The Causes and Effects of Interspecific Competition by House Wren's (*Troglodytes aedon*) on the Recovery of the Prothonotary Warbler (*Protonotaria citrea*) Population in Rondeau Provincial Park

Sandy Dobbyn[1] and Jon McCracken[2]

Zone Ecologist
Ontario Parks, Southwest Zone
659 Exeter Rd, London, ON N6E 1L3
519-873-4632 Fax: 519-873-4645
sandy.dobbyn@mnr.gov.on.ca

[2]Bird Studies Canada
P.O. Box 160 Port Rowan, ON N0E 1M0
519-586-3531, fax 519-586-3532 jmccracken@bsc-eoc.org

Abstract

*The prothonotary warbler (*Protonotaria citrea*) is critically endangered in Canada, with between 9 and 20 pairs breeding in southern Ontario annually since 1997. Rondeau Provincial Park is one of the core breeding locations for prothonotaries, supporting approximately 50% of the population each year. In 1997, the prothonotary warbler nest box program was initiated by the recovery team and nest boxes were erected throughout southern Ontario. At Rondeau, the program resulted in an initial population increase from 9 males in 1997 to a high of 13 in 2000. Since that time, however, the Rondeau population has been declining as a result of increased interspecific competition with house wrens (*Troglodytes aedon*). A number of potential causes for this increase in competition have been identified including decreased canopy closure, severe drought and immigration of house wrens from the adjacent cottage community. Implications for the protection of this species at risk are discussed.*

Keywords: *prothonotary warbler, house wren, Interspecific competition*

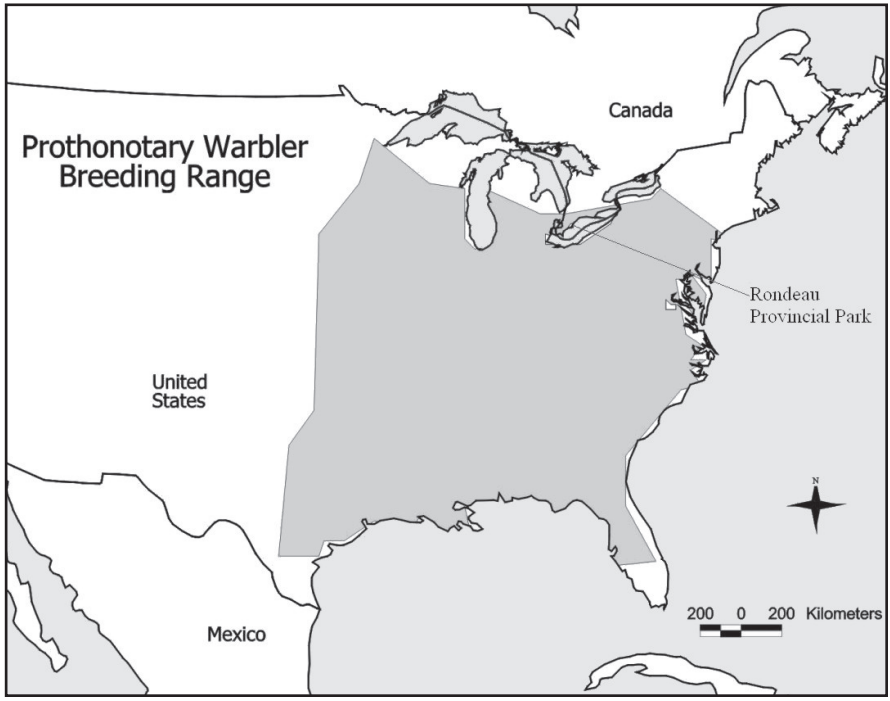
Introduction

The prothonotary warbler (*Protonotaria citrea*) is one of the most dazzling and sought after birds for Ontario bird watchers, and Rondeau Provincial

Park is the one location in the province where a birder can be relatively certain of seeing one. Prothonotary warblers are found throughout the eastern United States, but in Canada they are restricted to the Carolinian zone and almost entirely to the north shore of Lake Erie (Figure 1). Since Ontario is at the northern-most edge of the species range, the population has likely never been very substantial. In the last 70 years, however, the number of breeding pairs has declined substantially (McCracken, 1981; Page, 1995; McCracken *et al.,* 2005).

