Testing New Ground

STEEL SHOT STUDY FINDS FACTS FOR PHEASANT HUNTERS

BY CRAIG BIHRLE

If a day of pheasant hunting is ever unpleasant, Jerry Feist experienced one.

A participant in the first-ever scientific test of shotshell efficiency on ring-necked pheasants, Feist's task on that day was to bag six roosters at long range. The day had advanced from mid-morning to almost supper time, and Feist was the only one of six hunters who had not completed his mission. While most of the others also struggled to collect their long-distance birds, Feist had a particularly challenging outing.

An experienced pheasant hunter, the normally jovial Jerry would just as soon have cased his 12 gauge on this hot early October afternoon, but since this was an important test of ammunition that required a certain number of birds shot at several distance increments, he persevered.

Tom Roster, lead researcher for the CONSEP pheasant test, gets ready to draw a bead on a ringneck rooster. Test results provide a wealth of information for pheasant hunters.

Finally, a burly rooster evaded the nose of a curious dog and burst from drying cattails. Instinctively, Feist quickly shouldered his shotgun, and then waited…and waited…as the bird stretched the distance between them, effortlessly gliding toward a grassy island in the middle of a wetland. When the pheasant passed the range at which most hunters wouldn't think of trying a shot, Feist pulled the trigger and tumbled the rooster onto the island.

The shot distance, subsequently verified by his hunting partner Mike Johnson with a laser rangefinder, was close to 50 yards. The ammunition, at that time known only as "code black," was effective when properly placed by the hunter.

And that, in effect, was the essence of this fact-finding test. Which, if any, of three steel shot loads might prove better or worse for taking ring-necked pheasants, when the hunter can hit the bird. While most hunters have their own preference and ideas about lead and steel (or other nontoxic shot) loads for pheasant hunting, no *scientific* research has ever closely examined the issue with any shot type.

Discoveries from this test may surprise some, and contradict long-held assumptions by others, but when it comes to ring-necked pheasant hunting, the code black load (which unknown to Feist or any other hunter in the test, contained large steel pellets) was found to be more efficient for cleanly bagging pheasants than code green or code red loads, which contained smaller steel pellets. Not just at longer distances, either. At ***all*** distances.

That was the major finding among many derived from this two-year study of steel shot performance on pheasants. The test, conducted in fall 1997 and 1998 by the Cooperative North American Shotgunning Education Program, and designed and administered by independent shotshell ballistics expert Tom Roster, compared the capabilities of three different steel shot loads for taking ring-necked pheasants. The U.S. Fish and Wildlife Service, North Dakota Game and Fish Department, and South Dakota Department of Game, Fish and Parks funded the test.

CONSEP is an international organization of 24 U.S. states, including the North Dakota Game and Fish Department, the U.S. Fish and Wildlife Service, Canadian Wildlife Service, three foreign countries, as well as Remington Arms Company, Winchester Group/Olin Corporation, and many others. CONSEP exists to generate and provide scientifically valid, useful shotgunning and shotshell information to hunters, wildlife agencies and the arms and ammunition industry.

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Each steel shot load tested was color-coded. If test participants know what they are shooting, personal bias could affect results.

Testing of steel shot on pheasants is a direct response to expanding requirements for nontoxic shot use for upland game hunting on national wildlife refuges and waterfowl production areas managed by the U.S. Fish and Wildlife Service. Nontoxic shot is also required for upland game hunting on state-managed areas in some U.S. states, but not in North Dakota.

In North Dakota, South Dakota, Minnesota, Iowa and Montana, where most WPAs exist, hunters frequently seek pheasants on these areas where lead shot is no longer allowed. While steel shot effectiveness for taking ducks and geese is well-documented by CONSEP, hunters who choose to – or must – use nontoxic shot for pheasants had little more than educated guesses to guide them.

Steel shot is one of several nontoxic shot types approved for use in areas where lead shot is not allowed. Others include bismuth, bismuth-tin, tungsten-iron and tungsten-polymer. For this test, only steel shot was selected, Roster said, because it commands the vast majority of nontoxic shot sales, is readily available in a variety of shot sizes and load configurations, and is by far the least expensive of nontoxic shot types. "The average hunter," Roster said, "…at the turn of the century, is still concerned about economical ammunition that is legal to use."

