

## EVALUATION OF THE SINGLE SURVEY TECHNIQUE FOR ASSESSING COMMON LOON POPULATIONS

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**Abstract.**—We evaluated the accuracy of a single survey in estimating the resident Common Loon (*Gavia immer*) population on the Turtle-Flambeau Flowage, Wisconsin, during 1986 and 1987, by comparing it to estimates obtained during an intensive productivity and brood habitat study. On average, we located and verified 94% of the chicks but only 56% of the territorial adults during the single surveys. Determination of territorial adults was low because of our inability to classify adults without broods and highly variable numbers of nonresident adult loons present. We conclude that a single survey on large, multiple-pair lakes is ineffective in estimating territorial adult Common Loon populations and will not provide accurate trend data, although a single survey conducted when chicks are approximately 6-weeks old will yield good estimates of fledging success.

### EVALUACIÓN DE LA TÉCNICA DE UNA SOLA ENCUESTA PARA DETERMINAR EL TAMAÑO DE POBLACIONES DE GAVIA IMMER

**Sinopsis.**—De 1986 a 1987, evaluamos la eficacia de la técnica de una sola encuesta para estimar la población residente de somormujos (*Gavia immer*) en Turtle-Flambeau, Wisconsin, comparando ésta a estimados obtenidos durante un estudio de productividad. Durante la encuesta, se localizaron y verificaron (en promedio), el 94% de los polluelos, pero tan sólo el 56% de los adultos territoriales. La estimación de adultos territoriales fue baja debido a la incapacidad de clasificar a adultos sin polluelos, y al alto y variable número de adultos de somormujos no-residentes. Concluimos que una sola encuesta en lagos grandes con múltiples parejas, es inefectiva para estimar el número de somormujos territoriales y no provee información precisa de las tendencias poblacionales que puedan ocurrir. No obstante, si la encuesta se conduce cuando los polluelos tienen aproximadamente 6 semanas, ésta proyecta un buen estimado del éxito de los volantones.

Bent (1919) and Palmer (1962) have described the historic distribution of the Common Loon (*Gavia immer*). Recently, concern has been expressed

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over apparent population declines of the Common Loon across portions of its breeding range in North America (McIntyre 1988, McNicholl 1985, Sutcliffe 1978, Tate 1981). Current reduction of their historic summer habitat appears related to increased shoreline development and recreational use (McIntyre 1986, Plunkett 1979). Tate (1981) placed the Common Loon on a "blue list" of North American species displaying non-cyclic declines in at least part of its breeding range. Plunkett (1979) stated the need for obtaining population estimates and recommended subsequent monitoring of Common Loon populations at regular intervals. Effective survey techniques are essential for obtaining accurate population estimates to develop management strategies.

Although many studies have used extensive surveys to provide estimates of Common Loon abundance (Cross 1979, McIntyre 1979, Olson 1988, Parker et al. 1986, Robinson et al. 1988, Sawyer 1979, Zimmer 1982), we found no studies that compared the accuracy of a survey to the actual resident population. The objective of our study was to determine the effectiveness of a single survey using powerboats on large waterbodies for estimating a population of Common Loons.

#### STUDY AREA AND METHODS

This study was conducted on the Turtle-Flambeau Flowage (TFF), a single 5792-ha impoundment located in Iron County, northcentral Wisconsin (46°00'N, 90°10'W). The TFF was created during 1926 and contains >300 islands and 290 km of mainland shoreline. It is a shallow impoundment, approximately 50% is <3 m in depth; maximum depth is 16 m. Water levels generally drop 65–100 cm between May and August (Belant and Anderson 1991a). Summer homes and resorts occupy <5% of mainland shoreline. Predominant recreational uses are fishing and camping, with greatest activity adjacent to areas of human occupancy.

We conducted the single survey by powerboat once each year on 25 and 26 Jun. during 1986 and 1987, respectively. The TFF was divided into 6 non-overlapping routes which were surveyed simultaneously by 3 or 4 observers per route at speeds  $\leq 10$  kph. Surveyors traversed continuously along routes until adult loons or chicks were observed. When a loon was observed, surveyors stopped and visually searched for additional loons. Routes were traversed between 0500 and 1100 h to avoid excessive wind and wave action which could reduce observers' visibility. Because most resident adult loons are usually  $\leq 250$  m from shore and chicks are generally  $\leq 150$  m from shore (Strong and Bissonette 1989; Belant, unpubl. data), observers traveled within 150 m of all mainland and island shoreline within their survey area. We recorded location, time, number of individuals, breeding status, age class (adult, immature, or chick) by plumage characteristics (Palmer 1962), and to minimize duplication, the direction of loons in flight. Although one of us (Belant) coordinated the intensive population estimate and also participated in the survey, we believe our results are unbiased because all participants followed identical

TABLE 1. A comparison of Common Loon population estimates using a multiple, intensive survey (Belant and Anderson 1991a,b) and a single survey, Turtle-Flambeau Flowage, Wisconsin, 1986-1987.

