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Ox Yokes: Culture, Comfort and Animal Welfare

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Abstract

Three yoking systems are used globally to capture the power of oxen. These are the head yoke, withers yoke, and neck yoke. Each system has its strengths and weaknesses, with culture and cattle playing a role in the adoption and use of each system. The neck yoke system offers important lessons in understanding animal comfort and yoke design. Despite its success, the neck yoke should not be universally adopted, nor should it be universally promoted. However ignoring the lessons learned in North America over the last 400 years would ignore animals and teamsters who perfected this system and learned to maximize animal comfort and performance. Using history, research in Africa, as well as farm and competition experience from the United States and Canada, this paper addresses improving animal comfort, performance and welfare by understanding and appreciating yoking systems for oxen.

Brief History of Ox Yokes

Wooden yokes, usually hand carved from local materials, are easy, effective and economical ways to harness the locomotive energy of the ox. Yokes are simple in design compared to the more complicated harnessing systems used for horses. The first yokes were head yokes used in Southeastern Europe and Western Asia (Milisauskas & Kruk 1991, Bogucki 1993). The early versions were crude, not carved to fit the individual animal nor designed with the animal's comfort in mind (Minhorst 1991). Unfortunately, oxen continue to be used in poorly designed yokes around the world today. Yokes differ from region to region. The training, use, and technology associated with oxen as work animals can be considered a cultural tradition (Lieboweitz1992, Conroy 1998). The use of oxen in New England is grounded in rich cultural traditions. The lack of culturally accepted alternatives has greatly influenced the improvement of yoking systems. Globally, culture has had a great impact on the use and lack of change seen in systems of yoking oxen. There are three basic yoke designs, based on the way the yoked is used capture the power of the ox. These are the head yoke, the neck yoke and the withers yoke.[i]

Throughout history, as agriculture became more sedentary, the need for additional power from draft animals became essential. Ox yokes were designed with specific agricultural and transportation tasks in mind. Over time yokes were adapted and carved to better fit the animal in order to maximize comfort and their willingness to work. Yoke designs continue to vary according to local customs and regions of the world. This has been influenced by the type of cattle, the resourcefulness of the farmers, their skills in recognizing animal comfort and the culture of the people who introduced oxen to an area.

My own experience comes not from a single research study, but from a lifetime of working oxen on a farm, in the forest, and in competition. The use of oxen in New England is

grounded in cultural history and tradition. I learned how to drive oxen from ox teamsters who had passed this traditional skill along informally through the generations. I took this interest in oxen, and learned to appreciate other yoking systems, cultural preferences, and ultimately did formal research in East Africa on the adoption of oxen by the Maasai culture, new adopters of animal traction. Like many cultures before them, the Maasai have been forced to change their semi-nomadic lifestyle. Crop based agriculture has become an important part of their local economy. Like many cultures before them, the Maasai were forced to seek out additional power for field preparation and transport. Being prominent pastoralists, they quickly and successfully adopted animal traction out of necessity. However, even among the Maasai, the wounds caused by ox yokes were troublesome.

Figure 1
The author with his own oxen hauling a cart of manure.

Globally, yoke designs vary according to local customs and regions of the world. The English tradition was to use a wooden yoke that rested on the neck and was held in place by wooden bows that went around each animal's neck. The bows are held in place by a pin. In other parts of Europe the head yoke was common. It attached to the horns, where the animal would push with its head rather than shoulders. Most contemporary head yoke designs rest on the back of the animal's head, held in place by straps. These are still found in Spain, Portugal, France and other areas. Historically, forehead yokes could be found in Austria, Germany and Switzerland (Minhorst 1991). These were called forehead yokes because they were placed in front of the horns with padding to protect the head. These yokes have been largely abandoned due to frequent serious skull injuries to the cattle (Minhorst 1991 and 1997). India has the largest concentration of working cattle in the world, and many variations of the withers yoke continues to be used. The withers yoke can also be found on numerous continents, its simplicity being one of its greatest attributes. The withers yoke works best on humped cattle, having a hitch point that is designed to pull the yoke up high on the withers, unlike the head yoke or neck yoke designs.

