SPECIAL SCIENTIFIC REPORT

THE ONES THAT ALMOST GOT AWAY: UNSEEN VICTIMS OF WATERFOWL HUNTERS

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Executive Summary

Between 20 and 40% of ducks and geese struck by shotgun pellets are never retrieved. This includes birds that are killed as well as those wounded or crippled. The percentage of unretrieved waterfowl that is wounded and left to suffer is impossible to determine with certainty.

Crippling is a form of wounding that involves serious, disabling impairment. The degree of pain and suffering resulting from crippling has yet to be rigorously analyzed. No more than 10% of crippled waterfowl ever recover; the vast majority almost certainly suffers long, slow deaths.

Recent studies of waterfowl wounding losses in North America have not been conducted. The methodology of earlier studies has been criticized based on their reliance on hunters' memories and honesty, and is generally considered inaccurate. In the only study to date that explicitly compared direct observation of waterfowl hunting with hunters' reports, hunters responding to questionnaires reported "crippling losses" of 6–18%. Direct observation of hunters' behavior, in which trained observers were concealed from hunters, produced a range of crippling loss of 20-45% of all birds shot (actual losses may be higher, since some proportion of injuries are imperceptible to ground observers).

The inaccuracy of the results of early studies prompted a more recent reevaluation which entailed the mathematical reanalysis of U.S. crippling data. Using equations valid for every pellet type, this study shows that, for every duck bagged, another is crippled. This reanalysis predicts that even very competent hunters wound about five ducks for every 10 that they kill outright; novice hunters wound 50-150 ducks for every 100 killed. Based on probability and shot pellet characteristics, 33-60% of all ducks shot are crippled.

Wounding/crippling losses are both complicated and exacerbated by the general inability of most hunters to identify ducks by species. Despite their inferior identification skills, hunters generally fail to compensate through exercising self-restraint in shooting at waterfowl they do not recognize. Hunters shoot at more than 90 percent of all ducks and at 100 percent of geese that they judge to be within shooting range, regardless of whether species-specific restrictions apply within the area in which they are hunting. As a result, crippling tends to be all-inclusive and likely occurs in proportion to the relative abundance of a species in a habitat. When given the chance, hunters may be equally likely to wound any species of waterfowl they happen to encounter.

Educational efforts to curtail wounding have apparently failed. In part, evidence suggests that social influences – a feeling of competition with nearby hunters, crowding, observation of skybusting (shooting at waterfowl beyond the kill zone) in other hunters – may be at least as important as personality or education in contributing to wounding rates.

Wounding rates have not decreased over time. There are no large scale efforts underway in the hunting or wildlife management communities to reduce wounding rates. Indeed, the vigorous efforts of the states to counteract declines in hunter numbers by recruiting children into hunting increase the likelihood that wounding rates, if anything, will increase. Published waterfowl kill data do not take into account losses due to wounding. Were these losses included, the actual size of the official U.S. kill would increase by 25 to 67%.

Introduction

Between 20 and 40% of ducks and geese that are struck by shotgun pellets are never retrieved (Bellrose 1953; Hochbaum and Walters 1984; Nieman et al. 1987). This 'unretrieved kill' includes birds that are killed immediately but are not retrieved by hunters, as well as those that are wounded, most of which also eventually die (Van Dyke 1981; G. Russell, pers. comm.). The percentage of the unretrieved kill that is wounded and left to suffer is impossible to determine with certainty. While it is sometimes possible to confirm wounding via necropsy or X-ray (e.g. Whitlock and Miller 1947), very few wounded waterfowl are encountered and subsequently necropsied. For example, internal injuries may not be immediately debilitating but may nevertheless result in death; this type of injury is missing from evaluations of the frequency of wounding. Because many types of subtle wounding are not readily observable, estimates of the frequency of wounding are subjective at best.

One type of wounding, 'crippling,' is a serious disabling impairment that often involves broken limbs. In contrast to some other forms of wounding, the frequency of crippling can be more easily assessed because some forms of blatant disablement are readily observable. Suspect behavior of waterfowl that can often be attributed to the effects of shooting include acute enfeeblement, labored flying, erratic gliding, actions betraying wing injuries, and dangling legs.