The most economical steel shotshells in 12 gauge are those that come in one-ounce payloads, and that is what the CONSEP pheasant test investigated. The one-ounce load, Roster noted, contained plenty of shot for taking ducks in various waterfowl tests, and therefore seemed theoretically likely to be adequate for pheasant, since they are roughly the same size as a mallard. Shotshells were 1,375 feet per-second, 2 3/4-inch factory Remington 12 gauge loads (no specially-made loads), and shot sizes included No. 6 (.110 inch), No. 4 (.130 inch) and No. 2 (.150 inch), though shooters did not know the shot size they used each day. One-ounce loads of each shot size are also available in three-inch 20 gauge shells.

"The purpose of the steel shot pheasant test," Roster explained, "…was to try to find the most efficient of the three steel shot sizes for taking ring-necked pheasants."

After more than 300 pheasants bagged over typical pheasant habitat, at measured distances of less than 20 to more than 60 yards; after analyzing those birds for post-shot behavior, and x-rays and necropsies to determine pellet damage and penetration (terminal ballistics), one load distinguished itself.

"If you have a choice between steel No. 2s, No. 4s and No. 6s," Roster recommended, "the No. 2 steel would be your best choice. An interpolation of the data clearly indicates that No. 3 steel would be a close second."

While pheasant hunters sometimes look to larger shot sizes – No. 2 steel or perhaps No. 4 lead – for late-season hunting where shot distance might be longer than earlier in the season, this test clearly demonstrated that No. 2 steel is more efficient than 6s or 4s for harvesting pheasants at **all ranges**. At the same time, shooters were able to hit pheasants with steel 2s (111 pellets per ounce) at the same rate they did with steel 6s (326 pellets per ounce) and 4s (177 pellets per ounce). "We did not find a difference in the hunters' ability to hit the target," Roster noted, "regardless of the number of pellets in the shell."

While this test did not investigate lead shotshells typically used for pheasant hunting, hunters might make some assumptions, Roster said. Considering that a steel shot pellet, because of its lower density, is lighter than a lead pellet of the same size, it takes a steel shot pellet two sizes larger than a corresponding lead pellet to achieve roughly similar momentum. Given that steel No. 2s were the best of three steel loads tested, one might conclude that No. 4 lead would perform better than No. 6 lead, but that's not statistically proven, Roster cautioned.

On the way to statistically finding that No. 2 steel ***is*** better than steel 4s or 6s for taking pheasants, the CONSEP pheasant test produced other findings that will interest not only pheasant hunters, but all hunters who journey to fields and marshes with shotgun in hand.

