BROADHEAD PERFORMANCE

by Dr. Ed Ashby

Most often little attention is paid to what broadhead one selects to hunt with. Often the choice is predicated on what the local sporting goods store has in stock, what your hunting buddies use, what worked on Uncle Joe's deer last year, or on that tried and true axiom, "If it costs more it must be better". Volumes of data on terminal ballistics (what happens from the moment of impact) have been written for every conceivable rifle/bullet combination in existence. Virtually no such data exists for archery equipment.

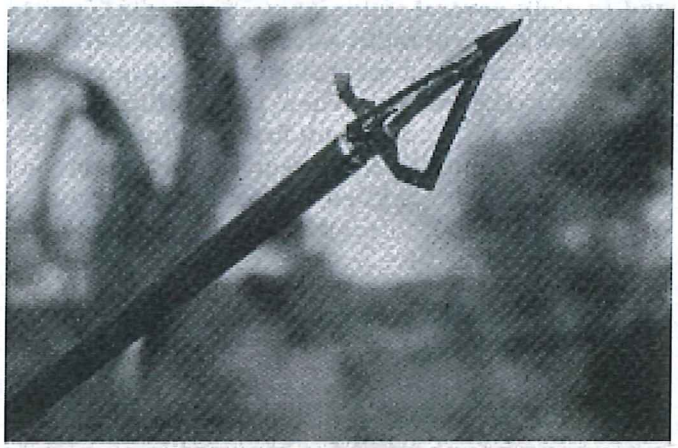
In the summer of 1985 I had the unique opportunity to participate in a field research project to evaluate, at least on a limited basis, the effectiveness of various types of broadheads. The project was conducted at Mkuzi Game Reserve in the Province of Natal, Republic of South Africa. Tony Tomkinson, Chief Ranger at Mkuzi, was the moving force behind the research and has been the person primarily responsibile for the opening of Natal to legalized bowhunting. Tony deserves the thanks of all archers for his dedication and Herculean efforts toward the opening of Africa to bowhunters.

Our plan was to evaluate the effectiveness of as many types of broadheads as possible on a wide variety of game from the size of bushbuck to zebra. We had hoped to evaluate the effectiveness of the bow against cape buffalo, but no buffalo were scheduled for herd reduction and no animals were available for testing. Still, the variety of animals tested are most applicable to selection of broadheads for North American game. The animals in the test included bushbuck (average weight from 106 to 143 pounds), warthogs (154-220 pounds), nyala (198-299 pounds), wildebeeste (473-550 pounds), and the zebra (700-1000 pounds). Some testing was also done on giraffe and white rhino, but the data from these animals was not included in the performance analysis. The size of these animals places them outside the practical realm for all but the very most experienced of archers. Nerves of steel, and the ability to run like hell are also required!

All testing to evaluate broadhead performance was done with heavy draw weight bows in order to negate bow weight as a limiting factor. Tony used only an 80# Martin Warthog compound for all his shooting, and I used a 94# longbow. The average arrow mass used with the longbow was 698.5 grains, the average velocity was 182 fps. The mass and velocity of necessity varied with the different broadheads. Tony's compound was not available to me to chronograph prior to the trip, and the average velocity is unknown, but I would expect it to be comparable.

Thirty-two varieties of broadheads were tested and included most popular fixed and replaceable blade heads, and a number of limited production semi-custom heads.

Some testing was also done with various arrow shaft materials. This data will be presented in a later report.



Typical result with an "Anderson 245" which stopped after hitting a rib on entry.

The data was accumulated using two different sources. One was animals hunted and taken solely with a bow. This method was employed to the maximum extent possible. Where more detailed evaluation of a particular shot was desired, the animal was taken with a rifle (being careful not to damage any tissue even remotely near the site for the test shot) then positioned and shot with the arrow immediately to minimize the effect of tissue change. Each shot was evaluated by wound channel examination and by dissection as required. All field evaluations were tape recorded and later transferred to written shot evaluation forms. Where field evaluation was not complete enough, such as shots into the spine, the animal was returned to the slaughter house for detailed dissection and shot evaluation. The data thus collected was transferred to computer files for detailed analysis. Shots taken on animals previously culled with a rifle were rated as lethal if: (1) the thorax was penetrated, (2) a major blood vessel was severed, (3) a major nerve center was pene-

trated, or (4) a major visceral organ was hit, i.e.: kidney, liver, etc.