In addition to a general lack of data regarding its frequency, the degree of pain and suffering resulting from crippling has yet to be rigorously analyzed. Pain intensity is probably affected by some combination of wound severity, the occurrence of subsequent infection, and vigorous physical activity. However, to my knowledge, there is no existing documentation of a link between apparent pain intensity and specific types of injury, incapacity, or disablement. Although field studies on this subject are conspicuously lacking, available evidence suggests that no more than 10% of crippled waterfowl ever recover (Van Dyke 1981); the remainder are therefore likely to die slowly.

Sampling procedures in some early studies of the frequency of wounding and crippling were so flawed as to require a more recent reevaluation describing the mathematical probability of wounding (Russell 1994). The results of this reevaluation were so disturbing that, in 1996, the Australian Animal Welfare Advisory Committee made an appeal to the Australian Minister of Environment to ban duck shooting. Inherent cruelty, as evident primarily from U.S. data, was a major component of that appeal. The Society for the Prevention of Cruelty to Animals promoted the ban. Senior government officials did not refute the evidence of high wounding or crippling rates, a seeming admission of complicity in promoting a hunting activity that contravenes the spirit of Australia's Prevention of Cruelty to Animals Act (Close 1997).

Although the national Australian government failed to act, the evidence of intolerably high crippling rates prompted New South Wales and Western Australia to ban duck shooting unilaterally (G. Russell, pers. comm.). An ongoing petitioning campaign in South Australia to outlaw duck shooting has so far produced the second-largest number of signatures of any South Australian petition on record. Crippling losses were the main justification for the success of the petition, and a primary factor in generating an erosion in public support for duck shooting. A 1996 South Australia Morgan poll indicated 67% public disapproval of duck shooting, up from 49% in 1986; support for duck shooting dropped from 37 to 21% over that period.

The attitude shift of the public in South Australia indicates that efforts to inform the public of statistics on waterfowl wounding generate disapproval of waterfowl hunting (Russell, pers. comm.). Institutionalized "misrepresentation of relevant research (is perpetuated) largely by the duck hunting lobby" (Russell pers. comm.). National campaigns to debunk this misinformation are a potentially valuable way to increase public awareness of the ethical issues surrounding waterfowl hunting. Waterfowl hunting in North America has yet to be successfully challenged on the basis of its inhumane elements.

Recent intensive studies of waterfowl wounding losses, or of crippling in particular, in North America are lacking (Trauger, pers. comm.; Wendt, pers. comm.). The few recent studies available include a mathematical demonstration of the probability of wounding (Russell 1994), a review paper and analysis of the economic consequences of wounding (Norton and Thomas 1994), and a study of the behavioral and social factors that increase the incidence of wounding (Kuentzel and Heberlein 1998). Wounding rates are assumed not to have changed over time (Norton and Thomas 1994; Roster, pers. comm.). However, the methods of previous studies have often been flawed because of their reliance on hunters' self-reports (Norton and Thomas 1994; Russell, pers. comm.), a methodology that depends upon the memory and honesty of participants who respond to questionnaires and is generally considered inaccurate (e.g. Kuentzel and Heberlein 1998). Moreover, there are now suggestions that wounding rates have recently increased (Fosyth, pers. comm.).

Research that has avoided traditional methodological pitfalls has generated figures that conflict with previous findings (e.g. Nieman, et al. 1987; Russell 1994). For this reason, it is imperative for wildlife biologists to reconcile these differences by conducting new field studies (Boyd, pers. comm.). In this paper, I first address the likely causes of waterfowl wounding. Next, I briefly review the existing literature regarding the frequency of wounding in general, or crippling in particular. I follow this with an examination of the methods used in previous research. Finally, I discuss the implications of waterfowl wounding and the need for both new empirical work, and increased public awareness on this subject.

Causes of Waterfowl Wounding

Characteristics of Shotgun Pellets

The use of steel shot has been mandatory in North America for over a decade as a result of evidence for lead poisoning of waterfowl that ingest lead shot after the hunting season (Bellrose 1959). Steel shot pellets are relatively hard (Diamond Pyramid Hardness, DPH, = 90) compared to lead, and this increases penetration. A standard 1 1/8 oz. steel shot load contains several hundred pellets which, when airborne, form patterns called "circular central normals." When such a pattern of shot is centered on the target (i.e. when pellet density is high), the impact is likely to be lethal and the probability of wounding decreases. In fact, five shot pellets penetrating a duck's body anywhere in combination are invariably fatal. Further, two pellets in any vital organ are lethal, as is a combination of one pellet in a vital organ and two others elsewhere (Kozicky and Madson 1973; Cochrane 1976; Russell 1994). However, muzzle velocity for steel shot is low, increasing the scatter of pellets, especially at ranges greater than 50 yards; therefore, the lethal range is reduced. As a result of these shotgun pellet characteristics, wounding can occur due to either aim error or long-distance shooting (i.e. outside of the lethal range, also called "skybusting").