Setting up the Test

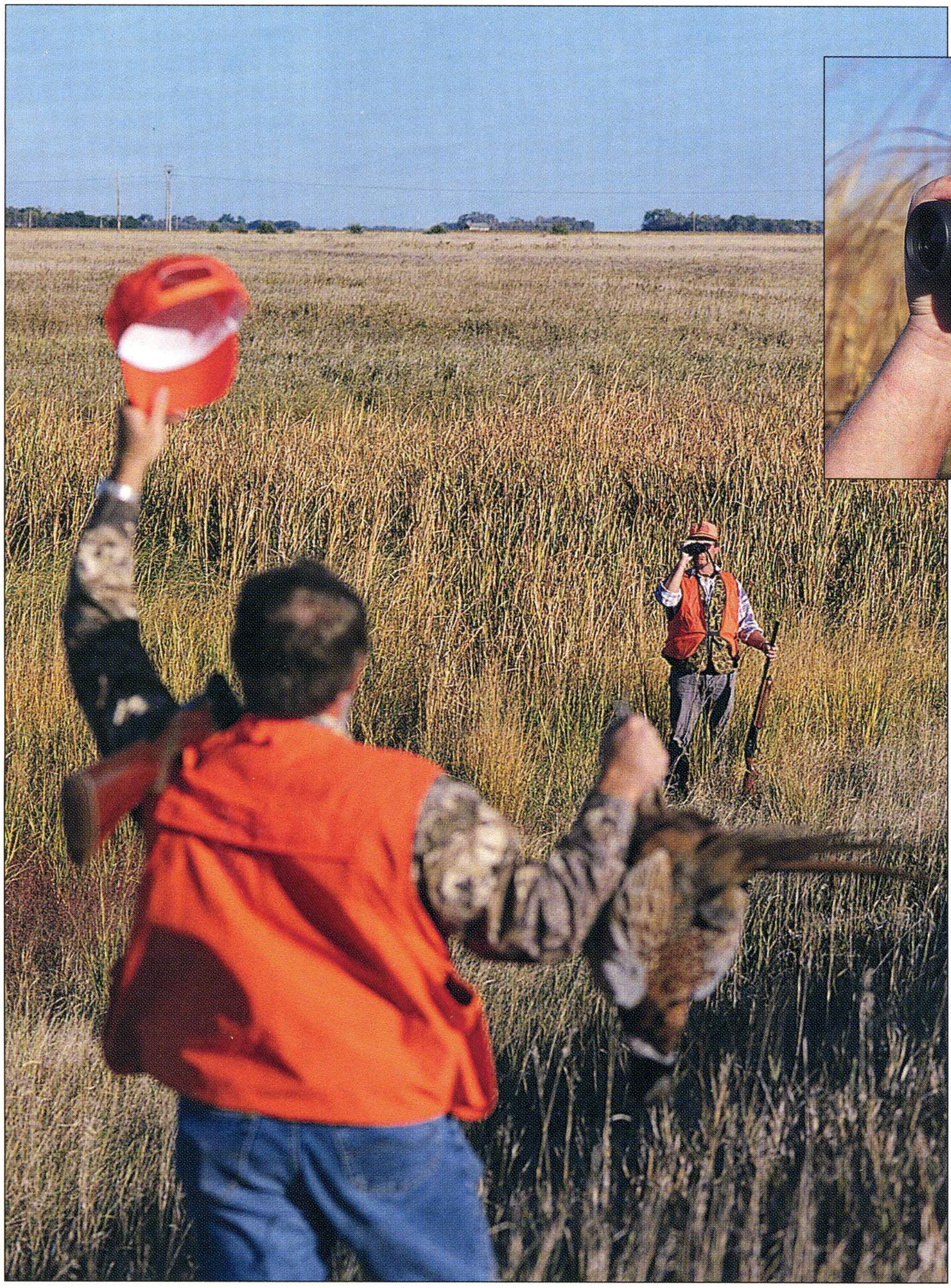
To gain objective evaluation of ammunition performance, shooters in the CONSEP pheasant test did not know the contents of their shells, nor did the researchers who later analyzed the results. Shells were coded either red, black or green, and only after researchers completed all analysis did they crack the code and learn that black was No. 2, green was No. 4 and red was No. 6 steel.

To achieve statistically reliable results, volunteer hunters participating in the test were directed to take 108 birds with each shot type. To compare ammunition performance at various distances, participants had to bag a certain number of birds within established distance increments of 20-29 yards, 30-39, 40-49, 50-59 and 60 yards or more. However, hitting pheasants at more than 50 yards was so difficult for most of the participants that not enough birds were collected to provide statistically sound data at that specific distance increment.

Each day, three teams of two hunters each, armed with their own shotguns, were assigned by a random distribution table to shoot one of the three color-coded loads. The load each team shot changed daily to ensure that over the test each load was used an equal number of times.

The same table rotated the three teams among three different habitat types pheasant hunters might encounter. These included: dense cattails around wetlands; low, even grasslands like native prairie; and brushy creek drainages with heavy upland cover. Altering habitat types, Roster explained, subjects the ammunition to a variety of environmental problems that might affect the average distance of shots taken and aid or inhibit retrieval of downed birds. For instance, if all birds taken with one load were flushed from a rock pile surrounded by a plowed field, retrievability would be much higher than for birds shot with another load over a dense cattail stand. Rotating habitat types subjects all three loads equally to the same environmental variables.