As a result of this decline, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first listed the prothonotary as "Vulnerable" in 1984 when the Canadian population was estimated at 50 pairs. The status was then uplisted to "Endangered" in 1996 based upon evidence that the Canadian population had declined to as low as 10 breeding pairs and was on the verge of collapse. By that time breeding was thought to be restricted to Rondeau Provincial Park and the Long Point region (McCracken, 1981; Page, 1995). A national recovery team was established in 1996 and a draft recovery strategy prepared in 1997. The goal of the recovery strategy was to increase the population to 25 breeding pairs in six distinct geographical regions by 2001 (McCracken *et al.,* 1997).

Figure 1. The range of the Prothonotary Warbler.



The prothonotary warbler is the only eastern North American wood warbler that nests in cavities – both natural cavities and those excavated by black-capped chickadees (*Parus atricapillus*) or downy woodpeckers (*Picoides pubescens*). Cavities chosen are generally located over, or adjacent to, standing water and less than 2 m above the ground. Several cavities are required in a territory because males build one or more incomplete "dummy" nests along with the functional nest. Interspecific competition for cavities with tree swallows (*Tachycineta bicolor*) and house wrens (*Troglodytes aedon*) can therefore be a limiting factor (Bock and Fleck, 1995). Other limiting factors that have been identified include loss of swamp forest habitat, nest parasitism by brown-headed cowbirds (*Molothrus ater*), and predation from raccoons (*Procyon lotor*), blue jays (C*yanocitta cristata*), and snakes (McCracken, 1981; McCracken *et al.,* 1997).

To address these limiting factors, the recovery strategy recommended that a nest box program be initiated to try and halt, or even reverse, the population decline (McCracken *et al.,* 1997). Aside from increasing the number of available cavities, nest boxes can be designed to prevent cowbird parasitism and predation from most terrestrial and some avian predators.

The nest box program was initiated in 1997 and has been ongoing since that time. The program initially resulted in a significant population increase; however, since 2001 the population has once again declined. At Rondeau Provincial Park, interspecific competition with house wrens has been identified as the most significant factor leading to the decline. This paper outlines the results of the nest box program to date, with an emphasis on the Rondeau population, and discusses the factors responsible for the recent decline.

Methods

Beginning in 1997 nest boxes were placed in suitable habitat at most of the historical breeding locations throughout Ontario. The total number of boxes in the program has ranged from 160 to 290 boxes annually with 40 boxes at Rondeau Provincial Park (McCracken and Dobbyn, 1997; McCracken and Wood, 2005).

To reduce predation from mammals and snakes, boxes were placed on metal poles rather than trees. Boxes were placed low to the water (60-75 cm) in an attempt to deter tree swallows and house wrens. All boxes utilized by prothonotary warblers had a predator guard (cone) affixed to the pole or the pole greased. All boxes were monitored throughout the breeding season and boxes with evidence of use by prothonotaries were monitored on a more

regular basis. All functional nests were monitored to determine fledging success (McCracken and Dobbyn, 1997).

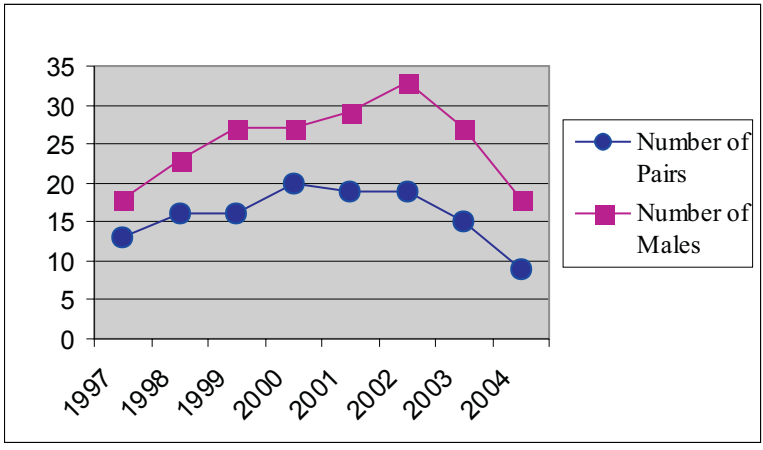
To determine if the local cottage community may be bolstering the house wren population in the park, ten-minute point counts were conducted at 15 locations along Lakeshore Road in both 2000 and 2002. Lakeshore Road is a 6.5 km long road, running north-south, which separates the majority of the cottage community from the forested area of the park. Point counts involved counting all singing house wrens and identifying if they were singing from the cottage side or park side of the road.

