WINTER WREN FORAGING BENEATH STREAM ICE

HAROLD G. KLEIN

Unusual behavior of a single Winter Wren (*Troglodytes troglodytes*) foraging for food under the shelf ice of a small stream was observed in midwinter, 150 miles north of this species' ordinary winter range. The bird was present from 20 January through 15 February 1993 along Ray Brook, Town of Beekmantown, Clinton County, in northeastern New York State. The accidental discovery of the wren's presence was made as I was snowshoeing on the snow-covered ice of Ray Brook on the afternoon of 20 January 1993. I had not been on this stream previous to this date. Probably, the wren had been occupying this area for some time, perhaps for the entire autumn and early winter.

On this first day of observation, the wren's behavior was not unusual for the species: it hopped and flew through the streamside vegetation and debris of dead branches and logs, as well as beneath the undercut banks. Because the latest recorded date of a Winter Wren in Clinton County was 30 December (Warren, 1979), this sighting was an unusual occurrence and I decided to follow up on this observation to see how long the wren would stay in the area. This was convenient to do because this stretch of stream was located on my cross-country ski circuit, and I could visit it almost daily. Repeated observations led to the discovery of an unusual foraging behavior, whereby the wren would fly down into the caverns beneath the suspended shelf ice of the stream, which had been formed previously in the early winter, when the water had been higher. Although there may be another explanation for this behavior, I conclude that it was driven by a search for food.

METHODS

The study area was a 500-yard stretch of Ray Brook, plus its immediate banks. The Winter Wren was never seen away from this area. Ray Brook is a rocky stream about eight yards wide, flowing over bedrock down a moderate gradient, and set in a shallow valley. The elevation is approximately 175 feet above sea level. The study area contained an ordinary amount of stream debris, consisting of dead branches and logs along the banks, and in the form of small log jams. The tree lined banks had been undercut in a number of places, providing places where the ground was not snow covered. The ground and the stream ice were covered by about a foot of snow at the beginning of the study period. The shelf ice had collapsed in places, forming 52 crevices

leading to caverns beneath the ice of the stream. The space beneath the shelf ice was approximately one to two feet in depth. The visible floor of the caverns was usually thin ice, but sometimes it was flowing water, depending upon weather conditions. The Ray Brook study area was observed intermittently from 20 January through 7 March 1993, although the last evidence of the Winter Wren was seen on 15 February 1993.

Information was collected by skiing on the stream ice or on ski trails that paralleled the stream. The stream could be observed with 10X50 binoculars from the parallel trails, and the presence of the wren could be determined without unduly alarming the bird. These observation periods varied from fifteen minutes to one and one-half hours each time out, and usually occurred once per day, but sometimes twice per day.

Signs of the Winter Wren were sought on the surface of the snow around and within the crevice openings to the ice caverns. Sign took the form of footprints and wing prints, which were attributed to the wren on the basis of size and circumstances (prints present where the wren was seen to enter or leave a crevice). Wren fecal droppings and insects found on the snow were collected and preserved in 10% formalin or alcohol for later examination under a stereoscopic dissecting microscope at 10X to 70X magnifications.

The temperatures and other weather information reported in the chronology were included to describe the severe winter conditions under which this bird existed. The temperature data are approximate, taken from my home thermometer, which was located about 100 yards from the study area.

RESULTS

OBSERVATIONS: The observations of this study will be described in a chronology; a summary follows. Of the twenty-seven days that the Winter Wren was present on, or presumably near, the study area, I inspected the area for sight or sign of the wren on twenty-two days. I directly observed the wren on eight days; on four additional days I found recent footprints or wing prints, indicating presence of the wren. After this period of the wren's confirmed presence, I kept the study area under surveillance for an additional twenty day period, inspecting it on nine days.

20 January: As described in the introduction, this was the first time I saw the Winter Wren. I was able to approach the bird to within five yards as it moved along the bank of the stream, and could identify it without binoculars.