All usable meat from animals taken was salvaged. Non-usable parts were used in the predator feeding program at Mkuzi.

Data from 154 shot records was included in the analysis of broadhead performance. The accompanying tables present a representation of a small portion of that analysis. Some of the factors that an attempt was made to address were: (1) what are the most lethal shot angles, (2) what shot angles tend to offer the least chance of a lethal hit, (3) which style of head gives the greatest portion of lethal hits on the most difficult shot angles, (4) is there a significant difference in penetration among the types of heads and, if so, which penetrates better, and (5) would a restriction on what types of heads could be used on what class of animals be appropriate.

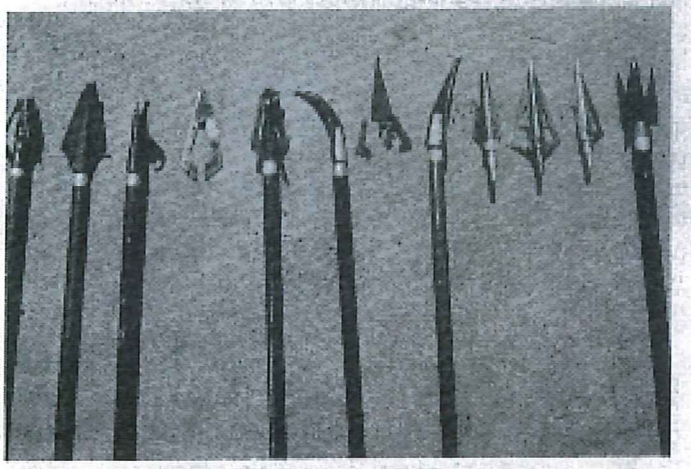
Any analysis based upon such a limited number of test reports certainly is open to criticism, but to the best of my knowledge this is the most extensive uniform methodology analysis of broadhead performance ever performed on actual game animals. The results, and my conclusions from those results, will most assuredly be controversial but the analysis was performed as uniformly and unbiasedly as possible.

One of the striking features noted during the testing was that a large number of the broadheads tested were very fragile, often bending or breaking whether bone was hit or not. Table I reflects an evaluation of the different type and the percent damaged during the testing. The rigid 2 blade (or more accurately, single blade with two cutting edges) broadheads appear to be significantly more resistant to damage than either the rigid multiblade or the replaceable blade type of broadhead.

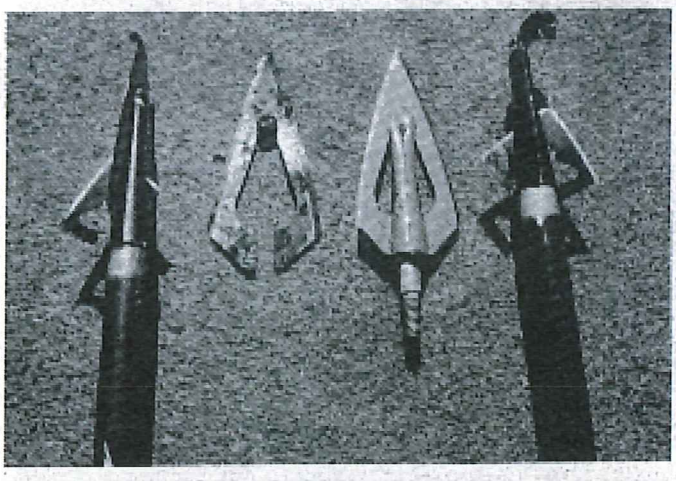
Table II is the result of evaluation of the probability of a hit being lethal based upon the hit location. Both brisket hits and shots from a forward quartering angle that hit back of the shoulder blade (to differentiate from shots taken into the very tough neck-shoulder junction area) were 100% lethal but this was based on a very limited number of shots. There were 25 shots quartering from the rear forward, with 24 of these being lethal hits. It is of little surprise that this shot is generally regarded by experienced bowhunters as the very best. Not only does it position the hunter so that he may move freely to position for the shot, but also gives a great probability of a quickly lethal hit.