Figure 2
Ox teamster transporting logs on a sled in New England 1895. These farmers were considered backward in their time, but helped keep this cultural tradition alive in the United States.

The design of yokes, like other traditions, have been passed through the generations and ended up in new lands where people resettled. In Australia and the United States the neck yoke, an English tradition was adopted widely, except where the Spanish influence pervaded. The Spanish settlers in America brought with them the head yoke, which can now be found in most Latin American nations. The exception is Brazil, where both the withers yoke and the head yoke are still used. The withers yoke design found its way to other countries, likely due to an Indian influence, including Eastern and Southern Africa. In all areas geography, cultural preferences, human creativity and the availability of wood influenced yoke designs. [ii]

Head Yokes

The head yoke requires the animals to lower their heads and push forward, with their head and horns bearing the entire load. Early American authors noted how cattle lower their heads and push each other in battle, using their rear legs to create the power that the spine and neck bear in the fight (American Agriculturist 1864). The most popular design is the style that lies on the back of the head and ties to the horns. Farmers in France, Germany, Spain, and other nations developed many designs and variations of the head yoke. As American and African nations were colonized, the early settlers brought with them their cattle and their favorite yoke designs. Much of Latin America continues to use the head yoke as influenced by the Spanish and Portuguese settlers. The French also influenced the adoption and use of the head yoke in early Canada and French colonies in Africa. These cultural preferences continue to this day.

The head yoke offers a number of advantages over the neck yoke. They provide more animal control and restraint. An ox team wearing a head yoke can more easily brake or stop carts and wagons on steep roads and paths, as they are directly attached to the load, with no room for any momentum to gather between the team and the cart (Roosenberg 1992b). The animal adjusts it head to both lift and push into a heavy load. The animals do not develop sores on their necks or shoulders from poorly fitted yokes, nor will they choke as ox might in a collar or neck yoke that is too tight.

Figure 3
Head yokes provide more animal control and use the natural tendency of the animal to push with its head.

The head yoke is not without its shortfalls. To get a comfortable fit, the yoke should be carved to fit securely to the back of an individual animal's horns. Some ox teamsters believe for this reason the yoke should not be used on another animal without major adjustments (Lohnes 1997). Yokes that slip back and forth on the animals' heads will quickly create sores and uncomfortable and unwilling animals. The head yoke also provides little flexibility in animal movement. On uneven terrain the animals must work with their heads tipped to the slope of the land, not the position of their body, increasing the chance of injury. The animals must also have rugged horns. Animals without horns cannot be worked and animals with small or weak horns run the risk of breaking them off. Finally, yoking time will be longer as each animal must be carefully strapped into the yoke.

In Uganda in 1995, an ox teamster told me that his East African Zebu cattle could not wear a yoke because it made them blind. I was dumbfounded until he told me that their heads were pulled up in the air, so the oxen could not see where they were going. The hitch point of his head yoke was designed like the hitch point on a withers yoke, which purposely lifts the yoke to sit against the hump. The hitch point will be discussed later, but like the neck yoke, head yokes are designed for oxen holding their heads below the level of their back. This is easily achieved with the lowered hitch point of the yoke, as will be described later.

In Nova Scotia, Canada, the tradition of keeping oxen has also been kept alive by a small group of farmers, who keep an estimated 1000 teams (James 1992, Lohnes, 1997). Competitions have been designed to pit the Americans against the Canadians. The differences between the two are the ox yokes they use and the strong cultural bias to maintain the status quo. Americans almost always use the neck-yoke. Canadians almost always use the head yoke. When they meet, competitions ensue and debates begin. Through competition and performance there seems to be no clear power or comfort advantage to either system. The advantage goes beyond physics and performance. There is no difference that can be accurately quantified. The use of the head yoke seems to also be deeply intertwined with

cultural tradition and a geographical and cultural influence that is centuries old (James 1992, Johnson 1997). Although now English Speaking ,the influence of the French on the Acadian settlers had a long lasting impact.

Figure 4
The head yoke is most often attached behind the horns and tied to the horns by a long strap.