Common Loons observed	1986		1987	
	Multiple survey	Single survey	Multiple survey	Single survey
Territorial adults	44	24	46	26
Unclassified adults on water	—	26	—	29
Unclassified adults in flight	—	7	—	13
Chicks	16 <sup>a</sup>	14	17 <sup>a</sup>	17
Total	60	71	63	85

<sup>a</sup> The number of chicks was determined the day before and immediately after the single survey was conducted.

protocol. Additionally, the survey group Belant participated in performed similarly to other survey groups.

Common Loon population estimates obtained from single surveys conducted during 1986 and 1987 were compared to population estimates obtained during an intensive productivity and brood habitat study initiated during the same years (Belant and Anderson 1991a,b). To determine the actual resident population, we located territorial pairs and nests by conducting intensive searches by boat from late-April through July 1986, and May through July 1987. Portions of the TFF not occupied initially by a territorial pair were again inspected at least twice per week during April through June and about weekly during July for occupancy. Territorial and incubating adults and subsequent broods were monitored at least weekly for 1 to 3 h until chicks were at least six weeks old to determine hatch success and chick survivorship (Belant and Anderson 1991a,b). All territorial pairs with chicks or nests were monitored the day before and immediately after the single survey to obtain total brood counts. We believe all territorial pairs on the TFF were located during both years of the study.

There were 22 territorial pairs on the TFF during 1986 and 23 pairs during 1987; of these, 17 and 21 pairs were known to have nested (Belant and Anderson 1991a). Sixteen (1986) and 17 (1987) chicks were determined to be present the day before and immediately following the single surveys.

## RESULTS

Seventy-one (1986) and 85 (1987) Common Loons were recorded during the surveys (Table 1). Fifty-seven adult loons were observed during the 1986 survey and 68 during 1987. Seven adults were observed in flight during 1986 and 13 during 1987, yielding 50 (1986) and 55 (1987) adults present on the water. Twenty-four (55%) and 26 (57%) of the territorial adults resident during 1986 and 1987, respectively, were correctly identified during the surveys ( $\bar{x}$  = 56%). These loons represented 12 (1986)

TABLE 2. Number of Common Loon adults and chicks observed on the water during single surveys in relation to known loon territories, Turtle-Flambeau Flowage, Wisconsin, 1986-1987. Percentages in parentheses.

	1986	1987
Known territories <sup>a</sup>	22	23
Known territories with chicks <sup>a</sup>	12 (55)	13 (57)
Territories with chicks observed	11 (92)	13 (100)
Territories with 2 adults observed	13 (59)	18 (78)
Territories with 1 adult observed	5 (23)	3 (13)
Territories with no adults observed	4 (18)	2 (9)
Total number of adult loons observed within territories	31 (62)	41 (75)
Number of adult loons observed outside of territories	19 (38)	14 (25)

<sup>a</sup> From Belant and Anderson 1991a,b.

and 13 (1987) pairs, each of which was accompanied by a brood. Fourteen of 16 (88%) and 17 of 17 (100%) chicks were recorded during the 1986 and 1987 surveys ( $\bar{x} = 94\%$ ); 1 brood of 2 chicks was not observed during 1986.

Most known territories ( $\geq 91\%$ ) had at least one adult loon present (Table 2). This represented the majority (75%) of the adults observed on the water during the surveys.

Approximately 5.2 h per route was required to conduct the survey each year at an average rate of 186 ha per route per hour. Total effort required each year was about 110 h.

