrel trails in southern Ontario

Figure 3. American Kestrel nest box located adjacent to an orchard (St. David's, Ontario) *EC/Glenn Barrett*



common, although declining in occurrence in preference for corn and soy, as well as ginseng, winter rye and field vegetables. A fifth trail (St. George) was located north of Hamilton, where there is a larger proportion of woodlots, pastureland and hay crops, along with a diverse, less intensive landscape of dairy and beef farming, small apple orchards and mixed crops. Trails were also monitored for several years in Holland Marsh and St Thomas, however, only the banding data from these two sites are included in this paper.

Pesticides typically are sprayed based on the crop type, pest cycles, and recommendations made by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). The three agroecosystems in this study were ranked as high, moderate and low pesticide use based on both the crop type (for their unique pesticide regimes: McGee *et al.* 2004) and contaminant profiles from previous kestrel egg analysis (Hebert et al. 1994). The orchard and vineyards agroecosystem (Niagara-on-the-Lake and Grimsby) is ranked as having the highest pesticide use. Tobacco, corn and soy (Delhi and Tillsonburg) crops have moderate pesticide use and woodlots, pasture and mixed crops (St. George) were ranked as having the lowest use. The objective of our study was to determine if there were differences in productivity and egg contamination of American Kestrels nesting in areas of differing pesticide usage, based on agroecosystem type. In addition, we wanted to document nestbox usage and return rates of banded nestling and adult birds in southern Ontario.

Methods

Nest box trails were erected in 2001 with the exception of the St. George trail which was established in the 1980s. Trails had from 20 to 35 wooden boxes of a standard design placed on wooden utility poles at a height of at least 5 meters above the ground, spaced at least 1 km apart along secondary roads. Nest boxes were monitored during the breeding season from 2002 to 2005, beginning in early April of each year. A single egg was collected from each nest once 3 eggs had been laid and incubation had been initiated. Eggs were sent for analysis of organochlorine contaminants (including DDT) to Environment Canada's National Wildlife Research Centre in Ottawa. The hatch date of each nest was estimated by counting forward from the first date of incubation and was verified by visits around the estimated date. Chicks were banded at 16 days of age and sex was determined by wing feather colouration; a final visit was conducted at age 22 days. No further visits were conducted after this time to prevent forced early fledging. Three major parameters of reproductive success were determined. Clutch size was the total number of eggs laid, including those collected for chemical analysis. Hatch success was determined by the number of eggs hatched divided by the number laid minus any eggs that were collected for chemical analysis. Fledging success was considered to be the number of chicks alive at the final visit on day 22 divided by the total number of eggs hatched. Adult birds were often in nestboxes during incubation and we were occasionally able to catch the birds and band them, and check for any existing bands.

Results and Discussion

We assessed reproduction in 50 to 60 active kestrel nestboxes annually in southern Ontario in each of four years, 2002 through 2005, totaling 219 breeding attempts (Table 1). Clutch size for kestrels was consistently 4-5 eggs among all trails over all years. A very small number of pairs produced 3 or 6 eggs. Although hatch success appeared lower in some crop types in different years, differences were not statistically significant due to variability in the data and there were no consistent trends over the years. Fledging success of kestrels in all agroecosystems was over 90% in all years. Overall, reproductive success did not appear to be associated with agroecosystem type in our study and was similar to values found elsewhere (Smallwood and Bird 2002).

The historically-used pesticide DDT, is the contaminant most likely to directly affect hatchability of eggs due to its ability to induce eggshell thinning, particularly in raptors (Lincer 1975). In Bald Eagles (*Haliaeetus leucocephalus*) and Peregrine Falcons (*Falco peregrinus*), concentrations of DDT in eggs of 10 to 20 ug per g wet weight were associated with significant levels of eggshell thinning and consequent reproductive impairment (Blus 1996). In our study, we found mean levels of DDT in kestrel eggs of over 5 ug per g in kestrel eggs in the Niagara-on-the-Lake trail (Table 2). Although these concentrations are significantly higher than those at most other sites, there with no evidence of an impact on reproductive success. In 1987 and 1988, kestrels nesting in the same fruit-growing areas of southern Ontario contained mean DDT concentrations of over 7 ug per g in their eggs (Hebert *et al.* 1994: see Table 2); in contrast to our study however, these birds experienced significant reductions in hatching success compared to those in other regions with lower egg concentrations of DDT. Nevertheless, their eggshells were not thinned to a degree to suggest this mechanism as the cause of failure (Hebert *et al.* 1994). In almost 15 years between these two studies, during which DDT would not have been sprayed at all, concentrations accumulated in eggs by kestrels declined very little, attesting to the persistence of this chemical in agricultural soil. Nevertheless, it is encouraging that exposure appears to have declined sufficiently to levels below the threshold of reproductive impacts in kestrels. Bishop *et al.* (2000b) found significant reductions in orchard-nesting Tree Swallow (*Tachycineta bicolor*) and American Bluebird (*Sialia sialis*) reproduction over a 7 year study, and reported that bluebird hatching success was