21 January: Overnight temperature -10°F. As I skied down the snow-

covered ice of the stream, I saw the Winter Wren fly up from the snow surface (probably from the perch mentioned later) and over to the white cedars bordering the stream and disappear. I skied further and, on looking back, saw the bird fly down into an ice crevice ten feet long and one to three feet wide. I approached the crevice and the wren suddenly flew out and over to the cedars. Inspection of the inside of the crevice revealed no visible source of insect food. The bottom of the crevice was ice-covered water, as far as I could see beneath the shelf ice. However, it was possible that, farther into the cavern formed by the shelf ice, there was open water, allowing the bird access to aquatic animal life. In the snow at the bottom of the crevice were wren-sized foot and wing prints, apparently marking the bird's takeoff from inside the crevice. Subsequent inspection this day of three other ice crevices revealed similar footprints and wing marks, indicating a pattern of cavern visits. I hypothesized the bird was obtaining food from this unusual foraging habitat. Of interest in this regard, was the discovery of fecal droppings on the snow, beneath a perch only two yards from the edge of the first crevice. This was a small stub beneath a slanted willow trunk; the perch was about one foot above the snow. From various sightings of the wren in close proximity to this perch, I concluded that these droppings had been deposited by this Winter Wren. I collected and preserved these droppings and another set on 10 February.

22 January: Overnight temperatures increased to above the freezing point; snow and skim ice in the crevices had melted, exposing flowing water. Several insects were crawling on the snow near some crevices. I carefully approached the stream on foot and watched the Winter Wren for fifteen minutes as it engaged in typical foraging behavior: flitting through the vegetation, acrobatically clambering about bank side debris, and venturing into rock cavities and beneath cut-bank overhangs. It investigated the surfaces of all these places, and presumably was picking off some type of animal food, either active or inactive insect life. Once it sprang upward a foot to take something from a dried herb. The wren also flew from a streamside bush directly into an ice cavern, remaining there, out of view, for several minutes. I was observing the wren at distances of ten to twenty yards, being slow and careful in my movements. It must have been aware of my presence, yet it did not show any signs of alarm; neither did it come over to my side of the stream. After working its way upstream for fifty yards, it reversed itself and came downstream toward me. At this point I departed the study area, leaving the wren to continue its search.

23 January-1 February: During this period, the Winter Wren was not seen; daily visits to the study area were made, except for 30 and 31

January. The mild weather continued for the first part of this period, and the caverns contained running water. No snow insects were seen on the snow surface. Toward the end of this period, low temperatures froze the water in the caverns, and there was a seven-inch snowfall 30-31 January, which covered the new ice on the floor of the caverns. The wren may have moved to other parts of the stream that were less frozen and provided better foraging for aquatic animals.

2 February: Cold weather continued, with overnight temperatures down to -10°F and a midday temperature of about 5°F. The Winter Wren was seen flitting about in the underbrush, about 100 yards upstream from the previous sightings.

3 February: Overnight temperatures started at 5°F and increased to 25°F by midmorning. The wren was observed going into two caverns and remaining there for as long as five minutes. Wren tracks were noted entering a crevice whose opening was only ten inches in diameter.

4 February: Overnight temperatures were down to 10°F by morning, plus a one-inch snowfall. Although the wren was not found during a one-hour visit in the late morning, it was seen in the late afternoon, flying down into caverns, staying for two to three minutes, and then flying to streamside debris or vegetation. Here it rested for several minutes before moving on to the next cavern. I saw the wren fly into six crevices during a one hour period.

5 February: Overnight low temperature was 20°F and the day was mild, but a north wind was blowing and snow commenced at 1 PM. I did not get to the study area until 3:30 to 4:30 PM, while it was snowing heavily. The wren was not seen.

6 February: About two inches of snow accumulated yesterday afternoon. A cold wave moved through overnight, reducing the temperature to -18°F. The midday temperature was only -10°F. The wren was not seen during two hour long inspections of the study area in the afternoon, but two crevices contained fresh foot and wing prints. At least one crevice contained flowing water.