Shooting test partners Mike Johnson (foreground) and Jerry Feist measure distance of a shot that bagged a pheasant. Inset: Feist using laser rangefinder to get accurate distance reading.



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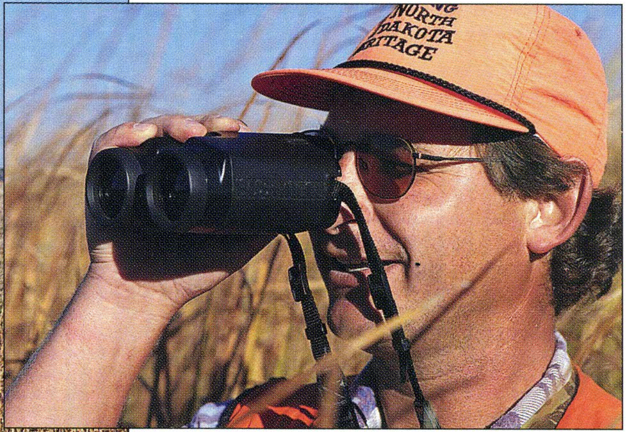

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The test was conducted at Dakota Hunting Club and Kennels, Grand Forks, North Dakota, owned by George Newton and managed by Mike Elgin. Each day, healthy, lively birds (averaging nearly three pounds in weight) were released into the three habitat types. Hunters did not know the birds' location, and other variables were also designed to simulate actual pheasant hunting.

After a hunter downed a flushed bird, he and his partner concentrated on the spot at which the bird was struck in the air, then the partner was guided to the corresponding location on the ground after the bird was retrieved. Using an electronic laser rangefinder, teams accurately measured shot distance in this manner.

Once a bird was recovered, the teams recorded the distance; angle of shot – going away, right-to-left, left-to-right, etc.; load code and bird behavior on a tag, and then attached the tag to the bird's leg. Behavior of retrieved birds was classified as either B-1 – dead or immobile within 30 seconds; or B-2 – mobile but retrieved. Hunters also recorded shot distance, angle, and load information for birds that were wounded – classified as visibly hit but not retrieved – such as those downed but not found, or those visibly hit that continued to fly and landed elsewhere.

Behavior of birds after they are hit is what determines the bagging efficiency of a particular load. In the pheasant test, No. 2 steel produced a statistically significant higher rate of B-1 birds than the other two loads, and a lower wounding rate (see table 1.)

At the end of each day, collected, tagged birds were frozen and shipped to Roster's laboratory in Oregon, or to a cooperating lab in Idaho. Each of the 324 birds taken in the test was later x-rayed to determine broken wing and leg bones, and certain terminal ballistic pellet performance characteristics, such as depth of penetration after striking the bird. Roster and his assistants, Mark Grovijahn and Josh Zellmann, then necropsied (examination of a dead body) each bird. Each necropsy is designed to:

1. Record the number and location of all pellets that strike a bird.
2. Measure how deeply each pellet penetrated the bird.
3. Look at whether leg bones were broken.
4. Look at whether wing bones were broken.
5. Remove and examine embedded pellets.
6. Record any other significant terminal projectile behavior (of which one unique and important characteristic was found for pheasants).

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Each pheasant bagged generated a variety of information, recorded on tags and attached for later reference.

Analyzing this information, Roster said, provides a picture of what goes into cleanly bagging a bird (B-1) vs. a bird that is not cleanly bagged (B-2).

In addition to field and lab work, Roster's assistants also pattern-tested each load used in the test at distances of 20, 30, 40, 50 and 60 yards, through three different chokes (see table 2).

Bagging vs. Wounding

Of the three loads tested, No. 2 steel exhibited the highest B-1 bagging rate over all distances, at 76.9 percent. No. 4 steel was second at 65.7 percent and 6 steel came in at 62 percent.

At distances of less than 40 yards, where the hunters in this test, when not constrained to fire at certain distance increments, took most of their shots, 86.5 percent of birds bagged with No. 2 steel were B-1, dead or immobile within 30 seconds. At less than 40 yards, No. 4 produced a 73 percent B-1 rate, and No. 6 produced a 75 percent B-1 rate.