Misidentification of Waterfowl

Wounding/crippling losses are complicated, and exacerbated, by indiscrimination in target selections by waterfowl hunters. Such indiscrimination is prevalent (Kaczynski l967; Boyd l97l; Geis and Crissey l973; Hochbaum l979; Hochbaum, et al. l982). Most waterfowl hunters admit that they are incapable of identifying all but the "two or three" most common duck species under hunt conditions (Smith, pers. comm.). They nonetheless fail to compensate for inferior identification skills through self-restraint in shooting at waterfowl they do not recognize (Smith 1976; Smith and Roberts 1976; Nieman, et al. 1987).

Although it may not be surprising that many waterfowl hunters have difficulty in correctly identifying bird species from a distance (i.e., while shooting at a bird), this difficulty often extends to their identification of birds in-hand (Hochbaum and Caldwell 1977; Nieman, et al. 1987). In one study, Nieman, et al. (1987) found that 38 – 81% of hunters were able to recognize red heads and 40 – 70% correctly differentiated between Ross' geese and lesser snow geese. Identification of other waterfowl species was far worse: As few as 17% of hunters were able to identify gadwell, 14% recognized ruddy ducks, and none was able to identify goldeneyes.

Despite acknowledged ineptitude in discriminating among waterfowl species, hunters shoot indiscriminately at more than 90% of all ducks and at 100% of geese that they judge are within shooting range (Hochbaum and Walters 1984; Nieman, et al. 1987). In areas where special protection pertains to certain species, non-selectivity by shooters is just as prevalent (Hochbaum and Walters 1984; Nieman, et al. 1987). Consequently, crippling tends to be all-inclusive and likely occurs in proportion to the relative abundance of a species in a habitat or hunting area, regardless of special protection laws. Rarer species offer fewer targeting opportunities; nonetheless, when given a chance, hunters may be equally likely to wound any species of waterfowl they happen to encounter.

Hunter Education vs. Social Influences

The Cooperative North American Shotgunning Education Program (CONSEP, based in Iowa) has suggested that 15 separate hunter behaviors may contribute to wing shooting-related waterfowl wounding; they further assume that hunter education programs have the potential to reduce wounding rates. The notion of reducing wounding through hunter education may sound like an effective solution. However, there are at least three problems with this idea. First, crippling rates presumed by CONSEP initiatives (30 – 36% of ducks shot; Roster, pers. comm.) are too conservative because, again, they are based on wounding rates reported by hunters (Forsyth, pers. comm.). Second, while some contend that long-range shooting and the resulting wounding are a result of personality traits of individual hunters, such as laziness and lack of concern for animal suffering (the “slob hunter;” Causey 1989), other evidence suggests that social influence—feelings of competition with other nearby hunters, crowding, observing other hunters skybusting, etc.—may be at least as important as personality or education-related factors (Wheeler, et al. 1984; Kuentzel and Heberlein 1998). These social influences may be increased in situations of high hunter density such as firing lines (Kuentzel and Heberlein 1998). Third, Russell (1994) has now shown mathematically that, due to shotgun pellet scatter, even highly skilled hunters are likely to wound on average 50 waterfowl for every 100 that they kill immediately (i.e. a minimum of 33% of all birds shot are wounded).

Existing Evidence of Wounding

In existing studies of waterfowl wounding—or “unretrieved harvest”—researchers have employed a variety of techniques. Tests involving tethered ducks indicate that, at ranges of less than 40 yards, the majority of ducks are killed immediately. However, at distances greater than 50 yards, ducks are increasingly crippled more often than they are killed. For example, at 60 yards, up to 66% of ducks shot are crippled (190 birds wounded for every 100 killed); at 70 yards, 32 – 76% of ducks shot are crippled, and at 80 yards, the percentage of ducks crippled increases to 59 – 91% (Kozicky and Madson 1973). In other studies of tethered waterfowl, distances were not varied. For tethered mallards, Cochrane (1976) calculated that 38 – 43% of birds shot are crippled (i.e. 62 – 75 birds are crippled for every 100 killed immediately). Finally, Kimball (1974) estimated that 16 – 18% of ducks and 16 – 19% of geese hit by shotgun pellets are crippled and not retrieved.