Neck Yokes

The neck yoke, worn on top of the middle of the neck at rest, with a set of bows around the animals' necks, requires oxen to push with their shoulders, neck, and chest. For years I believed this system was the only system anyone should adopt, because of the outstanding performance that could be achieved with a properly fitted yoke (Conroy 1986, Conroy 1988, Conroy 1999). I was influenced by my culture, which offered few alternatives and even less written material to fall back on. There were few innovators willing to change the system (Suits-Smith 1997, Conroy 1998). I remember being shocked when I saw pictures of oxen wearing withers yokes, and often wondered why anyone would chose such a system. Over time I learned that properly designed the withers yoke and the head yoke both had their advantages and their equally stubborn followers.

Figure 5
The neck yoke requires a proper fit like that of a shoe on an athlete in order to optimize performance.

New England is the only region in the United States with farmers who have continuously maintained the tradition of using oxen to this day. This is where I gained my early experience with oxen. The use of ox technology reflected the poverty and land in this region, as well as the stubborn cultural adherence to a system the farmers understood (Bunting 1986, Conroy 1999). Most ox teamsters today in the United States keep oxen for fun and competition (Suits-Smith 1997, Conroy 1999).[iii] The use of the English neck-yoke technology reflects a local sub-culture, regional geography, and a strong cultural tradition of how to "properly" train and use oxen.

Figure 6
Competitions in the USA kept this cultural tradition alive and forced teamsters to make yoke comfort a top priority

The neck yoke design used in the United States has not been static for centuries, as have other designs in the developed world. In New England, ox competitions have challenged **ox** teamsters continuously for 200 years to maximize the comfort of the animals in order to get peak performance (Welsch 1994). As a result the yokes are continually being improved and perfected. This paper will highlight the fit, design and steps in making a neck yoke. This system is culturally biased, but understanding this system and the comfort it provides for the animals offers many possibilities to improving other yoke designs.

Figure 7
Head yoke cattle in competition

Figure 8
Neck yoke oxen in competition

Table 1
Advantages and Disadvantages of the Neck Yoke and Head Yoke Systems

Head Yoke		Neck Yoke	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
better animal control	discomfort on uneven terrain	comfort on uneven terrain	less animal control
best for controlling carts or wagons on hilly terrain	animals have to have rugged horns	animal flexibility and maneuverability in the field or forest	animals can fight each other and pull away from each other in the yoke
for short heavy hauls the ox can more easily lift and start the load	the yoke is more complicated to make and fit	the animals can move faster with more flexibility	sore necks and bruised shoulders can easily develop if not fitted properly
no sore necks	yoking time is slow	yoking time is fast ========== no need for horns	appropriate materials or a flexible wood to is necessary for bows
can be used to eliminate problems like sore necks, animals fighting each other or not holding their heads in the correct position when in the neck yoke	Nova Scotian yokes are so precisely fitted the yokes cannot often be used on another team	one yoke can be used on many teams and different bows can be used to allow the same yoke to be used as animals grow	difficult to control animals pulling wagons or carts or sleds on hilly terrain

Withers Yokes

Despite the influence of Europeans in Eastern and Southern Africa most farmers did away with the neck yoke and head yoke designs. These African farmers adopted the withers yoke with wooden staves and rope or leather to hold the yoke in place. Again, human culture, ingenuity and available materials all influenced the withers yoke system. Instead of following the lead of the Europeans, Africans adopted a design more like what was used in India. This yoke was more easily manufactured than European designs and more universally transferred from one team to another. The withers yoke is also best adapted to *Bos indicus* cattle, which survive in more easily in Tropical and Sub-Tropical climates. With the hitch point higher on the yoke, this system can work well on *Bos indicus* breeds and their crosses, but withers yoke designs can usually be improved to better assure animal comfort and performance.

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Figure 9
These Maasai agriculturists show how simple and flexible the withers yoke system is to use

The withers yoke will rest against the hump, in front of the withers, and the staves do not interfere with the shoulders, but instead actually turn forward away from the shoulder. When the staves or "skeis" are used (sometimes in India they are not), the intention is to avoid contact with the mobile shoulders of the ox, as the staves could actually interfere with the movement and comfort of the animal. This fact is often overlooked as people compare the neck yoke and withers yoke. The assumption is frequently that the withers yoke is a similar but cruder system than the neck yoke. The withers yoke can work effectively, when an

appropriate piece of wood for the yoke bean is selected and the neck seat is carved and smoothed to maximize animal comfort. However, this is not often the standard in many Sub-Saharan African countries.