7 February: Overnight low temperature -35°F, midday temperature at 0°. A one and one-half hour search of the study area yielded neither a Winter Wren nor any fresh sign.

8 February: Overnight temperature 15°F., midday temperature 30°F. No sight nor sign of the wren.

9 February: Overnight low temperature -10°F, midday temperature 15°F. I toured the study area from noon to 1:30 and found the wren immediately. I watched the wren enter eight ice caverns, the openings of which were now small (down to ten inches in diameter), being blocked by snow accumulation and drift. The bird did not hop around in the

snow at the bottoms of the crevices (tracks only at the edge of the opening), but flew directly into the crevice and farther into the cavern beneath the ice shelf. It also visited streamside tangles of brush and vines, plus going into rotten stumps and holes among the rocks.

10 February: Overnight low temperature 15°F, midday temperature 25°F. Heavy overcast and light snow. The wren was found entering ice caverns, alternating with visiting streamside brush, stumps, and rock cavities, as previously described. One crevice opening was only three inches by one and one-half inches, yet it had tracks going down into it. On one or two occasions, the wren went under the shelf ice at one opening and came out another, about eight yards away. On one occasion, the wren went on a side trip away from the stream, following a long, large, suspended log, hopping beneath it on the bare ground, presumably looking for food. It then returned to the stream and continued visiting ice caverns.

11 February: Overnight low temperature 0°F, midday temperature 10°F. No wren was seen, but many of the caverns had wren tracks going into them via very small openings (less than six inches in diameter), caused by the accumulated snow.

12 February: Overnight low temperature -5°F, midday temperature 15°F. No wren was seen. A survey of the ice crevices was made. Fifty-two crevices were present on the study area; about 75% of them had Winter Wren tracks entering them. A major snowstorm started at 2 PM.

13 February: It snowed yesterday afternoon, all last night, and most of today, accumulating another foot of snow. I did not go to the study area today or on February 14. The temperatures were in the 20°F range during this period.

15 February: Overnight low temperature O°F. I snowshoed through the study area this morning. No Winter Wren was sighted. The caverns were surveyed for openings and wren sign. Only eleven of the original fifty-two crevices (21%) were open, and many of these openings were only a few inches in diameter. All eleven openings had fresh wren tracks leading into them. Another inspection of the study area in the late afternoon revealed no wren present, and apparently no new wren tracks at the eleven openings. Additionally, two patches of open water on the stream showed no new wren tracks present. This was the last date on which any evidence of the Winter Wren's presence was observed.

16-17 February: A severe snowstorm put down ten inches of snow. I did not visit the study area on these days.

18 February: Overnight low temperature -15°F, midday temperature 15°F. I snowshoed the study area and found that all ice crevice openings were now closed by the accumulated snow. Neither the wren nor any

sign of it was seen. There were still some foraging places available: the snow sheltered places beneath rocks, stumps, roots, logs, and streamside debris. However, an examination of the snow surface next to these places showed no foot or wing prints of the Winter Wren. Therefore, there was no evidence of the wren's presence since the snowfall of February 16-17.

19 February: Overnight low temperature -20°F, midday temperature 15°F. I inspected the study area; no sight nor sign of the wren. All crevices were still sealed with snow. There were two patches of open water on the study area and more open water downstream.

25 February: Since 19 February, there have been six inches of snow and the overnight temperatures have been around 0°F. An inspection of the study area showed neither the wren nor any sign of it. The ice crevices remained sealed by snow. There were some additional areas of flowing water where the ice had settled and melted, and some insects were associated with these openings.

26 February-7 March: During this period, I visited the study area on six days, and there was neither sight nor sign of the Winter Wren. Many insects appeared on the snow surface. A small number were associated with the open water melt-outs and were apparently emerging from the stream. These were similar to those observed previously, and a collection was made. Others (Snow Fleas, Order Collembola) were everywhere on the snow surface of the whole general area, but were most abundant on the stream snow cover. There must have been millions of them, for they appeared like coal dust on the snow. The Snow Fleas appeared on 3 March, when the overnight low temperature was around 20°F and rose to 40°F during the day. The higher temperatures, plus the weight and insulating effect of over two feet of snow on the ice, was apparently causing the ice shelf to melt and collapse in places. With little chance of seeing the Winter Wren on the study area, I ended the inspections.

