2004 Broadhead & Arrow Lethality Study Update, Part 1
by
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The new broadhead/arrow lethality study has been underway for a little over one year. Significant progress has been made. This report is an update of the study's status, and presents early information obtained during testing on feral Asian Buffalo..

Currently 66 different types/styles/configurations of broadheads are 'in process' for testing, as are a wide verity of shafting materials and designs. *Many broadheads have received only slight testing thus far, with no substantial data collected relative to their performance.*

More broadheads and shafts remain to be added to the study. A number of bows (recurves, longbows and compounds), and several crossbows, have been secured for developing the data. Any 'concrete results' are still years away. Not surprising, as the project was conceived as one requiring a decade to complete.

Finding, and acquiring access to, suitable areas with sufficient quantities of feral game remains a problem, but progress is being made. Field trips for data collection have been undertaken to Cape York, Western Queensland, NSW and the Northern Territory, and a small amount of data has also been secured in New Zealand and the United States. Considerable data has, however, been collected, especially on the Asian Buffalo. A second trip to study the effectiveness of various broadheads, shafts and arrow impact forces on Asian Buffalo is scheduled for 2005.

It was not the initial plan to collect so much data on the Asian Buffalo this early in the study. The opportunity to access high numbers of buffalo came along, however, and just could not be ignored. One never knows when such an opportunity might occur again!

It is NOT the purpose of this update to pass out any *conclusive* findings or results from the study. In most of the areas of study, far too little data has been collected to be *decisive*. However, substantial *interim* information from this year's testing on Asian Buffalo is included.

The following information is just that - *interim* - so PLEASE do not take it as THE LAST WORD! It is based on the dissection and recording of nearly 200 set-up test shots on freshly killed

buffalo, plus data from 'ancillary testing' conducted on 'focal points' pertinent to arrow/broadhead performance on buffalo.

The animal. The Asian Buffalo is the toughest non-pachyderm that I have tested on. He is more difficult to penetrate than the Cape Buffalo. He's more 'barrel-chested', and the skin thickness pattern is different. He is consistent with the Cape Buffalo in that both have an overlapping rib structure, such that an arrow MUST penetrate at least one of the ribs before entering the thorax.

Thickness measurements of the ribs, *at 'point of entry'* – right where one wants to place the arrow - for freshly killed Asian Buffalo averaged, for adult females, 0.252" (6.4mm), and .281" (7.14mm) on young adult bulls. The thickest ribs measured were on a massively bodied trophy bull, and were a substantial 0.338" (8.5mm). These measurements are from *totally* cleaned bone, even the periosteum removed. It is the 'pure bone' measurement. Buffalo ribs are not to be taken lightly!

The thickest skin on Asian Buffalo is on, and just back of, the shoulder area – also right where one needs to shoot. On big bulls, the *average* skin thickness in this area measured a solid 1" (25.4 mm). On young females, the *average* thickness was 0.69" (17.5 mm), and thickness *averaged* .875" (22.5 mm) on young bulls. (On the Cape Buffalo the thickest skin is on the back and neck, with the skin thinning lower on the body.)

Coupled with enormous skin thickness is a skin texture more fibrous than on any other animal I have previously tested on. The fibrous characteristic of the tissues carries over to the mesenteric tissues supporting the internal organs (See "sharpening broadheads", below).

Sharpening broadheads. I have long used "Hill type" serrations on broadheads for much of my hunting, but found them ineffective on these buffalo. The serrations collected so many strands of tissue fibers during penetration that the cutting edge was rendered useless. After penetration, the 'saw-toothed' serrations were so coated with long, stringy fibers that I was unable to get the edge to cut my own skin. (Not, that is, until the adhering fibers were removed – but that's another story. Not the smartest way to see if the broadhead was still sharp under all those fibers, I can assure you!)