Table 1. Reproductive parameters of American Kestrels nesting in southern Ontario

		Mixed crop St. George trail			**Orchard/Vineyard** Niagara and Grimsby trails			**Tobacco** Delhi and Tillsonburg trails		
Year	Reproductive Parameters	N	mean	SE	N	mean	SE	N	mean	SE
2002	clutch size	8	4.88	0.23	27	4.89	0.11	20	4.95	0.11
	hatch success (%)	8	87	4	27	84	4	20	91	3
	fledging success (%)	8	97	31	26	98	3	20	98	1
2003	clutch size	6	5.00	0.26	27	4.56	0.13	20	4.80	0.09
	hatch success (%)	6	67	21	27	79	7	20	89	7
	fledging success (%)	4	94	6	24	94	4	18	99	1
2004	clutch size	6	4.00	0.37	25	4.48	0.13	25	4.24	0.19
	hatch success (%)	6	97	21	25	93	8	25	97	8
	fledging success (%)	5	100	0	22	100	0	23	96	3
2005	clutch size	5	4.60	0.24	27	4.48	0.20	23	4.13	0.22
	hatch success (%)	5	87	23	27	67	8	23	95	10
	fledging success (%)	4	100	0	22	91	5	19	95	5

N=sample size; SE=standard error

Table 2. Concentrations of the pesticide DDT (ug per g wet weight) and its metabolites in American Kestrel eggs in the current study, 2002-04, and previously measured by Hebert *et al.* (1994) in 1989

	Mixed crop			**Orchard/Vineyard**						**Tobacco**					
	St. George			Niagara-on-the-Lake			Grimsby			Tillsonburg			Delhi		
Year	N	mean	SE	N	mean	SE	N	mean	SE	N	mean	SE	N	mean	SE
		0.514						0.972			0.290			2.522	
2002–4	8	A	0.203	11	5.079 B	1.091	16	A	0.274	7	A	0.092	3	AB	1.738
1989	–	–	–	10	7.465	–	10	5.535	–	10	1.1718		10	1.386	–

N=sample size; SE=standard error

Note: Data from 1989 was a single pooled sample analysis; those from 2002-4 were means of individual sample analyses. Means followed by the differing uppercase letters are significantly different (P < 0.05; Analysis of Variance test) negatively correlated with egg DDE levels. The mechanisms responsible for reproductive decreases have not been elucidated but the eggshell thinning phenomenon is not typical in songbirds. Reproductive success of American Robins (*Turdus migratorius*), Tree Swallows; House Wrens (*Troglodytes aedon*) and bluebirds were not significantly reduced in orchards containing high levels of DDT compared to non-orchard areas in central British Columbia (Elliott *et al.* 1994).

From 2001 to 2008 over 1270 kestrels were banded along all the trails. Of these, 1161 were banded as nestlings and 109 were banded as adults, captured in the nestbox during incubation. Band returns from across North American were compiled from the Environment Canada Bird Banding Office database. In addition, the authors obtained recapture data during nest box checking by examining any incubating adults that could be captured; in this way we also captured breeders which were banded by other banders and we obtained information on banding location of these birds from the banding office. Between these two sources we obtained band return information on a total of 53 birds, or 4% of banded birds; of these, 36 were alive (Table 3). For birds that were banded or recaptured by the authors at a specific nestbox we were able to include exact nestbox location (e.g. TI-23); however, for birds that were banded or recaptured by other banders or found dead by other individuals we were only able to provide more general recapture location information as provided by the banding office.

Although our recapture sample is small, there is an obvious trend for birds to return to the geographic area in which they were originally banded, either as nestlings or as adults (Table 3). Two female kestrels were recaptured nesting in consecutive years. One female had been banded as a chick in 2002 (ID 1) on the Grimsby trail, then nested successfully in different boxes on the Niagara trail for 4 successive years. The other female, banded as an adult during incubation (ID 2) in 2005, returned to a nearby box in 2006 and back to her original box in 2007, fledging a total of 13 young in the 3 years. Three males, one in each of the Delhi, Tillsonburg and Niagara-on-the-Lake trails, (IDs 3,5 and 6) and one female from the Grimsby trail, (ID 4) were banded as chicks and returned to the same trails as successful breeders within the next two years. An additional five adult females banded during incubation, (IDs 7 to 11) were also recaptured in nestboxes on the same trail (ID 10 in same box) within two years of banding. An adult female banded during incubation in 2007 on the St. George trail (ID 13) abandoned her nest when it was destroyed, but moved to another St. George box and fledged three young during that same year. During nestbox checks, we recaptured nine adult birds that had been banded by other banders. Of these, four captured in Tillsonburg and St. Thomas nestboxes, had been banded near Sparta, a small town near Tillsonburg (IDs 16, 18, 23, 24); three had been banded southeast of Kitchener (IDs 17, 20, 21), near our St. George trail, two of which were captured in the