Results from field studies of untethered birds have also produced estimates of wounding rates that vary widely. For example, a study of free-flying ducks in Michigan indicated a crippling rate of 19.1% of all ducks shot (Mikula 1977) and an Illinois study suggested that 24% of waterfowl struck by pellets are crippled (Anderson 1979). In contrast, cripples accounted for 40.7% of waterfowl struck by shot in a California study (Roster 1979), and similar data were obtained for Lacassine National Wildlife Refuge (Hebert, et al. 1984). Wounding rates have also been estimated specifically for Canada geese. One of only two studies to incorporate direct observations of hunters (rather than self reports) indicated Canada goose wounding rates of 44 – 45% (using steel shot) and 46 – 57% (lead shot) in Illinois (Anderson and Roetker 1978). However, the figures in this study reflected all geese struck by pellets and subsequently "flying off." Therefore, the data for this study could have only included birds with obvious indications of having been struck; it would have been impossible to accurately document those with minor injuries. Another investigation indicated that between 27 and 35.8% of Canada geese struck by shot were unretrieved cripples (Anderson and Sanderson 1979).

Research outside of the United States has also generated a range of wounding rate estimates. For example, Canadian research has produced various crippling estimates, from 24.8 to 41.8% of birds shot (Sowls 1955; Sorensen and Bossenmaier 1968; Boyd 1971; Hochbaum and Walters 1984), or even "as high as" 45% (Forsyth, pers. comm.). A crippling rate of 30 – 36% has been documented by "a preponderance" of international scientific studies, and it "has not changed over time" (Roster, pers. comm.). Tests done by the Victorian Department of Conservation and Natural Resources in Australia documented an average aim error of 85 cm and a consequent presumed wounding rate of one duck wounded (however severely) for each duck bagged (Russell, pers. comm.). Discrepancies in documented wounding rates are puzzling and suggest the need for a more rigorous analysis.

Methods Used to Estimate Crippling Rates

All but two studies cited above used hunters' self-reports, via surveys or questionnaires, to produce wounding rate estimates. This dependence on hunters' memories is as unreliable as any self-reporting methodology. Hunters asked to estimate the number of birds they crippled during a hunt may estimate too conservatively either because they are intentionally lying or because they were unaware that they were shooting at out-of-range birds (Kuentzel and Heberlein 1998). Hunters may lie in such instances because they are reluctant to admit that they knowingly failed to retrieve fallen ducks, even though they were able to do so (Nieman, et al. 1987). In addition, many hunters apparently fail to see the crippling they cause (Roster, pers. comm.).

In fact, hunters incorrectly recall their own crippling rates by a substantial margin. As an alternative to self-reports, trained observers can generate data that reflects actual crippling occurrences betrayed by detectable events such as birds dropping out of flock formation or other clear indications of immediate disablement. In the only study to date that has explicitly compared methods of direct observation with self-reporting, hunters reported "crippling losses" (which, here, apparently refers to all un-retrieved kill) of 6 – 18% in questionnaires. Meanwhile, direct observation of hunters' behavior—in which observers were concealed from hunters—produced a range of crippling loss of 20 – 45% of all birds shot (Nieman, et al. 1987). Therefore, studies relying primarily on hunters' memories to determine the rate of crippling—or overall wounding—are of dubious interpretive application.

However, even direct observation of hunters may underestimate wounding rates. Such observations are necessarily subjective and flawed because, without after-the-fact necropsy, many types of subtle wounding are indeterminable. For example, some types of non-crippling injuries are virtually impossible to detect, especially under field conditions, because birds can superficially appear unshot. In addition, injuries that are not immediately fatal, but ultimately lethal, could go unnoticed. Although blatant disfigurement can be clear evidence of pellet injury, some proportion of injuries are imperceptible, thus biasing wound-rate calculations based on observational criteria. Therefore, actual wounding incidences are under-represented by figures reflecting only observable injuries. Nonetheless, documentation of crippling through observation of hunts in progress provides some indication of a minimum frequency of occurrence.