#### DISCUSSION AND MANAGEMENT RECOMMENDATIONS

More adult loons were observed on the water during the single survey than determined to be territorial from the intensive study. This suggests that the TFF was used frequently for feeding and socialization by non-resident loons. Nonresident loons are common on large, multiple-pair lakes (Croskery 1988, Strong and Bissonnette 1988). The number of nonresident adults counted on the TFF at various times during the nesting and brood-rearing periods ranged from 0 to 27 (Belant, unpubl. data). The occurrence of nonresident loons and our inability to distinguish their territorial status rendered the survey inaccurate for estimating the population of territory holders. Strong (1990) also noted that nonbreeders confound population estimates.

The majority of adult loons observed during this study were on established territories. Additionally, most territories were occupied by at least one loon. However, unless accompanied by a brood, we could not distinguish these birds from nonresident adults. With the exception of Belant, no individuals who participated in the single surveys were fully aware of the number, location, and extent of territories. Even if one or more adults without chicks were observed within a territory, there would be no way of determining whether these adult(s) were actually the resident(s) of that territory during the single survey.

Although peak hatching of initial clutches on the TFF occurred before

the single surveys (Belant and Anderson 1991b), chicks that hatched after the surveys were missed. Because the methods we used during the single surveys did not include searching shorelines for nests, we could not reliably identify adults that may have been associated with nesting activities as territorial.

Thus, the single surveys provided poor estimates of territorial loons. It is impractical (perhaps impossible) during a quick, single survey to determine whether a loon is territorial. Adults were consequently classified as territorial only if accompanied by a brood. We conclude that single surveys can not be used to accurately determine the number of resident, territorial adults on large lakes or impoundments. Additionally, single surveys on large, multiple-pair lakes will unlikely provide reliable trend data because of variability in the number of nonresident loons present during a given time period. We also believe that this type of survey would be inadequate for confidently determining the presence of territorial adults on small, single-pair lakes unless an active nest or chick(s) is observed. Belant (1991) and Miller and Dring (1988) have documented adult Common Loons defending multiple lakes. Thus, defensive and/or territorial behavior can no longer be used as the sole criteria for determining permanent occupancy by loon pairs during the breeding season, as loons may defend a lake or portion of a lake they are not nesting or rearing chicks on.

We were highly effective in determining the number of chicks present using the single survey because chicks were still young, relatively immobile, and close to shore. Strong and Bissonette (1989) observed similar behavior in Common Loon chicks. Survivorship is high after chicks are 4–10 weeks old (Strong 1990, Yonge 1981). Chick survival on the TFF was 100% after 6 weeks of age (Belant and Anderson 1991b). Therefore, we recommend conducting the survey on the TFF when chicks are approximately 6 weeks old. Although chicks have been reported to begin making extended movements at this time (Olson and Marshall 1952), at least on the TFF, they are still within the adult territory and are readily visible. Conducting the one-day survey on the TFF at this time should provide reliable estimates of the number of chicks that will fledge, enabling long-term monitoring of overall productivity.

During our study, three to four observers were assigned to each survey route. We recommend that the number of observers be reduced to two per route or 12 individuals total, reducing hours expended by at least 40% (from approximately 110 h to 63 h) without sacrificing accuracy. Surveys partitioned into non-overlapping routes that are simultaneously searched are advantageous on large (> 1000 ha) lakes, providing for more expedient data collection with greater accuracy.

In conclusion, we recommend use of the single survey technique for estimating Common Loon fledging success, provided chicks are about 6 weeks old at the time of the survey. However, because of our inability to classify territorial adults and the variability in the number of nonresident adults present, we do not recommend use of single surveys on large,

multiple-pair lakes for estimating resident adult Common Loon populations.

#### ACKNOWLEDGMENTS

We thank Wisconsin Department of Natural Resources (WDNR) personnel for collecting survey data. A. J. Ramminger assisted in collecting intensive population census data. Lodging was provided by J. M. Wilson. M.-K. W. Belant, P. Croskery, and two anonymous reviewers provided helpful suggestions for manuscript improvement. The project was funded by WDNR, University of Wisconsin-Stevens Point, Wisconsin Society for Ornithology, North American Loon Fund, and the Swartz-Hart Foundation.