Table 3. Band returns from American Kestrels banded or recaptured in southern Ontario, 2001-2008.

Banding information					Recapture information			
ID	date	age	sex	location	recapture location	date	status	age at recapture
Returning breeders								
1	May-02	nestling	F	GR-21	NOL-22	Apr-03	Alive	1 YR
1	May-02	nestling	F	GR-21	NOL-22	May-04	Alive	2 YR
1	May-02	nestling	F	GR-21	NOL-13	May-05	Alive	3 YR
1	May-02	nestling	F	GR-21	NOL-17	Apr-06	Alive	4 YR
2	Apr-05	AHY	F	GR-11	GR-7	May-06	Alive	AHY
2	Apr-05	AHY	F	GR-11	GR-11	Apr-07	Alive	AHY
3	Jun-03	nestling	M	DE-22	DE-24	Apr-04	Alive	1YR
4	Jun-07	nestling	F	GR-5	GR-21	Apr-08	Alive	1YR
5	Jun-03	nestling	M	NOL-5	NOL-2	May-05	Alive	2YR
6	Jun-02	nestling	M	TI-22	TI-18	Mar-04	Alive	2YR
7	May-04	AHY	F	TI-35	TI-34	Jun-05	Alive	AHY
8	May-03	AHY	F	TI-19	TI-23	Apr-04	Alive	AHY
9	May-03	AHY	F	SG-24	SG-23	Apr-05	Alive	AHY
10	Apr-06	AHY	F	GR-2	GR-2	May-07	Alive	AHY
11	May-06	AHY	F	TI-5	TI-6	May-07	Alive	AHY
12	Mar-04	AHY	M	GR 11	GR-11	Apr-04	Alive	AHY
Breeder, recaptured same year								
13	Apr-07	AHY	F	SG-3	SG-15	May-07	Alive	AHY
14	May-07	AHY	F	SG-23	SG-23	Jun-07	Alive	AHY
15	May-07	AHY	F	TI-34	TI-34	Jun-07	Alive	AHY
Breeder, banded elsewhere								
16	Jun-03	nestling	F	near Sparta,ON	TI-27	May-04	Alive	1 YR
17	May-01	nestling	F	30 mi SE of Kitchener, ON	GR-25	Apr-04	Alive	3 YR
18	Sep-01	HY	M	near Sparta, ON	TI-23	May-06	Alive	5YR
19	Jul-96	nestling	F	near Hillman, MI	Ti-25	May-02	Alive	6YR
20	May-01	AHY	F	30 mi SE of Kitchener, ON	SG-10	Jun-02	Alive	AHY
21	May-01	AHY	F	30 mi SE of Kitchener,ON	SG-9	May-02	Alive	AHY
22	Mar-02	AHY	F	near Port Huron, MI	SG-26	Jun-02	Alive	AHY
23	Jun-03	AHY	F	near Sparta, ON	ST-12	May-05	Alive	AHY
24	Jun-03	AHY	F	near Sparta, ON	ST-25	May-05	Alive	AHY