Results

The number of prothonotary warblers in Ontario increased from 13 pair in 1997 to 20 pair in 2000. The number of males increased from 18 in 1997 to a maximum of 33 in 2002 (Figure 2). There have always been a few unmated males in the Ontario population, however, the proportion of unmated males is increasing. Between 2000 and 2002 the number of females remained relatively constant, but the number of males continued to increase. After 2002, however, the number of both males and females significantly declined. In 2004 there were fewer pairs than when the nest box project started in 1997 (Figure 2).

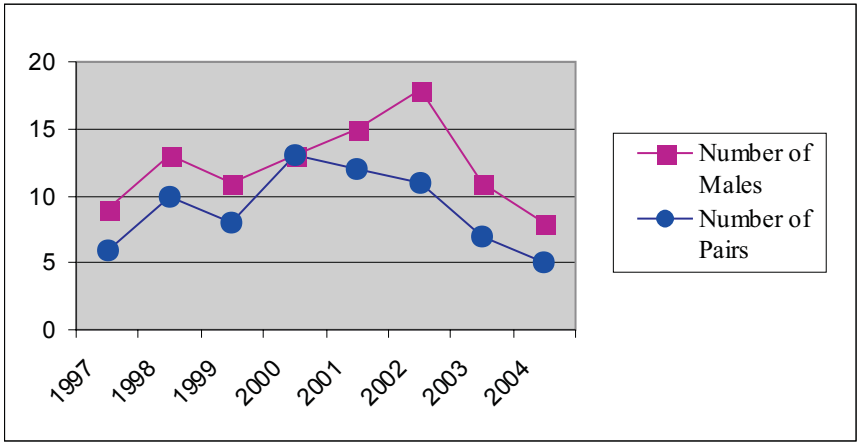
During the same time period, the Rondeau Provincial Park population increased from 6 pair and 9 males in 1997 to 13 pair (and males) in 2000. Between 2000 and 2002 the number of pairs dropped to 11, but the number of

Figure 2. Total number of Prothonotary Warbler pairs and males in Ontario, 1997-2004.



males increased to 18, following the provincial trend of an increasing number of unmated males. After 2002 the number of birds at Rondeau dropped at a similar rate to the entire population, with only 5 pair and 8 males found in the park in 2004 (Figure 3).

Figure 3. Number of Prothonotary Warbler pairs and males at Rondeau Provincial Park, 1997-2004.



During each year of the nest box program approximately half of the Ontario population was found at Rondeau Provincial Park. On average 56% of all pairs (range of 46% to 65%) and 48% of all males (range of 41% to 55%) were found in the park (Figures 4 and 5), demonstrating the importance of Rondeau to the overall Ontario population.

A number of potential factors were considered as the cause for the overall population decline, with drought and interspecific competition being considered the predominant ones. A severe drought that began in 1998 resulted in lower water levels in forested wetlands. This reduced the amount of suitable habitat and increased interspecific competition from house wrens and black-capped chickadees. This drought was the worst on record since the 1960s and in July 1999 Lake Erie's water level dropped below its long-term average for the first time since the 1970s (Figure 6). The water level in most of the existing prothonotary habitat is directly related to lake levels, meaning that many of the breeding sites were drying up by early summer.

An increase in interspecific competition from house wrens, tree swallows, and black-capped chickadees was noted at all sites, but house wrens were having the most significant impact on prothonotary breeding success. Although all sites were being impacted by house wrens, the largest impact

Figure 4. Proportion of all Ontario male Prothonotary Warblers found at Rondeau, 1997-2004.