To further evaluate different types of edge finishes, testing was done on seven layers of fresh shoulder skin, about 2 feet

square, laced together along the edge with wire. This was hung from a steel bar suspended between two trees, and weighted along the bottom with a heavy steel pipe, which was also supported by the trees. The bottom weight was hardly necessary, as the skin alone was so heavy that the truck had to be used to hoist it aloft!

In the 'skin test', the same set of arrows was used repeatedly, with the method of sharpening being changed between sets of shots. One set of 'control arrows' was used to verify that the tissue structure and resistance of the skin had not changed from dehydration between sets of shots. Wet bags and shade trees were used to keep the skin hydrated while the broadheads were being resharpened.

The performance of each individual arrow was compared against its own performance with differing edge finishes.

All shooting was from 20 yards (as were all the set-up test shots, the distance being verified with a laser rangefinder). Serrated, file sharpened, and honed and stropped edge finishes were tested. I had planned to do 'micro serrations' too, by finishing on a fine diamond steel, but ran out of both daylight and skin that wasn't full of holes!

Honed and stropped heads *averaged* 26% more penetration than smooth filed heads. The filed heads, as smooth as I could get them with a fine-toothed broadhead file, and sharp enough to shave hair, still picked up MANY fibers. This greatly reduced the cutting effectiveness and, obviously, retarded penetration significantly. The smooth filed heads *averaged* 46% more penetration than the "Hill style" serrated heads! It is evident that the type of edge finish on the broadhead significantly affects the degree of resistance to penetration in these fibrous tissues.

The penetration pattern was consistent, with every single arrow averaging greater penetration with a honed and stropped edge than with a smoothly filled edge. Likewise, every smoothly filed broadhead penetrated a greater distance than it did with a 'Hill type' serration. The results appear very valid and consistent, regardless of the broadhead's profile, construction or number of cutting blades.

Clearly, only honed and stropped broadheads should be used on Asian Buffalo. The advantage of the honed/stropped broadhead over other sharpening techniques was also born out in initial

analysis of penetration on *comparable shots,* from *comparable shot angles*, on the fresh buffalo carcass set-up shots.

Arrow Mass and Impact Force in the Skin Testing: Some limited penetration test utilizing lighter, substantially higher velocity, arrows on the buffalo skin were also undertaken. Here, some results from this *limited testing* are presented. Much testing remains to be done on the complex relationships between kinetic energy, momentum, tissue resistance and penetration.

Three broadhead configurations, of types commonly used on light, fast arrows, were tried. All were of the replaceable blade type, with one being a 3 blade "mechanical" broadhead, one a three blade with bone-breaker type tip, and one a short and wide four blade cut-on-impact (COI) type. New blades were used for each shot.

In the following comparisons, only data from the heavy arrows with honed and stropped broadheads was used as a basis of comparison against the lighter arrows with their "surgically sharp" replaceable factory blades.

The lighter weight arrows had an average total mass of 384.3 grains. *Impact velocities* averaged an even 320 fps. (The velocity of all arrows used in the study were checked on one chronograph and then verified on a second chronograph.) Arrow mass *averaged* 46.8% that of the heavier arrows. Their *average impact velocity* was 2.44 time that of the heavier arrows. Their *average impact kinetic energy* was 2.55 times greater.

The closest comparable broadhead configurations were with 3 blade broadhead. Three blade points on the heavy-slow arrows *averaged* 40.7% greater penetration than the 3 blade points on the light-fast arrows. The *single best* penetrating 3 blade shot with the light-fast arrows showed 21.1% less penetration than the *average* penetration for the heavy-slow arrows with 3 blade points.

The light-fast arrows undoubtedly suffered some penetration loss due to the lower *average* mechanical advantage of the broadheads used. The COI 4 blade did penetrate better than either the mechanical or 3 blade with the bone breaker tip.

The best penetrating heavy shaft/broadhead combination, which was both the heaviest and the slowest arrow tested in the 'skin test', had an *average* penetration that was one-hundred-thirty-

point-eight percent (130.8%) greater than the light-fast arrows. This heavy arrow was a double shaft. It had only 41.3% as much *impact kinetic energy* as the *average* light-fast arrows. It also carried a 2 blade broadhead of high mechanical advantage. Allowance for that must be made.