	Banding information				Recapture information			
ID	date	age	sex	location	recapture location	date	status	age at recapture
Banded nestling, recaptured during hatch year								
25	Jun-07	nestling	F	SG-15	N of Sudbury, ON	Dec-07	Alive	HY
26	Jun-01	nestling	F	TI-14	St. Thomas , ON(BT)	Sep-01	Alive	HY
27	Jun-01	nestling	M	NOL-12	St. Thomas, ON (BT)	Oct-01	Alive	HY
28	Jul-03	nestling	M	HM-18	Amherstburg, ON (BT)	Sep-03	Alive	HY
29	Jun-04	nestling	M	DE-7	St. Thomas, ON (BT)	Sep-04	Alive	HY
30	Jun-04	nestling	F	NOL-17	St. Thomas, ON (BT)	Aug-04	Alive	HY
31	Jun-02	nestling	F	NOL-6	Morgan, GA	Oct-02	Alive	HY
Banded nestling recaptured elsewhere after hatch year								
32	Jun-03	nestling	F	TI-8	Milverton,ON	Jul-04	Alive	1 YR
33	Jun-04	nestling	M	SG-3	Ancaster, ON	Jan-05	Alive	1 YR
34	Jun-04	nestling	M	TI-1	NE of Sudbury, ON (BT)	Mar-06	Alive	2 YR
35	Jun-03	nestling	F	DE-23	N of London, ON	May-06	Alive	3 YR
36	Jun-05	nestling	F	ST-12	W of Westminster, ON (BT)	Mar-08	Alive	3 YR
Banded nestlings found dead in hatch year								
37	Jun-06	nestling	F	TI-24	Tillsonburg, ON	Jun-06	Dead	HY
38	May-03	nestling	M	GR-15	Grimsby, ON	Jun-03	Dead	HY
39	Jun-07	nestling	F	TI-30	N of Ingersoll	Jun-07	Dead	HY
40	May-04	nestling	M	GR-5	Grimsby, ON	Jul-04	Dead	HY
41	May-03	nestling	F	GR-18	N of Peterborough, ON	Jul-03	Dead	HY
42	Jun-06	nestling	F	NOL-1	NOL-1	Jan-07	Dead in nestbox	HY
43	Jun-05	nestling	F	NOL-14	NOL-14	Dec-05	Dead in nestbox	HY
44	May-06	nestling	M	NOL-13	Niagara-on-the-Lake, ON	Nov-06	Dead	HY
Banded nestlings found dead after hatch year								
45	Jun-03	nestling	M	NOL-9	Port Colborne, ON	Jan-04	Dead	1 YR
46	Jun-03	nestling	M	TI-8	S of Tillsonburg, ON	Jan-04	Dead	1 YR
47	Jun-04	nestling	F	DE-17	Grimsby, ON	Mar-05	Dead	1 YR
48	Jun-05	nestling	unk	TI-26	Tillsonburg, ON	May-06	Dead	1 YR
49	Jun-07	nestling	M	GR-7	Stoney Creek, ON	Jun-08	Dead	1 YR
50	Jun-02	nestling	M	TI-27	Tillsonburg, ON	May-04	Dead	2 YR
51	Jun-07	nestling	M	SG-18	Bremen, GA	Feb-09	Dead	2 YR

Banding information					Recapture information			
ID	date	age	sex	location	recapture location	date	status	age at recapture
Banded breeders found dead								
52	Apr-04	AHY	M	TI-30	Tillsonburg, ON	Jan-05	Dead	1 YR
53	Apr-07	AHY	F	GR-29	GR-29	Apr-08	Dead in nestbox	AHY

HY =Hatching Year bird capable of sustained flight that has hatched during the calendar year; AHY=After hatch year is a bird in its first year or of unknown adult age. Band locations; GR-Grimsby, SG-St. George, TI-Tillsonburg, DE-Delhi, HM-Holland Marsh and NOL-Niagara-on-the-Lake, ST-St. Thomas, (BT)-Banding trap

St. George nestboxes. In contrast however, two were birds originally banded in Michigan, indicating that, while the general trend is for birds to return to the same geographic area to breed, some widerspread distribution also occurs. The two oldest birds recaptured in our study were a 6 year old female and a 5 year old male both, in the tobacco agroecosystem (bird ID#s 18 and 19).

Birds banded as nestlings in our trails and recaptured alive by others as adult birds were typically found in southern Ontario, with the exception of ID 34 which was captured in Sudbury in early spring. Similarly 6 of 7 birds banded as nestlings and found dead as adults in subsequent years were found extremely close to their natal areas, with the exception of bird ID 51 which was recovered in Georgia in the winter. Similarly, 2 of 2 birds banded as adults and later found dead were on the same trail as banded. One was found in April, dead in the box she had bred in the previous year.

Recaptures of live hatch year juveniles occurred primarily early in the fall, where 5 of 7 were trapped at migration banding stations on the north shore of Lake Erie; Hawk Cliff (Port Stanley) and Holiday Beach (Amherstburg). Interestingly, another was found in December north of Sudbury (ID 25) and another in October in Georgia (ID 31).

Retrievals of dead hatch year juveniles were typically very close to the breeding area, either in the summer or fall after fledging. One exception was a bird found near Peterborough (ID 41). In a couple of cases, banded juveniles were found dead in their natal nestboxes late the following winter during nestbox cleaning (Bird ID 42 and 43).