COLLECTIONS: Microscopic examination of the insects collected as they emerged from the stream identified them as Small Winter Stonefly (*Allocapnia pygmaea* , Family Capniidae, Order Plecoptera). They were about 1/4 inch long, and therefore easy prey for a Winter Wren to handle, especially since they are not strong fliers and were observed only walking on the snow surface. Some were winged and others wingless, apparently not yet transformed into the adult stage. These were the insects seen on 22 and 25 January, 28 February, 3, 4, and 7 March, and were associated with mild weather spells, when the stream water was flowing freely at the crevices or where the ice had collapsed.

Microscopic examination of the fecal droppings showed that they were composed mostly of insect exoskeleton parts in fragmentary condition. These were similar to the Small Winter Stonefly insects collected. Moreover, one entire exoskeleton was found, complete with wings. It was definitely of the species, *Allocapnia pygmaea*.. The fragments of exoskeletons could have come from naiads (preadult, wingless, aquatic stages), because there are no major anatomical differences between the late naiad stage and the adult stage, except for the loss of gills and the acquisition of wings. In addition, there was a relatively small number of Snow Fleas in each dropping collection; the source of these was uncertain. I concluded that the Winter Wren had been feeding mostly on Small Winter Stonefly that it had captured during its ice cavern forays.

DISCUSSION

This Winter Wren persisted under severe winter conditions in this particular area far north of the usual limits of its winter range on the Mohawk River and south shore of Lake Ontario, My main conclusion from this study is that it probably owed its survival to the food it obtained from the stream in the ice caverns. I believe this is shown by the consistent visits of the wren to these ice caverns from before 20 January to 15 February. Although the wren was undoubtedly gleaning animal food from other sources, such as the bare ground, rocks, and vegetation, the food provided from the stream may have been essential to its survival. When this source was denied the wren because of unusually heavy snowfall during the midwinter, the wren no longer persisted on the study area even though there were foraging surfaces on the vegetation and on the bare ground beneath rocks, stumps, roots, and logs. On 18 February and later, these places were inspected for the presence of the Winter Wren or its tracks; neither was seen. I conclude that it was the presence of the ice caverns that had attracted and the held the Winter Wren to this stream habitat, and was the factor allowing it to survive this far into the winter.

Although I did not directly observe this Winter Wren obtain food from within the ice caverns, the fortuitous discovery of its fecal droppings provided evidence that it was eating aquatic insects. Adult Small Winter Stonefly are known to emerge from the water and mate from February through April; my sightings of adults emerging as early as 22 January during a mild spell of weather indicates that there was a food resource for the wren in the stream, made accessible in the ice caverns. Even without emerging adults, these aquatic insects would

have still been exploitable by the Winter Wren. Bent (1964) quotes E. H. Forbush, "The winter wren feeds along the banks of streams, frequently pecking at something in the water, and sometimes in its eagerness to secure its prey, it immerses the whole head. It may thus secure water insects."

Although I believe that foraging for food was the purpose of this Winter Wren's visits to the ice caverns, there may be other explanations that should be discussed, such as seeking water or shelter. Although the wren probably drank water while in the ice caverns, the frequent, sequential visits I observed on two occasions would not have been necessary to satisfy a thirst. If shelter were the reason for the wren's visits, it should have remained for longer periods of time inside the caverns, once it had entered. Also, there were many sheltered roosting places among the undercut roots and banks of the streamside.