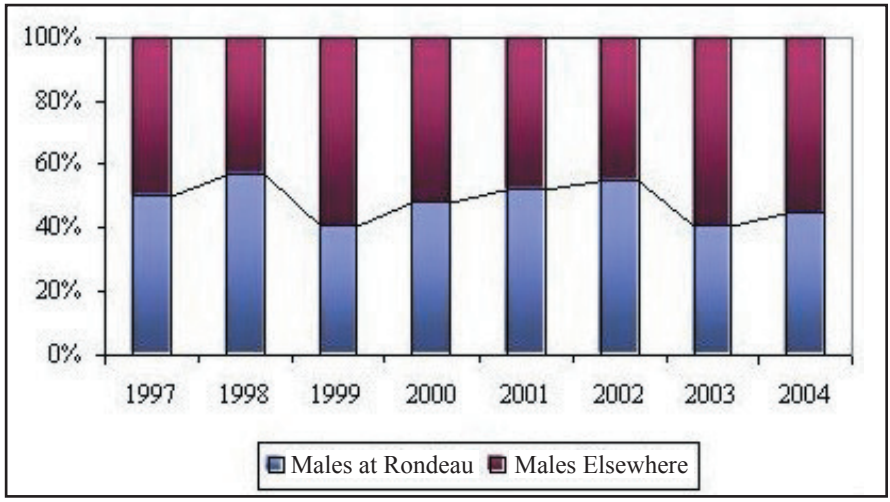
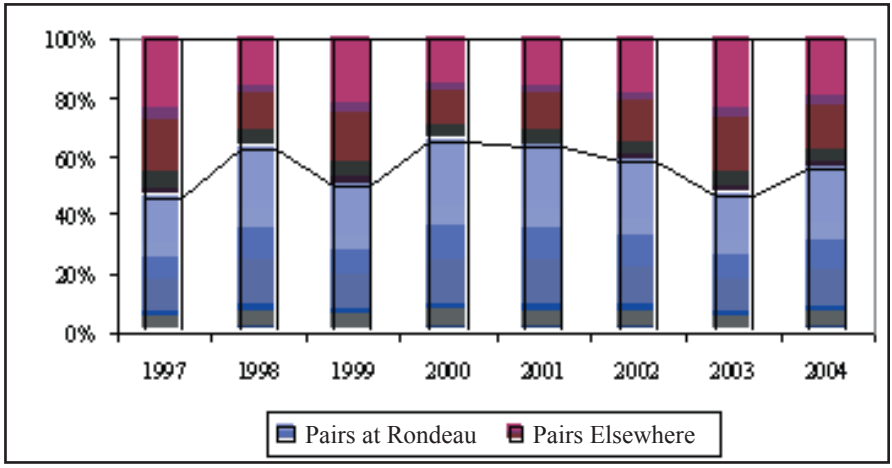


Figure 5. Proportion of all Ontario Prothonotary Warbler pairs at Rondeau, 1997-2004.



was at Rondeau Provincial Park. From 1997 to 2004 the percentage of nest boxes utilized by house wrens across Ontario ranged from 11% to 32%, but at Rondeau the percentage increased from 18% to 70% (Figure 7). An analysis of occupancy in the 40 boxes at Rondeau shows that prothonotaries originally occupied between 52% and 55% of the boxes in the late 1990s, but declined to 15% by 2004. During the same time period, house wren occupancy increased from 18% to 70% (with a peak of 82% in 2001) (Figure 8) and the number of nests taken over by house wrens increased from 0 to

Figure 6. Average Lake Erie water levels 1997-2004 (May through July).