What that means to hunters who need to make a choice between steel shot loads, is that of all birds bagged, No. 2 steel produced a higher percentage of clean kills than the other two steel shot sizes tested.

The other side of the equation is wounding loss, or birds visibly struck by pellets but not retrieved. All pheasant

Table 1. *Bagging performance and wounding rate (visibly hit but not retrieved) of ring-necked pheasants by load and distance.*

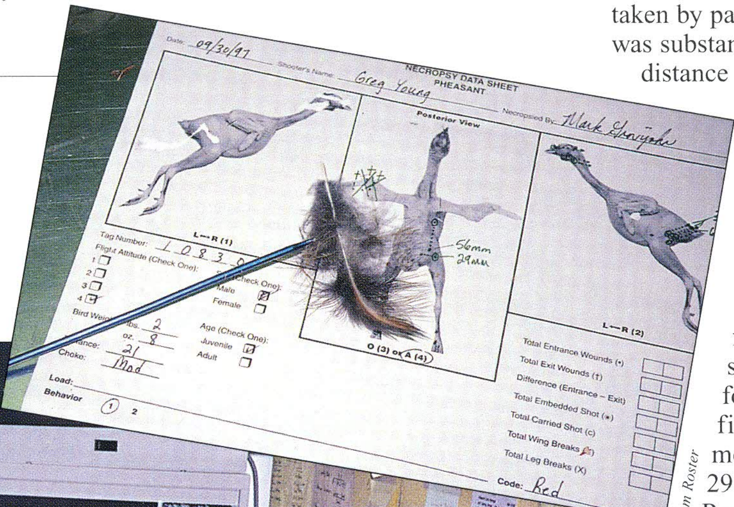
Distance Increment (Yards)	BLACK (NO. 2 STEEL) B-1[a]	B-2[b]	B-3[c]	Wounding Rate[d]	GREEN (NO. 4 STEEL) B-1	B-2	B-3	Wounding Rate	RED (NO. 6 STEEL) B-1	B-2	B-3	Wounding Rate	Combined Test Wounding Rate[e]
<20	0	0	0	0.0	2	0	0	0.0	0	0	1	–[f]	–
20-29	20	1	0	0.0	18	4	0	0.0	18	3	1	4.5	1.5
30-39	25	6	4	11.8	26	16	6	12.5	27	12	7	12.5	13.2
40-49	24	12	5	12.2	21	11	9	22.0	18	19	6	14.0	16.0
50-59	10	4	1	6.7	3	5	3	27.3	4	4	1	11.1	14.3
>60	4	2	0	0.0	1	1	0	0.0	0	3	1	33.3	8.3
All	83	25	10	8.5	71	37	18	14.3	67	41	17	13.6	12.2

[a] *B-1 = bagged (dead or immobile within 30 seconds).*
[b] *B-2 = bagged (mobile but retrieved).*
[c] *B-3 = visibly hit, but not retrieved.*
[d] *Load Wounding Rate =* $\frac{B\text{-}3}{B\text{-}1 + B\text{-}2 + B\text{-}3}$ *for that load only.*
[e] *Combined Test Wounding Rate =* $\frac{B\text{-}3}{B\text{-}1 + B\text{-}2 + B\text{-}3}$ *for all loads combined.*
[f] *Rate is meaningless; would fall close to 0.0% with larger sample.*

hunters have lost roosters that "hit the ground running" because the bird was not centered in the pattern (a nice way of describing shooter error), or perhaps because pellets did not penetrate to vital organs. All pheasant hunters who use steel shot and want to reduce the potential for crippling loss can tilt one factor in their favor by choosing No. 2 steel whenever possible.

Of all birds struck with the No. 2 steel load, 108 were retrieved and 10 were lost, an 8.5 percent wounding loss rate. No. 6 steel produced a 13.6 percent wounding loss, and No. 4 steel came in with a 14.3 percent wounding rate. Interestingly, hunters lost only two of 68 birds hit at distances of less than 30 yards with all three loads combined, a wounding rate of 2.9 percent. All test loads together produced 15.1 percent wounding loss at shot distances of 40 yards or greater.