Therefore, I believe that the visitation pattern I observed fits foraging behavior better than other explanations. This bird was expending fair amounts of time and energy flying from cavern to cavern. Theoretically there should be a positive return for this investment. The ice caverns must have provided a preferred and profitable food resource. This bird remained attracted to the ice caverns, repeatedly visiting them even as they were being progressively closed by the accumulating snow. Apparently there was a renewable resource in the caverns: insects emerging from the water or animals being carried along by the current and becoming newly available on a daily basis.

When the heavy snowfall of 16-17 February completely closed the ice caverns, the Winter Wren apparently moved away from the study area to more suitable feeding conditions, such as open water stretches of the stream, or it succumbed to inadequate food and hypothermia. High mortality in Winter Wren populations, caused by severe winters, has been reported in Europe and North America (Armstrong and Whitehouse 1977; Bent 1964; Robbins *et al.* 1986). Had the unusually heavy snowfalls in mid February not closed the ice caverns, this Winter Wren presumably could have persisted on the study area until milder weather conditions generated much insect activity, such as occurred at the end of February and the beginning of March.

The ability of Winter Wren to survive north of its usual winter range may be due in part to its consumption of plant food. Grzimek (1973) stated that the Winter Wren eats "a certain amount of supplementary plant food." Bent (1964) cites an observation of a Winter Wren feeding on red cedar berries. Aside from these citations, there appears to be little knowledge concerning the importance of plant food to this species in the winter. Martin, Zim, and Nelson (1951) does not contain an analysis of

Winter Wren food habits. An inquiry made to the U. S. Fish and Wildlife Service Patuxent Environmental Science Center revealed that no food habits data for the Winter Wren were on file. An inquiry made to the Cornell Laboratory of Ornithology Feeder Watch Project produced an interesting sample of their data on Winter Wren visits to backyard feeders: 63 visits in 1992, 46 in 1993, and 50 in 1994. However, there were no details regarding what the wrens were eating, which could have been seeds or suet, or live insects that were attracted to the feeder. Therefore, the subject of "supplementary plant food, " especially during the winter, remains unclear.

An additional conclusion is that these observations provide an insight into preadapted, opportunistic behavior. This Winter Wren exhibited an interesting example of adjustable behavior, foraging in a place that would be inaccessible to other bird species. However, this bird is a member of a species preadapted for exploiting such a source of food. The Winter Wren's well-known behavior of scurrying about beneath logs, stumps, and debris, and of entering cavities in logs, among rocks, and beneath undercut stream banks predisposes it to entering ice caverns. Armstrong and Whitehouse (1977) states that in Europe, wrens will penetrate beneath snow-covered brush in their search for food. Holmes and Robinson (1988) categorized the Winter Wren as a "manipulative searcher", having observed it during the summer, finding hidden prey by "searching methodically among fallen dead wood, root masses of upturned trees, and dense foliage near the ground." Twenty-five percent of prey attacks took this form of foraging, by probing into various substrates, such as earth, leaf litter, or loose bark. Other forms of feeding behavior included: 61% of attacks by gleaning from the surface of a variety of substrates (mostly bark), 9% involved jumping up or hovering to seize prey from a leaf or twig, and only 4% of prey attacks were hawking flying insects. Thus, the Winter Wren apparently adjusts its hunting method to suit the location of prey animals and the kinds of substrates involved.

The habitats exploited and the foraging methods used are reflected in the diets fed to chicks. For the European Winter Wren, Armstrong and Whitehouse (1977) reported many non-flying food types: spiders, harvestmen, slugs, centipedes, caterpillars, pupae, worms, and even fish on occasion. In Oregon, Van Horne and Bader (1990) found that the food of nestlings was composed totally of arthropods, mostly spiders, adult beetles, adult flies, and moth and butterfly larvae. There was a preference for the first two groups over the last two. As a final example of opportunistic behavior, Martin (1991) described a Winter Wren capturing, killing, and eating three small trout fry from the shallow water of a Long Island river in February.