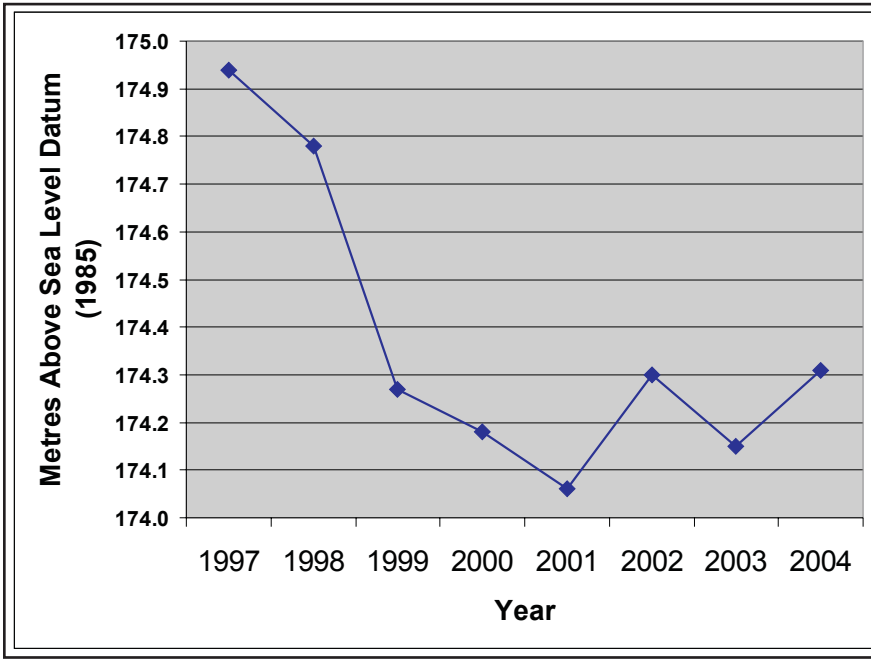
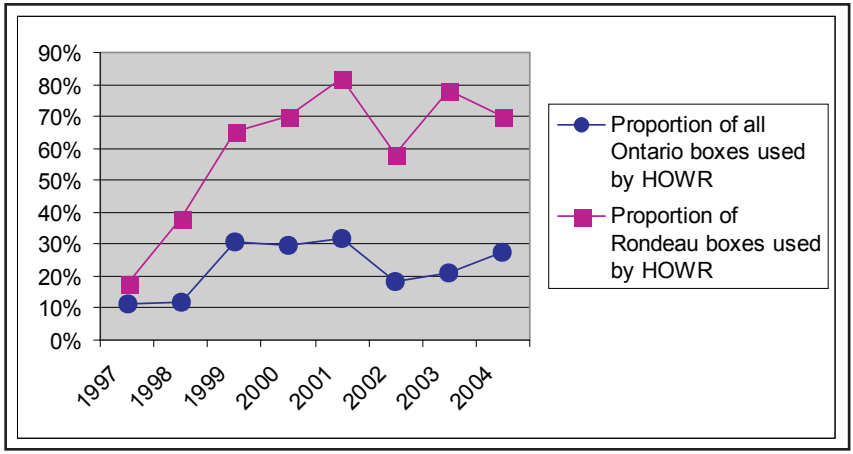


Figure 7. The proportion of nest boxes in Ontario and Rondeau Provincial Park utilized by House Wrens annually from 1997 to 2004.



67%. This resulted in a concurrent reduction in prothonotary nest success from 100% in 1997 to 13% in 2002 (Figure 9).

A visual survey of 222 cottage lots along Lakeshore Road in Rondeau Provincial Park in July 2002 found 124 house wren boxes. A second survey in the spring of 2005 (before leaf out) detected 177 boxes. Call count surveys

Figure 8. Use of 40 original nest boxes at Rondeau Provincial Park, 1997-2004.