For the entire test, wounding loss was 12.2 percent. "That's a pretty low wounding rate," Roster noted, especially when compared to findings of 15 shotshell lethality tests on waterfowl, some of which examined both lead and steel. Trained observers in those tests detected 30 percent or more of birds hit by hunters with either shot type were not retrieved.



Tom Roster

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Pheasants vs. Ducks

Before pheasant hunters get all smug over apparent superior shooting prowess, Roster suggests there's at least a couple of reasons why participants in this test were successful in retrieving nearly 90 percent of the birds they hit. First, an effective retrieving dog accompanied each team to track birds downed in heavy cover or pursue birds able to run after they hit the ground. Most hunters in the waterfowl tests did not have dogs to retrieve birds because, according to Roster, "From the shooting tests we learned that most waterfowl hunters do not own or use dogs."

Second, the average distance of a shot taken by participants in the pheasant test was substantially closer than the average distance of a shot taken by participants in duck and goose tests.

On the first day of each half of the pheasant test, Roster gave hunters freedom to fire at birds without distance requirements, just as they would on a typical pheasant hunt. When roosters flushed, participants could shoot whenever they felt comfortable. "The majority of shots fired, when left to their own means…were fired at the 20 to 29 yard distance increment," Roster said.

A somewhat lower number came in the 30-39 yard zone, with few shots beyond 40 yards. Of 72 pheasants taken when hunters could select their own shots, 57 were killed at between 20 and 39 yards.

That distance is significantly shorter than the 39-yard average shooting distance found in duck hunting tests, and 50.5- and 68-yard average distances recorded in over-decoy and pass shooting goose hunting tests, respectively. "And you have hardly any wounding," Roster added, "which tells you that the pheasant hunter participants were really able to hit the birds at that distance, and the loads were really able to kill them."

Roster speculates that the angle of shots in the pheasant test may also contribute to increased hitting ability. About 75 percent of birds killed in the test were going-away type angles from the hunter. The other 25 percent were side shots. None of the birds were taken on overhead or incoming shots, though these types of angles are often presented to blockers in field or driven pheasant hunts. Waterfowl hunters typically encounter mostly side and overhead shots, and few going-away shots.

While left-to-right or right-to-left shots accounted for only 25 percent of shots fired in the test, they produced nearly 50 percent of the wounded and lost birds. Given similar shooting distances, "...they evidently have a lot more trouble hitting on the side shot," Roster said.

Anatomical Challenges

Necropsies of pheasants taken in the test discovered that the back end of a pheasant presents two obstacles a charge of shot must overcome to produce a clean kill. Inside the body cavity is the gizzard, a large dense muscle filled with "sand" that Roster says "...is a great stopper of shot."

On a typical going-away pheasant shot, a pellet must penetrate the massive gizzard to reach the heart and lung area. As shooting distance increases, the gizzard is more likely to stop pellets. A gizzard presents the same obstacle for duck and goose hunters, but few of their shots are at birds going straight away.

Add to the gizzard the fine, hair-like underfeathers of a rooster's tail end. "One of the great lessons we learned from doing this test," Roster commented, "is that there's a much higher rate of feathers that get balled up around pellets trying to penetrate a pheasant, than we were ever able to notice with waterfowl."

Known scientifically as the abdominal and dorsopelvic feather tracts, these feathers at the extreme rear of a pheasant were frequently found to ball up or wrap around pellets as they punctured the skin, and to significantly impede that pellet's ability to penetrate. The feather-balling problem was most prevalent in No. 6 steel shot, affecting well over 50 percent of pellets in bagged birds. No. 4 steel had slightly less feather-balling than 6s, while No. 2 steel was found to have significantly lower occurrence.

Overall, when all pellets that struck pheasants were measured, No. 2 steel "had a significantly higher mean depth of penetration and percentage of pellets that penetrated all the way through and exited the bird, than did the other two loads," Roster noted.