It is disturbing that almost 30% of the broadside shots into the chest-shoulder area were non-lethal. This has long been considered the "classic" shot. The rump hit proved fatal just over half the time — and is dependent on whether the femur is hit, whether the head can break the femur to reach the femoral and iliac vessels just deep of the femur, or whether the hit is medial to the femur and penetrates deep enough to reach the vessels (significant penetration is required on a large animal such as a zebra). As had been expected from past experiences, the toughest shot on which to make a kill was into the area of the neck-shoulder junction.

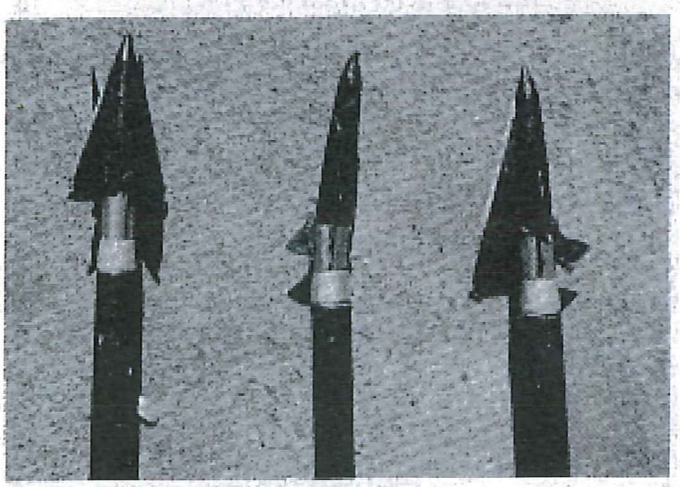
Table III reflects a further analysis of broadside shots when single blade heads are compared to multiblade heads; when only shots that hit the heavy shoulder blade are considered; and when a rib is hit on entrance.



Damaged broadheads from one morning's shooting.



Bear Razorheads, three stainless steel "Super Razorheads", one of the old style. Note bent tip on all three stainless heads.



"Viper" heads after soft tissue hits.

Among the single blade hits, 12 penetrated the scapula (shoulder blade) and rib cage to enter the thorax to be lethal hits. Four failed to reach the thorax: an Anderson 245 shot as a single blade (penetration was 3/8" into a zebra scapula); a Black Diamond, which according to my field recording, "bent into a long curve" on impact with a zebra scapula; a Premium I which hit a warthog scapula and "bent at a 90-degree angle, arrow deflected, head destroyed"; and a Grizzly which penetrated the thickest part of a zebra scapula and a rib, but did not enter the thorax sufficiently to be considered lethal.

Only three of the three blade heads hit a scapula: 2 Rocky Mt. Razors (one on a zebra, one on a wildebeeste) and a Bodkin (zebra). None penetrated the scapula.