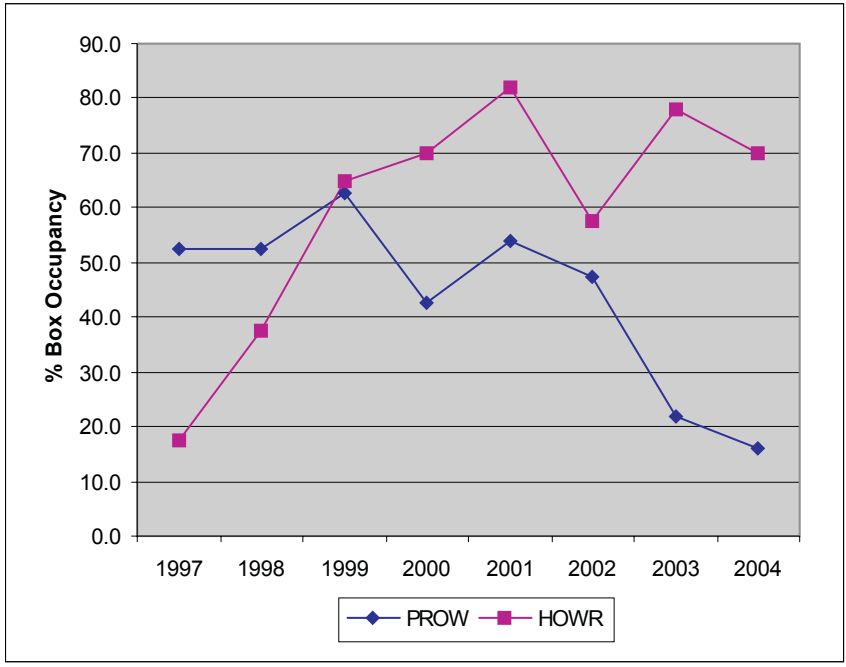
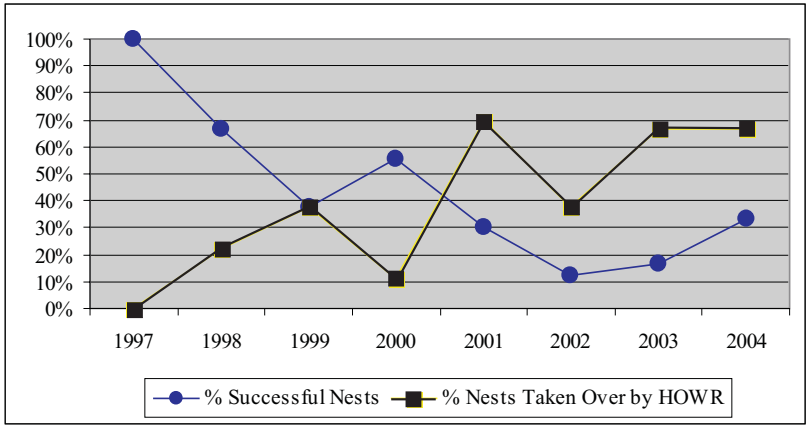


Figure 9. Percent of successful Prothonotary nests and percent of functional nests taken over by House Wrens at Rondeau Provincial Park, 1997-2004.



conducted in 2000 and 2002 along the same road showed that there were significantly more house wrens calling from the cottage side of the road than the forest side ($P<0.001$; paired t-test, see Table 1) indicating that nest boxes in the cottage community may be bolstering the park's house wren population.

Discussion

The prothonotary warbler is declining throughout its North American range (Sauer *et al.,* 2005) due to conditions on both its breeding and winter range.

Table 1. Comparison of the number of House Wrens counted on each side of Lakeshore Road in Rondeau Provincial Park (pooled results from 2000 and 2002).

	West side of Lakeshore Road	East side of Lakeshore Road (cottage side)
Total number of House Wrens counted (15 stations)	21	60
Mean/Station	0.7	2.0
Standard Deviation	0.74	0.91

Prothonotaries spend the winter in coastal mangrove forests of Central America and northern South America and the loss and degradation of these forests due to harvest, charcoal production, resort development, and commercial shrimp farming has been identified as a significant factor in the species decline continentally (McCracken, 1998; McCracken *et al.,* 2005). At the same time, however, habitat is being lost on their breeding grounds. In the southeastern U.S. and Canada, forested wetlands are being lost at a dramatic rate, and the majority of pre-settlement habitat has disappeared (Petit, 1999; McCracken *et al.,* 2005).

Although the amount of prothonotary habitat in Ontario has not physically declined since 1997, drought combined with low lake levels has reduced the amount of that habitat that remains suitable. Prothonotary warblers require pools of open water in their territories and breeding densities and reproductive success are significantly higher when sites are inundated (Petit and Petit, 1996; Wood and Cooper, 1998). In recent years much of the Ontario habitat has dried up by mid-June, and is now more suitable for species such as house wrens and black-capped chickadees. Although some Prothonotaries continue to return to their territories in Ontario (as determined by colour banding), the population is not being augmented from first-year birds or immigrants from the U.S. owing to poor habitat conditions. Thus, as older birds are lost from the population, there are no new birds to replace them, resulting in a population decline.