#### LITERATURE CITED

- BELANT, J. L. 1991. Multiple lake defense by Common Loons. *Passenger Pigeon* 53:187-189.
- , AND R. K. ANDERSON. 1991a. Common Loon, *Gavia immer*, brood habitat use in northern Wisconsin. *Can. Field-Nat.* 105:372-375.
- , AND ———. 1991b. Common Loon, *Gavia immer*, productivity on a northern Wisconsin impoundment. *Can. Field-Nat.* 105:29-33.
- BENT, A. C. 1919. Life histories of North American diving birds. U.S. Natl. Mus. Bull. 107:47-60.
- CROSKERY, P. 1988. Flocking behavior of Common Loons (*Gavia immer*) in northwest Ontario: early-summer sites. Pp. 66-75, in P. I. V. Strong, ed. Papers from the 1987 conference on loon research and management. North American Loon Fund, Meredith, New Hampshire.
- CROSS, P. A. 1979. Status of the Common Loon in Maine during 1977 and 1978. Pp. 73-80, in S. A. Sutcliffe, ed. The Common Loon. National Audubon Society, New York, New York.
- MCINTYRE, J. W. 1979. Minnesota Common Loon survey report—1978. Pp. 123-125, in S. A. Sutcliffe, ed. The Common Loon. National Audubon Society, New York, New York.
- . 1986. The Common Loon. Pp. 679-695, in R. L. DiSilvestro, ed. Audubon Wildlife Report 1986. National Audubon Society, New York, New York.
- . 1988. The Common Loon: spirit of northern lakes. Univ. Minnesota Press, Minneapolis, Minnesota. 228 pp.
- MCNICHOLL, M. K. 1985. Profiles on risk status of Canadian birds: 1. Common Loon. *Alta. Nat.* 15:73-74.
- MILLER, E., AND T. DRING. 1988. Territorial defense of multiple lakes by Common Loons: a preliminary report. Pp. 1-14, in P. I. V. Strong, ed. Papers from the 1987 conference on loon research and management. North American Loon Fund, Meredith, New Hampshire.
- OLSON, D. L. 1988. The population and distribution of Common Loons in Wisconsin. P. 131, in P. I. V. Strong, ed. Papers from the 1987 conference on loon research and management. North American Loon Fund, Meredith, New Hampshire.
- OLSON, S. T., AND W. H. MARSHALL. 1952. The Common Loon in Minnesota. *Occas. Pap.*, No. 5., Minnesota Mus. Nat. Hist.
- PALMER, R. S. 1962. Handbook of North American birds, Vol. 1. Yale Univ. Press, New Haven, Connecticut. 567 pp.
- PARKER, K. E., R. L. MILLER, AND S. ISIL. 1986. Status of the Common Loon in New York state. N.Y. State Dep. Environ. Conserv., Delmar, New York.
- PLUNKETT, R. L. 1979. Major elements of a five-year comprehensive plan of research and management for the Great Lakes and northeastern United States populations of the Common Loon, *Gavia immer*. Pp. 154-162, in S. A. Sutcliffe, ed. The Common Loon. National Audubon Society, New York, New York.
- ROBINSON, W. L., J. H. HAMILL, H. R. HILL, AND T. A. DEBRUYN. 1988. The status of the Common Loon in Michigan. Pp. 132-144, in P. I. V. Strong, ed. Papers from the

- 1987 conference on loon research and management. North American Loon Fund, Meredith, New Hampshire.
- SAWYER, L. E. 1979. Maine Audubon Society loon survey 1978. Pp. 81-99, in S. A. Sutcliffe, ed. *The Common Loon*. National Audubon Society, New York, New York.
- STRONG, P. I. V. 1990. The suitability of the Common Loon as an indicator species. *Wildl. Soc. Bull.* 18:257-261.
- , AND J. A. BISSONETTE. 1988. Territorial activities of common loons on multiple-pair lakes. Pp. 19-24, in P. I. V. Strong, ed. *Papers from the 1987 conference on loon research and management*. North American Loon Fund, Meredith, New Hampshire.
- , AND ———. 1989. Feeding and chick-rearing areas of Common Loons. *J. Wildl. Manage.* 53:72-76.
- SUTCLIFFE, S. A. 1978. Changes in the status and factors affecting Common Loon populations in New Hampshire. *Trans. Northeast Fish Wildl. Conf.* 35:219-224.
- TATE, J., JR. 1981. The blue list for 1981. The first decade. *Am. Birds* 35:3-10.
- YONGE, K. S. 1981. The breeding cycle and annual production of the Common Loon (*Gavia immer*) in the boreal forest region. M.S. thesis. Univ. Manitoba, Winnipeg, Manitoba.
- ZIMMER, G. E. 1982. The status and distribution of the Common Loon in Wisconsin. *Passenger Pigeon* 44:60-66.

Received 10 May 1991; accepted 27 Mar. 1992.