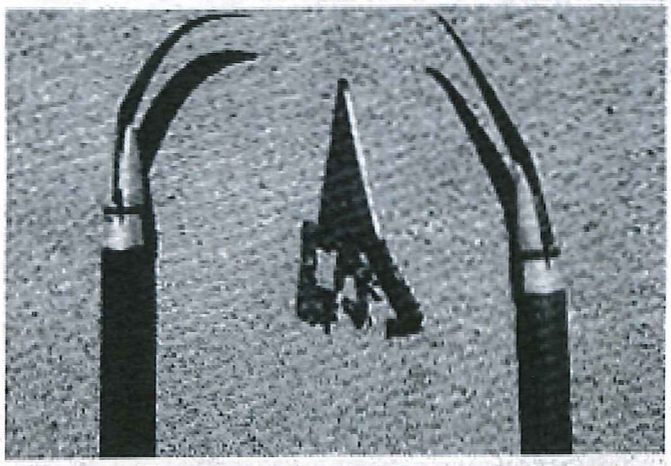
Among the four, five, and six blade heads, there were eight hits on the scapula. Only two of these penetrated the bone: an Interceptor which penetrated a zebra scapula, and a Kolpin 6 used on a warthog. The Kolpin 6 achieved 10" of total penetration, but most of the blades (five of six) were sheared off and left in the scapula.

If the analysis of the effect of hitting bone on entrance is carried one step further, in order to see the effect of hitting a rib on entrance, all of the single blade heads were lethal hits, with an average penetration of 19.1" (Table IV). There were ten shots in this group. Among three blade heads, only three shots hit ribs on entrance and only one of these, a Snuffer that chipped a rib on entrance on a warthog, penetrated to be a lethal hit. Penetration on this shot was 14". The two non-lethal hits were both with 150 grain Rocky Mt. Razors (one on a nyala and one on a wildebeeste). With the other multiblade heads, seven of twelve hits encountering a rib on entrance penetrated to be lethal. Five failed to penetrate the rib.

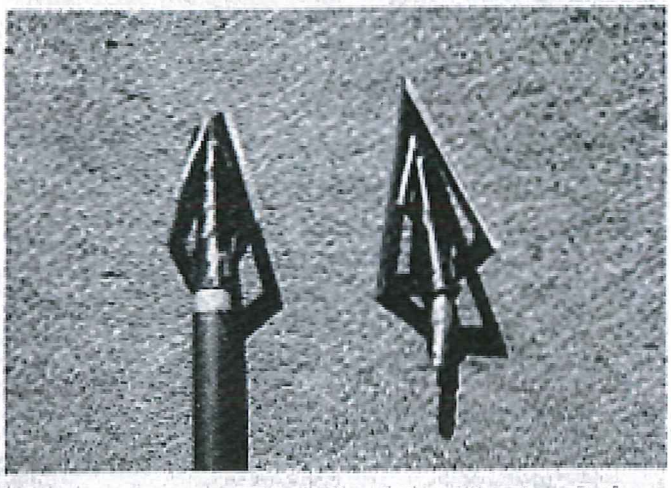
The last section of Table III was the most striking result of all. If one considers only that most difficult of all shots, with the animal quartering toward the archer and the arrow striking in the area of the neck-shoulder junction, it is noted that only 51.5% of all the hits were lethal (Table II). Eighty-five percent of all the hits with single blade heads were lethal (17 of 20 hits) and none of the hits with multiblade heads were lethal (zero of 16). Only three single blade heads failed to penetrate. All three bent on impact with bone. The bulk of these shots (8 of 17) with the single blade heads were on the animal we judged to have the heaviest bone structure of all the test animals, the wildebeeste. The wildebeeste also has an average skin thickness of 8mm. Most shots with the multiblade heads were taken on lighter built animals (4 on warthog, 7 on nyala, and 2 on wildebeeste).

A glance at Table IV reveals that when a bone of any type is hit, the single blade head offers vastly superior penetration. Even with a soft tissue hit, the single blade heads penetrate substantially better than the multiblade heads. If the thorax is entered, the superior penetration of the single blade would be offset, to some degree, by the greater cutting area of the multiblade heads. But, there is a significant reduction in the percentage of shots reaching a lethal area with multiblade heads.

The strong point of the single blade heads is the vastly superior penetration. Nowhere was this more clearly evident than when analysis was completed on shots that hit the vertebral column. There were 12 hits on the vertebral column with single blade heads, 10 of these penetrating sufficiently to sever the spinal cord. Of these 10 hits, six penetrated the scapula before hitting the spine! One hit penetrated a rib before hitting the spine. Nine multiblade heads hit the spine, none hit bone before hitting the spine, and none penetrated enough to reach the spinal cord!