Another interesting aspect of this Winter Wren's adjustable behavior relates to the shape and size of its winter home range. Phillips and Black (1956) censused a large population of Winter Wren and followed some marked birds during two winters in mixed coniferous-hardwood forests on the coast of Washington State. Food was abundant and available all winter; there was no cold weather or snow. The authors concluded that these wrens had roughly circular daily home ranges with an average diameter of less than 200 feet. In contrast, my Winter Wren's observed home range was long and narrow (the study area): 500 yards long and about 16 yards wide. The wren's actual home range must have much larger, because it was absent from the study area much of the time. Presumably, it ranged farther up and down the stream. Its home range shape and size was necessarily adjusted to conform to productive sources of scarce animal food.

CONCLUSION

The opportunistic foraging behavior observed in this Winter Wren is in accord with the nature of the species, which apparently is adapted to adjust to a variety of environmental conditions, using a large repertoire of behaviors. The species has an extensive geographic range from North America, through Asia and Europe, and extending into northern Africa. A great variety of habitats must be utilized by this species over this vast geographic range. In Europe at least, the species breeds in several kinds of habitats, from forest to moor, and in agricultural settings such as gardens, parks, and hedgerows (Armstrong and Whitehouse, 1977).

Also, the behaviors of this bird suggests that Winter Wren, and other bird species, may engage in unusual foraging behaviors to sustain them through winter periods in inhospitable times and places. In the light of my experience and the literature citations, it seems that the place to look for wintering Winter Wren in New York State, when the landscape is snow and ice covered, would be small streams that are partially open because of springs or that have formed ice caverns, as in my study. More focused observations by birders may reveal such interesting and instructive behaviors, and provide a more complete picture of a species' potential for adjusting to unusual environmental conditions, by utilizing variations on its species specific adaptations.

ACKNOWLEDGEMENTS

Thanks are due my wife, Carole, for assistance in word processing, editing, and advice; to Gordon D. Muir and other librarians at State University of New York at Plattsburgh, for help in literature searching; to Lynda Garrett, Librarian, Patuxent Environmental Science Center, U. S. Fish and Wildlife Service, for searching the archives for food habits analyses and for library assistance; to Kenneth V. Rosenberg and Diane L. Tessaglia, Cornell Laboratory of Ornithology, for feeder watch data; and to the Dept. of Biological Sciences, SUNY, Plattsburgh, for laboratory facilities.

5 Haynes Road, Plattsburgh, New York 12901

LITERATURE CITED

Armstrong, E. A., and H. L. K. Whitehouse. 1977. Behavioral Adaptations of the Wren (*Troglodytes troglodytes*). *Biol. Rev.* 52:235-294.

Bent, A. C. 1964. *Life Histories of North American Nuthatches, Wrens, Thrashers and Their Allies.* Dover Publications, Inc., New York, N. Y.

Grzimek, Bernhard, ed. 1973. *Grzimek's Animal Life Encyclopedia, Vol. 9, Birds III.* Van Nostrand Reinhold Co., New York, N. Y.

Holmes, R. T., and S. K. Robinson. 1988. Spatial Patterns, Foraging Tactics, and Diets of Ground-foraging Birds in a Northern Hardwoods Forest. *Wilson Bull.* 100:377-394.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. *American Wildlife and Plants.* McGraw-Hill Book Co., New York, N. Y.

Martin, Peter. 1991. Fishing by a Winter Wren. *Kingbird* 41:93.

Phillips, R. E. and H. C. Black. 1956. A Winter Population Study of the Western Winter Wren. *Auk* 73:401-410.

Robbins, C. S., D. Bystrack and P. H. Geissler. 1986. *The Breeding Bird Survey: Its First Fifteen Years, 1965-1979.* U. S . Dept. Interior, Fish and Wildlife Service, Resource Publ. 157, Washington,, D. C.

Van Horne, Beatrice and Ahmad Bader. 1990. Diet of Nestling Winter Wrens in Relationship to Food Availability. *Condor* 92:413-420.

Warren, Philip H. 1979. *Birds of Clinton County.* Northern Adirondack Chap., Nat. Aud. Soc., Plattsburgh, N. Y.