The advantages of the withers yoke are its simplicity, flexibility, and ability to be used on many different teams, without special equipment or adjustments. It is easy to make with minimal hand tools, and the staves can be quickly and easily repaired. Its disadvantages are that it more easily breaks than other yokes, the animals are less easily controlled during training, and the yoke is frequently made of a narrow pole with no improvement or design to maximize the surface area on the hump or the top of the neck.

Figure 10
The withers yoke is designed to ride high on the neck, against the hump, and not interfere with the shoulders of the oxen.

Adopting and Using the Best Yoking System

Which system of harnessing the power of the ox is best? There is no correct answer. If I have learned anything from my work with farmers all, it is that different designs can all be functional. As an animal scientist I study animals. I have not always understood the plows they pull or how to design the best cart for the animal to pull. My interest has been the animal and how to maximize their performance. Once I got over my own cultural bias toward the neck yoke, I realized that each yoking system has strengths and weaknesses. To suggest a radical change in the way a population of people act by trying to introduce new yokes or harnessing systems requires far more energy than instead understanding why it is the yoke system is being used in the first place.

Heavy work in the field or on the road, will quickly show where the weaknesses are in any yoking systems (Conroy 1999). There is no need to completely adopt a new system. Find a local solution to the local problem. Ox yokes are easily and readily made using local

materials. There are few systems of field power that are more sustainable. The resources available will influence design, the cattle will impact the design, the culture and geography of the people will influence design and success of a particular system. Work with each of these design constraints in mind, and understand animal behavior and comfort first and foremost before trying to change a culture.
Be sensitive but critical to new ideas. Be willing to test them. Always monitor and maximize animal comfort and physically condition the animals to the task and the yoke. Difficult or repetitive heavy work is the best test of a harnessing system. If animals breakdown, evaluate the comfort, design and appropriateness of the yoking system employed, before giving up on a particular system of yoking altogether.

Figure 11
Testing the withers yoke (front) with the neck yoke behind in Uganda. Note how the withers yoke twists forward at the bottom and the neck yoke turns into the animals neck and shoulders. These are very different designs. You must understand them before making recommendations for new systems.

Understanding the Animal

Cattle have been yoked for thousands of years for one reason. They can be. They easily adapt to training without complicated bridles, nose rings, bits, reins and harnesses. Trying to adapt a harnessing system required for another specie often shows ignorance toward the cattle being worked. Cattle work in pairs because they are herd animals that are calmed and more easily controlled by the presence of another animal. Single cattle can be worked, but it takes more effort in training and more complicated yokes to accomplish any task of transport or plowing.

Figure 12
Horses hold their head higher than an ox during a heavy pull, they also have less prominent and more tightly held shoulders.

Obviously cattle differ in their anatomy and physiology from equines. Cattle hold their heads lower, have more prominent and loosely attached shoulders, walk slower, are more deliberate and more tolerant in difficult environments. They are also thicker skinned, less likely to become lame, and more likely to stand their ground, rather than run in fright. For this reason cattle and horses do not make good mates in a yoke. Donkeys are more like cattle in their nature, but are still anatomically very different than cattle in the way they are put together. Simply watching donkeys and cattle yoked together portrays the reasons you cannot expect equines to wear yokes.

Figure 13
Donkeys and an ox yoked together can be forced to work, but the donkeys suffer miserably, while the ox suffers the least and achieves the most work in this withers yoke.

Prominent Shoulders

Coming from a strong tradition of using neck yokes it is easy for me to see the anatomical difference that allows oxen to use this system, and makes it totally inappropriate for equines. An ox has shoulders that protrude at a low angle from his body. These shoulders are highly mobile and more loosely attached than those of a horse or donkey. Whoever first

designed the neck yoke knew this, and ox teamsters in New England have capitalized on this anatomical difference.