Another means of estimating wounding rates is through mathematical modeling. A sophisticated mathematical reanalysis of U.S. crippling data, using equations valid for every pellet type, shows that, for every duck bagged, another is "crippled" (Russell, pers. comm.). Russell (1994) predicts that very competent hunters wound about five ducks for every 10 that they kill outright, whereas average and novice hunters wound 50 – 150 ducks for every 100 bagged. In other words, based on probability and shot pellet characteristics, one can predict that 33 – 60% of all ducks shot are crippled. High aim errors tend to correlate with the use of shotguns with chokes of less than 0.85 (Russell 1994), and full-choke shotguns apparently reduce wounding.

Total Waterfowl Mortality Due to Hunting

Published waterfowl harvest data are misleading because they only partially account for losses due to wounding. Waterfowl harvest estimated by the U.S. Fish and Wildlife Service (USFWS), for example, are adjusted by using hunters' self-reports of the number of birds wounded (12 – 18% of all geese, ducks, and coots shot in 2000; Martin and Padding 2001). This is despite the fact that higher wounding rates have been documented for some time. Several decades ago, Bellrose (1953) estimated that 60% of the mallard fall flight sustains shotgun pellet injuries, a minimum of about six million mallards. About one-half die immediately, the others are crippled or otherwise wounded. Bellrose (1953) further estimated that crippled waterfowl accounted for about one-third of all wounded mallards, about one-sixth of all mallards struck by pellets. Later studies, such as those cited above, produced higher estimates of 36 – 45% of all waterfowl shot (Mikula 1977; Hochbaum and Walters 1984; Nieman, et al. 1987). In an analysis of the economic consequences of waterfowl wounding, Norton and Thomas (1994) assumed an unretrieved kill (i.e. waterfowl either killed and not retrieved, or wounded) rate of 20 – 40% of all birds shot. This range of estimates was based on studies including those that used direct observation of hunters, as well as hunters' self-reports of wounding losses.

Therefore, although the official duck harvest for the United States and Canada in 1992 was 6.6 million ducks, the actual hunting mortality of ducks is 25 – 67% greater than the size of the official harvest, or between 8.2 and 11 million ducks (Norton and Thomas 1994).

Because crippled waterfowl rarely recover (Van Dyke 1981), waterfowl wounding substantially increases the actual annual waterfowl mortality due to hunting (Table 1). We can begin to get an idea of total annual hunting-related waterfowl mortality by using estimates of wounding based on either direct observation (Nieman, et al. 1987) or the probability of wounding (Russell 1994). To estimate hunting-related waterfowl mortality, we can use the estimated number of waterfowl killed and retrieved by hunters in 2000 (18.5 million waterfowl; Martin and Padding, 2001) and equation (2) provided by Norton and Thomas (1994):

crippling losses = [(declared harvest) x (crippling rate)] / 1 – crippling rate

Using this equation and rates of wounding of 20 – 60% generates estimates of total hunting-related waterfowl mortality of 23.1 – 46.3 million birds (Table 1). The wounding rates assumed by Martin and Padding (2001) of 12 – 18%, in contrast, led them to estimate a total hunting-related waterfowl mortality (retrieved and unretrieved harvest) of 21.2 million birds. Clearly, waterfowl harvest figures are minimal estimates and may reflect less than half of the actual mortality due to hunting. To remedy such a systematic downward bias, wounding losses should be incorporated into official harvest computations (Nieman, et al. 1987; Norton and Thomas 1994).

Table 1: Estimates of actual hunting-related waterfowl mortality in 2000, based on USFWS estimates of retrieved waterfowl harvest of 18.5 million birds (Martin and Padding 2001).

Estimated % of Waterfowl Wounded (of all those shot)	**Mortality via Wounding**	**Total Hunting-Related Waterfowl Mortality**
based on hunter self-reports (Martin and Padding 2001)		
12%	[(18.5 million) x (0.12)] / 0.88 = 2.5 million	21 million
18%	[(18.5 million) x (0.18)] / 0.82 = 4.1 million	22.6 million
based on direct observation (Nieman, et al. 1987)		
20%	[(18.5 million) x (0.20)] / 0.80 = 4.6 million	23.1 million
40%	[(18.5 million) x (0.40)] / 0.60 = 12.3 million	30.8 million
based on probability (Russell 1994)		
33%	[(18.5 million) x (0.33)] / 0.67 = 9.1 million	27.6 million
60%	[(18.5 million) x (0.60)] / 0.40 = 27.8 million	46.3 million

Conclusions and Implications of Crippling

Wounding is an inherent component of waterfowl hunting. The majority of ducks and geese wounded in this way are not likely to recover (Van Dyke 1981); for these birds, death can be protracted.