No. 2s also had a significantly higher incidence of breaking wing and leg bones they struck. For pheasants prone to run when wounded, a broken leg can mean the difference between a bagged or lost bird.

Final Factors

Every hunter's objective is to cleanly bag every bird at which he or she fires. Achieving that objective involves a combination of shooting skill, and selecting a shotshell load that will deliver multiple hits that penetrate to vital areas at the distance the hunter is shooting. While shooting skills vary, ammunition lethality tests such as that completed by CONSEP provide hunters with information that is easily put into use.

The No. 2 one-ounce steel load is superior for taking pheasants, when compared to one-ounce 4s and 6s. Fours and 6s both performed adequately at shorter distances, but did not provide any advantage over No. 2 steel.

While the test did not look at 1 1/8 or 1 1/4 ounce steel loads, Roster recom-

Pheasant hunting produces predominantly going-away shots (left), while duck hunters mostly encounter overhead or side shots (right). Pheasant hunters in the test were able to hit birds going away with significantly greater frequency than duck or goose hunters were able to hit side or overhead shots in other ammunition tests.

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Table 2. *Pattern testing results[a] of Remington 2 3/4" 12 ga. 1 ounce loads of No. 6 (.110"), No. 4 (.130"), and No. 2 (.150") zinc-galvanized steel shot through a Remington Model 11-87 shotgun with 28" barrel containing a bore diameter of .729" and containing Remington factory Remchoke screw-in choke tubes.*

	No. 2 Steel (Code: BLACK) Lot No. AD04K503 111 Pellets[b] (406.7 grains)			No. 4 Steel (Code: GREEN) Lot No. CD13L512 177 Pellets (408.4 grains)			No. 6 Steel (Code: RED) Lot No. CC15S517 326 Pellets (465.3 grains)		
Distance	**Imp. Cyl. (.718")**	**Mod. (.708")**	**Full (.690")**	**Imp. Cyl. (.718")**	**Mod. (.708")**	**Full (.690")**	**Imp. Cyl. (.718")**	**Mod. (.708")**	**Full (.690")**
20 yards	109[c]	109	111	176	174	175	305	323	321
	98%[d]	98%	100%	99%	98%	99%	94%	99%	99%
30 yards	92	103	104	132	151	160	210	276	298
	83%	92%	94%	74%	85%	90%	54%	85%	91%
40 yards	60	73	77	89	114	122	145	199	241
	54%	66%	70%	50%	64%	69%	45%	62%	74%
50 yards	45	61	65	60	71	79	99	154	173
	41%	54%	59%	34%	40%	45%	30%	47%	53%
60 yards	35	40	44	42	47	55	71	105	120
	31%	36%	39%	24%	26%	31%	22%	32%	37%

[a]*Pattern tested outdoors at Bismarck, North Dakota, USA (elevation 1,700 feet) in no greater than 8 mph wind at an ambient temperature of 45° to 68° F.*
[b]*Average in-shell pellet count (AS_c) and shot charge weight for 25-round sample (N=25).*
[c]*Average pattern count (AP_c) inside 30" diameter circle at distance for 15-round sample (N=15).*
[d]*Average pattern percentage (AP_p) inside 30" diameter circle at distance for 15- round sample (N=15) computed as* $\frac{AP_c}{AS_c}$

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mended those heavier loads for hunters who want to further improve their ammunition's ability to cleanly bag birds, especially at longer ranges. No. 3 steel (.140 inch), in one, 1 1/8, or 1 1/4 ounce charge, would also be an effective shotshell choice, Roster noted.

Hunters should not, however, assume that No. 2 steel is the best choice for other upland birds like sharp-tailed grouse or partridge. These birds are smaller than pheasants, and while 2s would certainly provide adequate penetration, the lower pellet count when compared to 4s and 6s might not produce adequate pattern density to ensure multiple hits.

Until CONSEP conducts lethality tests on other upland birds and with other shot types in the future, pheasant hunters should welcome these additional insights they can now apply to steel shot buying decisions.

CRAIG BIHRLE *is associate editor of North Dakota OUTDOORS.*

KANSAS HUNTER EDUCATION

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