"Premium I" broadheads damaged by impact with bone.



Shattered "Magnum II" broadhead that hit only soft tissue (L). "Magnum I" (R) notice bent adaptor.

A number of items were observed as our testing progressed, some of which we had not kept track of sufficiently to analyze fully and some of which could not be quantified.

Since we had plans to test a large quantity of

broadheads, most heads with tapered ferrules had been mounted on the "screw-in" type broadhead adaptors. Most replaceable blade heads have this screw in type mounting system integral with the broadhead. This appears to be a weak link in the arrow / broadhead system as a large number of the adaptors bent on both soft and hard tissue hits. It appears that it would be advantageous to use a fixed broadhead taper mounting system, especially for medium and large animals.

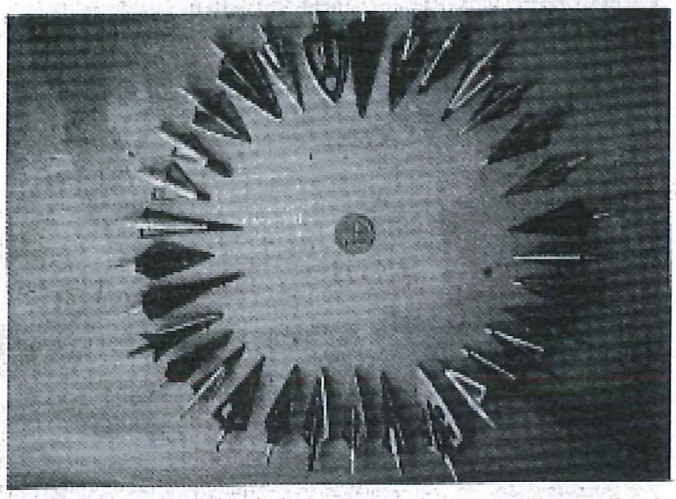
Several shots were tried with the free rotating type broadhead adaptors. Claimed benefits are truer flight (less tendency to wind plane) and deeper penetration (head can rotate freely away from a bone when one is hit). Sufficient shots were not recorded to verify or refute such claims. These adaptors appear to be at least as strong and bend resistant as conventional screw-in type adaptors (which, as noted, left something to be desired). No significant increase in penetration was apparent.

It has long been claimed that multiblade broadheads leave a better blood trail than single blade heads. There appears to be no way to quantify this factor. From field observation, it appears that the degree of blood trail is most dependent on (1) where the animal is hit and (2) was there an exit wound. In the testing, there were 77 shots with single blade broadheads and 77 shots with multiblade heads. Twenty-two point one percent of the single blade heads had total penetration while only 10.4% of the multiblade heads achieved total penetration. With the single blade more than twice as likely to leave an exit wound, and also more likely to immobilize the animal if the spine is hit, the claim of increased trailing ease with the use of multiblade broadheads appears to be ill founded. Subjectively, I can tell no difference in the degree of blood trail between single and multiblade heads given roughly equal hit locations and the absence of an exit wound. With an exit wound, the blood trail is greatly increased, especially when the shot is taken at a downward angle, such as from a tree stand.

Based on the test results, no responsible bowhunter using a multiblade head should take a shot at even a deer size animal that is facing him or is angling toward him. The chance of a hit into the non-lethal neck-shoulder area is too great. Conversely, with a heavy draw weight bow, a strong single blade broadhead, and good arrow mass this becomes an effective shot even on relatively large animals.

To this point, I have refrained from recommendations of specific broadheads, so now it is time to stick my neck out and give everyone a chop at it. How did the specific broadheads compare? Four broadheads tied for the title of "worst performance". Each head was totally destroyed on each shot — several of which did not hit any bone! They were the Kolpin 6, Razorbak 5, Bear stainless steel Super Razorhead (conversely, the old standard Razorhead performed quite well), and the Viper (which was a failure in all categories). Almost every Magnum II 4-blade broadhead shattered on impact, even on soft tissue. It is suspected that this was the result of faulty tempering (too brittle), as no such problem was encountered with the Magnum I, which is identical except for the shape of the trailing edge. The Premium I broadhead also failed in every instance where a bone was encountered, but performed well in soft tissues.