It is not currently possible to accurately document waterfowl wounding rates or to assess the total number lost to wounding. However, visible evidence for crippling, a more easily observed form of wounding, is more readily obtainable. Crippling rates of up to 45% of all birds shot have been documented via direct observation of hunts in progress. Estimates based on the mathematical probability of wounding are even higher—33 – 60% of all waterfowl shot—probably because this estimate includes some types of unobservable wounding.

Wounding (or crippling) occurs for a variety of reasons. Approximately 9% of waterfowl shot are intentionally not retrieved by hunters (Nieman, et al. 1987), despite laws prohibiting this behavior. Crowding and feelings of competitiveness with nearby hunters may also encourage long-range shooting or a tendency not to retrieve shot birds (Kuentzel and Heberlein 1998). If hunters and wildlife managers hope to continue to engage in waterfowl hunting, it seems inevitable that wounding rates must be reduced. Appropriate modification of current hunter behavior, through both education and hunting regulations, is essential.

Steel shot pellets tend to produce relatively high wounding frequencies, especially at long ranges (Anon. 1978). However, a return to the use of lead shot would result in lead poisoning of birds that eat the shot pellets (e.g. Bellrose 1959; Dieter and Finley 1979).

Participation in waterfowl hunting has declined by more than 50% since 1960 in North America (Boyd, pers. comm.). Although absolute numbers of wounded birds has therefore likely decreased, wounding rates have either remained unchanged or have increased slightly. International initiatives to boost participation in waterfowl hunting by young teenagers constitute an inauspicious development (Close 1997) because such novices are known to generate comparatively high wounding frequencies (confirmed mathematically by Russell 1994). The likelihood of elevated wounding losses makes their participation "indefensible" (Close 1997).

Wounding inevitably generates pain, and crippling may do so more acutely. There has been no comprehensive documentation of suffering by wounded waterfowl. Soreness, tenderness, and aching seem the likely result of minor injury. Crippling might generate excruciating and prolonged agony. Nonetheless, wildlife management agencies appear to be insensitive to the inhumaneness of waterfowl hunting. In fact, there is a general lack of inquisitiveness on the part of wildlife management agencies with respect to ethical issues surrounding waterfowl hunting. It would be preposterous to presume that wounded waterfowl experience no pain. Even if pain thresholds for wounding have yet to be precisely established, stress and suffering torment are likely. Officials of wildlife management agencies ought to suspect the inevitability of pain due to wounding, and failure to institute effective remedial incentives constitutes complicity (Russell, pers. comm.).

To put the issue of wounding into perspective, Bellrose (1959) estimated that 2 – 3% of the annual fall flight of North American waterfowl (about 2.4 million birds) died miserably of lead poisoning from ingested lead pellets. This evidence eventually prompted a ban on the use of lead shot for hunting waterfowl. Crippling potentially results in the miserable death of three to four times that many birds.

In Australia, the Royal Society for the Prevention of Cruelty to Animals undertook as a national campaign to publicize the wounding aspects of waterfowl hunting, and the consequent pain and suffering. Official condoning of inhumaneness in waterfowl hunting amounted to an intentional contravention of Australia's laws prohibiting cruel treatment of animals (Close 1997). That was why the Animal Welfare Advisory Committee recommended a national ban on duck shooting in Australia. Similar developments have not materialized in North America; however, a similar turn of events seems inevitable in the United States (Russell, pers. comm.).

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Appendix

Waterfowl harvest surveys and crippling losses

"The harvest estimates prepared by the National Harvest Survey are the hunters' recollections of how many ducks and geese were bagged in the season, there is no question about cripples. The estimates do not include corrections for cripples or for memory problems. In that sense, the N.H.S. estimates represent, in a statistically sound fashion, what hunters report."

-Helene Levesque, Harvest Survey Coordinator,
Canadian Wildlife Service, April 25, 2001

"Our estimates are based on questionnaire responses by a sample of waterfowl hunters (duck stamp purchasers). Their average responses are multiplied by the total number of duck stamp buyers who bought stamps intending to hunt waterfowl. The harvest and activity estimates are adjusted to include hunters young enough to be hunting without a duck stamp and to exclude memory and exaggeration biases. In unretrieved kill no correction for memory or exaggeration is used. Hunter observation data (i.e. spy blinds) has not been used in compiling our annual reports."

-Woody Martin
U.S. Fish and Wildlife Service, April 24, 2001

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