The strong site fidelity seen in southern Ontario kestrels appears to be similar to other populations in North America. Steenhof and Peterson (2009) report that 20% of over 900 adults banded in nest boxes in Iowa were recaptured in the area in at least one subsequent year. Our numbers are much lower, with only 8% of 109 banded adults being recaptured in our nestboxes or found dead in the area; most were exclusively within the same trail. Our lower recapture rates are probably a function of the lower intensity of our study — our goal was to obtain eggs for contaminants and reproductive parameter, not to band adults, whereas Steenhof and Peterson were specifically interested in site fidelity. The propensity of nestlings to return to their natal region (philopatry) also appears to be strong in our Ontario kestrels, which bears out findings of other North American researchers. Miller and Smallwood (1997) reported that 34 colour-marked nestling kestrels in Florida dispersed an average of approximately 8 km from their natal nestbox to the site of first breeding, the farthest being 34 km. While we don't have exact distances available for our recaptured birds, most birds returned to their natal trail.

Conclusion

American Kestrels breeding in man-made nestboxes in agricultural landscapes in southern Ontario appear to be successfully reproducing and maintaining occupancy of the nestbox trails over several years. There do not appear to be impacts of agricultural exposure to pesticides on productivity despite the fact that concentrations of DDT in eggs have declined little in the past 15 years. Site fidelity of this population of birds appears to be consistent with that in other parts of the continent. Continuing to monitor kestrel reproduction, site fidelity and pesticide levels in their habitats may provide necessary information to help reverse the continent wide decline of this species.

Acknowledgements

The authors would like to thank Cyril Crocker for allowing us to utilize his St. Thomas kestrel nestbox trail. We would also like to thank Bill Read and many others who, over the years, have helped the authors establish, maintain and monitor the other kestrel nestboxes described in this paper.

Literature Cited

Bishop, C. A., **P. Ng**, **P. Mineau**, **J.S. Quinn** and **J. Struger**. 2000a. Effects of pesticide spraying on chick growth, behavior, and parental care in tree swallows (*Tachycineta bicolor*) nesting in an apple orchard in Ontario, Canada. Environmental Toxicology and Chemistry 9:2286-2297.

Bishop, C. A., **B. Collins**, **P. Mineau**, **N.M. Burgess**, **W.F. Read** and **C. Risley**. 2000b. Reproduction of cavity-nesting birds in pesticide-sprayed apple orchards in southern Ontario, Canada, 1988-1994. Environmental Toxicology and Chemistry 19:588-599.

Blus, L.J. 1996. DDT, DDD and DDE in Birds. Pp 49-72 *In* Beyer, W.N., G.H.Heinz, and A.W. Redmon-Norwood, Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations. Lewis Publishers, Boca Raton, LA.

Crowe, A. S. and **J. E Smith.** 2007. Distribution and persistence of DDT in soil at a sand dune-marsh environment: Point Pelee, Ontario, Canada. Canadian Journal of Soil Science 87:315-327.

Elliott, J. E., **P.A. Martin**, **T.W. Arnold** and **P. H. Sinclair**. 1994. Organochlorines and reproductive success of birds in orchard and non-orchard areas of central British Columbia, Canada, 1990-91. Archives of Environmental Contamination and Toxicology 26:435-443.

Hebert, C.E., **D.V. Weseloh** and **V. Glooschenko**. 1994. Organochlorine contaminants in a terrestrial foodweb on the Niagara Peninsula, Ontario, Canada 1987-1989. Archives of Environmental Contamination and Toxicology 26:356-366.

Lincer, J. L. 1975. DDE-Induced eggshell-thinning in the American Kestrel: a comparison of the field situation and laboratory results. The Journal of Applied Ecology 3:781-793.

McGee, B., **H. Berges** and **K. Callow.** 2004. Survey of Pesticide Use in Ontario, 2003. Ontario Ministry of Agriculture, Food and Rural Affairs, Policy Analysis Branch, Guelph, Ontario.

Miller, K. E. and **J.A. Smallwood.** 1997. Natal dispersal and philopatry of southeastern American Kestrels in Florida. Wilson Bulletin 109:226-232.

Smallwood, J. A. and **D. M. Bird.** 2002. American Kestrel (*Falco sparverius*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/602

Steenhof, K. and **B.E. Peterson**. 2009. Site fidelity, mate fidelity, and breeding dispersal in American kestrels. The Wilson Journal of Ornithology 121:12-21.

**Pamela Martin*, Environment Canada, 867 Lakeshore Road, Burlington, ON L7R 4A6.

Kimberly O'Hare, 191 Parkview Drive, Hamilton, ON L8S 3Y4

Glenn Barrett, Environment Canada, 867 Lakeshore Road, Burlington, ON L7R 4A6.