Figure 14
The prominent points of shoulder on an ox shown in this team pulling a heavy load, demonstrates why the horse collar and padding are inappropriate for oxen.

A horse can no more work in a neck yoke than an ox should work in a horse harness. The horse collar on an ox has to be lifted and pushed forward with each shoulder with every step an ox takes, especially during heavy work like logging, or plowing. The low hitch point of the traces on the hames forces the ox to be as uncomfortable as the donkey in a withers yoke. The driving harness is equally troublesome, as it squeezes the mobile shoulders of the ox together under a heavy load, when he needs them to move and maneuver with. There have been arguments that padding can help. Indeed it probably can, but under heavy continuous work the horse harness on an ox falls apart and proves to be an inadequate and inappropriate system.

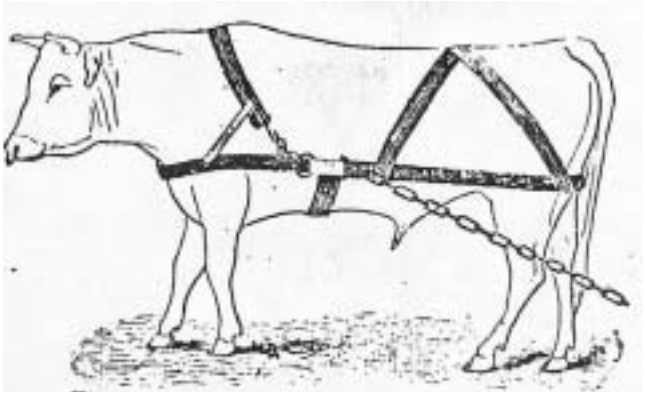

Figure 15
The horse harness cannot work effectively on an ox doing heavy work, because of his prominent shoulders

Around the world there are many other systems of yoking or harnessing the power of oxen. Some are very crude, often reflecting the poverty and resources of the farm. The most common system continues to be a wooden yoke, which most often is designed for two animals. The use of the single yoke is quite common with buffalo in Asia, but the ox is most often worked in pairs. The single yoke can be designed as a head yoke that fits behind the horns, a forehead yoke, or the neck yoke. Harnesses are also used on single animals. The primary criteria in selecting a system of yoking or harnessing the power of the single ox differs little from the yoke or harness used for two animals. Make sure the yoke fits

comfortably, monitor the fit constantly, and design a system that is appropriate for the animal and the tasks for which it is intended.

(photo will be in final version)

Figure 16
Single Animals can work effectively and comfortably in a yoke

Animal Comfort and Harnessing Systems

While there are and have been great debates over the most appropriate harnessing system for cattle, there are a number of factors that must be considered. Harnessing systems can work on cattle, but they must take the anatomy of the ox into consideration. Crude yokes or harnesses that quickly cause sores are inappropriate on any ox and in any culture. A good yoke or harnessing system is one that minimizes breakdowns of both animal and equipment. Whatever system is chosen, it must be one that is comfortable for the animal. Any design that does not fit the animal

(photo will be in final version)

Figure 18
Watching the animal's heads is an indicator of how well the yoke fits and functions. In this team, the yoke rides too high on the front team, lifting toward the withers, due to an inappropriate hitch point on the yoke of the front team.

is inappropriate. This point cannot be overemphasized. There are far too many ox teamsters who simply ignore animal comfort. Whatever system of yokes or harnesses adopted animal comfort is the most important thing to remember.

A person wearing shoes that do not fit quickly becomes sore and unable to walk. Even when the shoes fit but are not appropriate for the task, problems develop. When the fit or adaptation to the system (whether it be ox yokes or human shoes) is inappropriate, performance is decreased and shortfalls in the system develop.

The initial fit and design of a harnessing system is important, but this will make no difference if the animal's comfort is not monitored on a regular basis. Cattle gain and lose weight. Cattle grow quickly. This will affect the size of the yoke and how it fits. Even comparing harnessing systems is difficult as the ox must be accustomed and conditioned to both systems being tested in order to offer a good comparison.