At Rondeau Provincial Park the cause of the decline is a bit more complex.

Rondeau has long been considered the stronghold for the prothonotary warbler population in Canada and historically supported much higher numbers, owing to the large amount of forested wetland in the park (McCracken, 1981). Although water levels in the park did not drop as significantly as at some of the other sites, drought combined with at least two other factors has resulted in a dramatic increase in the house wren population and a concurrent increase in interspecific competition. House wrens regularly take over prothonotary nests, break their eggs, and kill their young. Since 1997 the number of nest boxes occupied by house wrens has increased from 18% to 82% and the number of boxes used by prothontaries has declined from 55% to 15%. Prothonotary nest success has also been dramatically reduced.

The second factor that we attribute to the increase in house wrens is forest fragmentation. On the evening of July 21, 1998 Rondeau Provincial Park was hit by a large thunderstorm complex. Gusts as high as 180 km/hr were recorded in Erieau and resulted in thousands of trees being uprooted or broken off. Damage was localized within the park, with some areas experiencing a loss of upwards of 50% of the trees, (Larson and Waldron, 2000) while other areas received very little damage. Loss of canopy has resulted in an increase in forest openings and edge habitat, making some areas of the park more suitable for house wrens (Belles-Isles and Picman, 1986).

The third significant factor that we attribute to the increase in house wrens is bolstering from the local cottage community. Having a large number of house wren boxes on the cottage leaseholds increases the number of cavities and makes the park more attractive to house wrens. Bock and Fleck (1995) demonstrated that the addition of nest boxes results in an increase in several cavity nesting species including house wrens. House wrens also have higher breeding success when nesting in boxes and may therefore choose nest boxes over natural cavities (Purcell *et al.,* 1997). Adult house wrens have also been found to be fairly site faithful, particularly when breeding success is high (Drilling and Thompson, 1988). The large population of house wrens along the cottage community probably spread into the parks forested areas once windthrow and drought made the forest more suitable for them.

House wrens have been shown to reduce breeding success in a number of other cavity nesters including tree swallows, Bewick's srens (*Thryomanes bewickii*) and Carolina chickadees (*Poecile carolinensis*) (Finch, 1990; Kennedy and White, 1996; Doherty and Grubb, 2002). Almost 70% of nest boxes occupied by prothonotary warblers were taken over by house wrens in 2004.

To try and dissuade house wrens from using nest boxes we initially attempted to remove nesting material on a regular basis. As with Alworth (1996), we found that this did not reduce next box usage by house wrens and likely only prolonged the house wren nesting season.

We then attempted to use a number of guards, shields, and box modifications to discourage house wrens. We tried a thicker face plate and nails surrounding the hole to make it more difficult for these to get sticks into the box. We tried shields to reduce visibility of the hole and open topped, open front, and bottom entrance boxes to reduce suitability of the boxes for house wrens. None of these methods resulted in a decline in occupancy or breeding success.

To try to reduce the number of nest boxes on cottage leaseholds, the prothonotary warbler recovery team is producing educational materials that explain the impact of house wrens on the prothonotary population, and how a reduction in boxes on leaseholds may help. We hope to reduce the number of boxes through box retirement and a prohibition on new boxes rather than removing all of the boxes at once. This is to prevent a mass swamping of the park's natural habitat with all of the house wrens that would be displaced from the cottage community.

Rondeau Provincial Park has long been the cornerstone of the prothonotary warbler population in Canada. Although drought and low lake levels have significantly affected many of the other breeding sites in Ontario, Rondeau still has adequate habitat to support a larger population. Determining a way to control house wren numbers will be a key to ensuring that the park continues to protect this endangered species.

Acknowledgements

Funding for the prothonotary warbler nest box program has been provided by the Canadian Wildlife Service (Ontario Region), Environment Canada's Habitat Stewardship Program, Human Resources Development Canada, and Bird Studies Canada.

References

Alworth, T. 1996. An Experimental Test of the Function of Sticks in the Nests of house wrens. *The Condor*. 89:841-844.