Dr. Ed Ashby with a South African bushbuck. Probably the first one taken by an American archer in South Africa.



The thirty-two types of broadheads tested.

Most of the replaceable blade type broadheads proved too fragile and gave inadequate penetration, particularly in bone. The best performer of this group in our testing was the Muzzy.

The multiblade broadheads offering the best performance were the Catclaw and the Interceptor. If one feels compelled to use a multiblade broadhead, it would be difficult to find one that outperforms the Interceptor. It may also be used as a single blade head without the bleeder blade insert. In our testing,

the Martin Brute was used only as a single blade head but also accepts the Bear type bleeder blade insert and may well be a good choice as a multiblade broadhead for whitetail size animals.

It appears that once one leaves the deer class animals (and even on a large mule deer) a tough single blade broadhead should be the choice. Most of the tougher single blade heads performed well, but most also occasionally failed when heavy bone was encountered at an oblique angle.

Three broadheads took all we could throw at them and finished all the tests undamaged. Each gave outstanding performance. What were the "best of the best". One was the old Ben Pearson Deadhead. No longer in production, it performed flawlessly. A second excellent performer was the Maxi-Head, a long concave single blade with a serrated edge. My own personal choice for the award of the best broadhead tested is the Grizzly. A large, long, tough broadhead with a length three times its width. This broadhead is available in two hardnesses, Rockwell 44 and 55, and in several weights. Only the 190 grain weight was tested. Only one shot was taken with the 44 hardness, and the tip was very slightly flattened, this after penetrating a wildebeeste shoulder blade on a neck-shoulder shot. Penetration was 12 inches. Only one non-lethal hit was recorded with the Grizzly head, this on a zebra. To quote the field recording, this shot went "through the thickest part of the scapula (one inch of bone), into a rib, did not reach into thorax . . ." On none of the shots was the 55 hardness Grizzly damaged, and some remarkable shots were recorded. For example: "zebra, through scapula, into spine, cut spinal cord, head penetrated 3" into spine . . ."; "nyala, through scapula into spine, cut spinal cord . . ."; "wildebeeste, neck-shoulder shot, through scapula, through thorax, cut rib on opposite side . . ."; "bushbuck, hit right gut, cut left femur below ball joint, exited left hip . . ."

Progressively more difficult shots were taken with the Grizzly broadhead in an attempt to find the limits of its performance. It recorded a remarkable 95.8% lethal hits on the toughest shots I could devise, and was 100% lethal on that tough neck-shoulder shot (and 75% of those neck-shoulder shots were on the toughest animal tested, the widebeeste).

I would like to express my deepest appreciation to the Natal Parks Board for making this testing possible, and to thank Tony Tomkinson personally for all he has done to advance bowhunting in Africa. It is encouraging to know that there exist game departments willing to do research and find answers before proposing laws that may prove detrimental and/or difficult to change once in place.

One of the goals of our test was to determine if restrictions should be placed on what type of broadhead should be used on what class of animal. My recommendation, based upon these test results, is that multiblade broadheads not be allowed for use on animals larger than nyala (large mule deer size). Certainly larger animals can be taken cleanly with multiblade broadheads when everything goes perfect, but if your bowhunting goes like mine, well . . . I need all the help I can get.

As long as the very fastest of arrows travels not much over 250 fps, and most less than 200 fps, and animals move faster than the arrow, no archer can guarantee where his shot will hit. We each owe it to the animals we hunt to use equipment capable of making a clean kill when things don't go just as we planned. That includes adequate bow weight, tough, well constructed broadheads with a well-sharpened edge, and adequate arrow mass.