What must be done is a more substantial and direct comparison and correlation of data. In the new study the impact force of **every shot** is being tracked, *for both kinetic energy and momentum* (along with over 100 other 'bits' of information relative to each shot). It will be interesting to see what results are when data is sufficient to permit a *statistically significant* number of direct comparisons - with equal broadheads, shaft diameters and materials, animal species, shot angles and tissues hit … but for that we will all have to just wait an see. A lot of data will be needed!

Broadheads. I won't get much into specifics here. The broadhead portion of the study has a LONG way to go before data is sufficient to give conclusive information. DO NOT take this as any form of 'final evaluation' on ANY of the broadheads mentioned.

Even from the early testing, one thing is certain. There are DEFINITELY more good broadheads available today than a few years ago.

In the testing **thus far**, the advantage in *consistent* penetration and performance goes to the **modified** 190 grain Grizzly (narrowed to 1" at the back, with the 'tanto' tip retaining its original profile and width, and modified to a full cut-on-impact (COI) design, with a finished weight of approximately 170 grains).

In this buffalo testing, no other broadhead *averaged* penetrating as deeply as the modified Grizzly, and nothing handled the heavy bones as well. Considering 'kill zone' hits, from all reasonable shooting angles (See "Shooting Angles", in Part 2), only once did it fail to *at least* get through a buffalo rib. That shot was on an Easton Obsession shaft, with a total arrow mass of 570 grains.

The modified Grizzly was followed by the 190 gr. Grizzly (with its tip modified to a full COI form). Testing was planned for the lighter weight Grizzlys, but they did not arrive in time.

There are other broadheads deserving of special mention for their performance in this *initial* buffalo testing,. The

SilverFlame 180 grain is a strong head, and I LOVE the quality of the steel in its blade. Initial concerns were that the ferrule might be too weak, but none have been damaged *so far*, and they were 'punished' during this buffalo test. More testing at higher impact force is planned for future test.

The Australian made, 125 gr. Blackstump, non-vented, made an outstanding showing. Only one sample of this head was on hand to test, but that situation has been corrected. Though few shots with it were recorded, analysis of those placed it second only to the modified Grizzly and 190 gr. Grizzly in average penetration (on comparably placed shots at similar impact angles).

The Eclipse did very well. It appears that they certainly have something with the Teflon coating. In the 'skin test' it far out-penetrated all other broadheads OF SIMILAR PROFILE. None have yet been damaged. The Teflon coating did not *appear* to have measurable effect on penetration through bone. Only broadhead design and construction *seem* of importance there.

Some original Ben Pearson Deadheads remain in testing, even though they are no longer produced. The Deadhead has been in the testing from the very start, over twenty years ago. They are one of only three broadheads (or modifications thereof) that have never been damaged on any shot into real tissues, of any type, on any animal, in all my prior studies. It is certainly one of the best wide-cut 2 blade heads ever produced. They deserve to be made available again.

A number of other broadheads remain undamaged, and are still SOLIDLY in the running for 'best quality' broadheads, but: 'mechanicals'? – none *yet tested* have given adequate performance on buffalo.