Belles-Isles, J. and J. Picman. 1986. Nesting Losses and Nest Site Preferences in house wrens. *The Condor*. 88:483-486.

Bock, C.E. and D.C. Fleck. 1995. Avian Response to Nest Box Addition in Two For-

ests of the Colorado Front Range. *Journal of Field Ornithology*. 66(3):352-362

Doherty, P.F. and T.C. Grubb. 2002. Nest Usurpation is an 'Edge Effect' for Carolina Chickadees *Poecile carolinensis*. *Journal of Avian Biology*. 33:77-82.

Drilling, N.E. and C.F. Thompson. 1988. Natal and Breeding Dispersal in house wrens (*Troglodytes aedon*). *The Auk*. 105:480-491.

Finch, D.M. 1990. Effects of Predation and Competitor Interference on Nesting Success of house wrens and Tree Swallows. *The Condor*. 92:674-687.

Kennedy, E.D. and D.W. White. 1996. Interference Competition from house wrens as a Factor in the Decline of Bewick's Wrens. *Conservation Biology*. 10(1):281-284.

Larson, M.H. and G.E. Waldron. 2000. Catastrophic Windthrow in Rondeau Provincial Park, Ontario. *Canadian Field-Naturalist*. 114(1):78-82.

McCracken, J.D. 1981. *Status Report on the prothonotary warbler (*Protonotaria citrea*) in Canada*. Committee on the Status of Endangered Wildlife in Canada: Ottawa. 27 pp.

McCracken, J.D. 1998. *Status of the prothonotary warbler's Critical Wintering Habitat in Latin America: A Focus on Mangrove Ecosystems*. Unpublished report to the World Wildlife Fund Canada from Bird Studies Canada: Port Rowan, Ontario. 44 pp.

McCracken, J.D., P. Burns, M. Cadman, J. Robinson, D.A. Sutherland, and P.A. Woodliffe. 1997. *National Recovery Plan for the prothonotary warbler in Canada*. Unpublished report to RENEW, Ontario Ministry of Natural Resources and the Canadian Wildlife Service. 40 pp.

McCracken, J.D. and J.S. Dobbyn. 1997. *The 1997 prothonotary warbler Nest Box and Census Program*. Unpublished report by the Long Point Bird Observatory: Port Rowan, Ontario. 88 pp.

McCracken, J.D., S. Dobbyn, L. Friesen, D. Lebedyk, J. Robinson, D. Ware, and D. Wills. 2005. *National Recovery Strategy for the prothonotary warbler (*Protonotaria citrea*), Draft #2*. Recovery of Nationally Endangered Wildlife (RENEW): Ottawa, Ontario. 24 pp.

McCracken, J.D. and R.W. Wood. 2005. *The 2004 prothonotary warbler Recovery Program in Canada: Population Surveys, Nest Box Monitoring and Colour Banding*. Unpublished report by Bird Studies Canada: Port Rowan, Ontario. 43 pp.

Page, A.M. 1995. *Updated Status Report on the prothonotary warbler (*Protonotaria citrea*) in Canada*. Committee on the Status of Endangered Wildlife in Canada: Ottawa. 21 pp.

Petit, L.J. 1999. Prothonotary warbler (*Protonotaria citrea*). In: A. Poole and F. Gill (Eds.). *The Birds of North America*. The Birds of North America, Inc.: Philadelphia, PA.

Petit, L.J. and D.R. Petit. 1996. Factors Governing Habitat Selection by prothonotary warblers: Field Tests of the Fretwell-Lucas Models. *Ecological Monographs*. 66:367-387.

Purcell, K.L., J. Verner and L.W. Oring. 1997. A Comparison of the Breeding Ecology of Birds Nesting in Boxes and Tree Cavities. *The Auk*. 114(4):646-656.

Sauer, J.R., J. E. Hines, and J. Fallon. 2005. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2004*. Version 2005.2. USGS Patuxent Wildlife Research Center, Laurel, MD. Available on the web at: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

Wood, L.A. and R.J. Cooper. 1998. Reproductive success and territory dynamics of breeding prothonotary warblers in a bottomland hardwood forest. Paper presented at the 1998 North American Ornithological Conference, 6-12 April 1998, St. Louis, M.O.