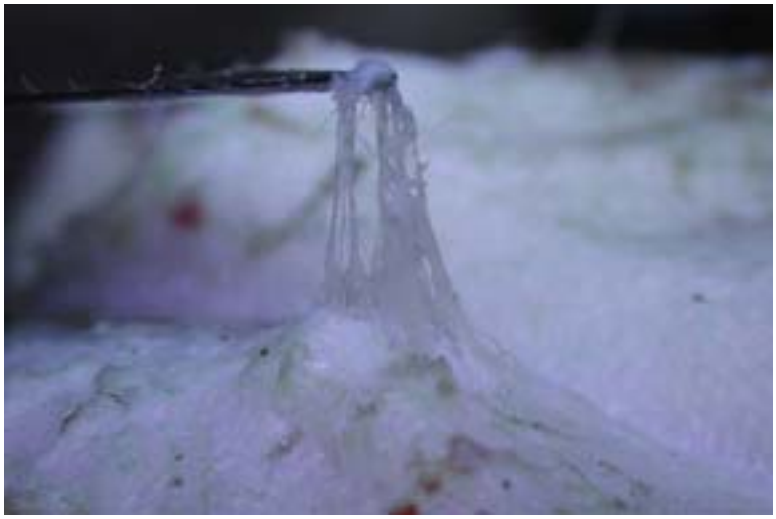
Modular, replaceable blade, broadheads? Some … possibly … but much higher levels of *impact force* will be required for most to *consistently* achieve adequate penetration, even on perfectly placed shots. Damage rates – bent/broken blades and ferrules – is relatively high on those tested, even at moderately low impact force. (In this first testing I was LOOKING for the lower threshold of 'fully adequate' *impact force*, *when using the best penetrating arrow/broadhead combinations I could come up with*. Higher impact force thresholds will be done in future testing)

Another ‘focal point’ was broadhead cut width. I have often used very narrow broadheads on game animals. One used extensively I call a “Grizzly Extreme”. It is the 190 gr. Grizzly narrowed to 11/16” (17.5mm) width. On 'soft' animals it has given much higher penetration than either the 190 gr. Grizzly (1 1/8” cut) or the modified Grizzly (1” cut).

In this *initial* testing, the 1" wide, modified Grizzly, gave 26% MORE penetration than EITHER the wider Grizzly OR the narrow Grizzly Extreme. For buffalo, there definitely *appears* to be a 'too narrow' cut width to reduce skin drag on the shaft.

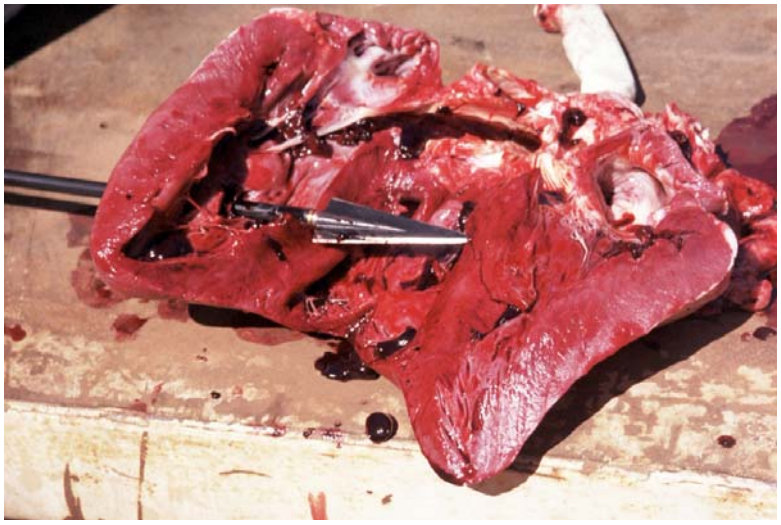
In Part 2 of this report we will look at *initial* data relative to arrow shafting, shot placement, shooting angles, some ancillary test data relative to the ‘skip angles’ of broadheads on buffalo ribs, and some comments and observations.

Setup test arrows for the 2004 study.



Fibrous texture of Asian Buffalo skin.

These double shaft arrows, imbedded in off-side ribs, show central lung shot and shot into top of heart.



Buffalo heart dissected for examination of wound channel.

Penetration of these broadhead was halted by entrance ribs.

The setup used for the skin penetration test.

Test shots on buffalo skin. Note penetration of small diameter, double shaft arrow.

Some of the broadheads damaged during 2004 testing.

190 grain Grizzly (top); 1” wide modified Grizzly (center); and Grizzly Extreme (bottom).