Figure 19
A withers yoke with no design considerations for comfort on the ox, the young animal already developing wounds

Case Study of the Neck Yoke or Bow Yoke

The neck yoke uses a single solid yoke beam designed with a dropped hitch point, and carved neck seats to comfortably fit the animals wearing it. The yoke has holes drilled through it that accommodate the wooden bows, which hold the animals in place by the neck. The yoke is also designed with a staple, which holds the yoke rings in place, in order to hitch a pole or chain to the yoke. Variations in the shape of the beam, the shape of the neck seat and the shape of the bows reflect the animals' preference and size. There may also be teamster preferences, local customs or the yokes intended for specific tasks, which influence design. The design of the hitch point on the yoke also reflects the teamster's intentions.

Figure 20
. A cart with a high tongue weight requires a yoke with a broad neckseat to help evenly distribute the weight on the necks of the oxen.

In years past oxen were used in multipurpose neck yokes designed for many jobs around the farm. Yet some ox teamsters had specific neck yokes for logging or plowing

which placed the animals closer together. Yokes were also designed for weeding or cultivating, which were wider between the bows. In addition many New England Ox Teamsters used slide yokes in winter to give the animals more flexibility on slippery ground. These yokes also were used when oxen were hitched to carts, as this design allowed more animal movement in turning corners. This helped prevent the ox on the inside of the turn from getting knocked over by the pole on a tight turn.

Figure 21
The slide yoke was a New England commonly used in winter and for work on roads to offer the oxen a degree of flexibility in finding good footing.

Neck Yoke Design Considerations

Some neck yoke designs are more appropriate and valuable than others. The value is not so much in the beauty of the yoke, but in how it rides on the necks of a team of oxen hard at work. A beautiful looking yoke may be totally inappropriate when placed on the animals, if it has been constructed without careful attention to the animal's needs and the teamster's intentions. There are a number of factors which influence the how well the neck yoke functions.

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Figure 22
The dropped hitch point can be seen on this yoke attached to a snow plow

The Dropped Hitch Point

The neck yoke is designed to capture the power of the ox through the use of its neck and shoulders. This design has the hitch point at the bottom of the yoke. This lowered hitch point acts as a lever, tipping the bows into the shoulders of the ox at work. This also pulls down on the animals' necks, forcing them to lift the yoke as they push into it. This lift aids in pulling heavy loads, such as what might be encountered in logging, plowing or pulling contests. The neck yoke has more surface area with which to capture the animal's strength, than does the head yoke or withers yoke.

The dropped hitch point is critical to the function of the neck yoke. If the hitch point were on the top of the yoke it would pull the heads of the oxen into the air. If the hitch point were in the center of the yoke, the yoke would pull back onto the withers, with little pressure against the lower neck and shoulders. Both of these hitch points decrease the amount of power that can be captured from the ox team. Therefore partially adopting this system of using bows does little good without the dropped hitch point. In fact it will decrease animal performance substantially.

Figure 23
The dropped hitch point pulls and turns the yoke into the animals' shoulders, thereby maximizing the surface area of the neck seat and bows in contact with soft tissue on the animal.

The dropped hitch point has other implications. If the oxen are hitched to something like a wagon tongue or cart tongue, the dropped hitch point does not function in the same manner as it would when the team is pulling something low, near the ground surface. The yoke will not slip into the shoulders as it was intended. This will create some difficulty in pulling heavy wagons up hills, as the animals can no longer use their power to lift the load to their benefit. Some yokes are designed with an adjustable hitch point to accommodate different situations.

Figure 24
The oxen will indicate animal comfort if the teamster learns what to watch for

The position of the yoke hardware (staple) in relation to the center of the yoke is also important. The staple acts as a lever to position the yoke and bows on the animal's neck and shoulders. If the staple and hitch point is forward of the yoke's center this creates more "twist" or leverage, putting more pressure on the bottom of the bows and less on the top of

the neck. If the hitch point is behind the center point of the yoke this creates less leverage or pull, thus moderating the pressure on shoulders from the bows. The most modern yoke uses rings or hooks that can be easily adjusted forward or back to adjust this leverage, based on the task at hand, the implement being pulled and/or the animals' comfort.

HOW TO FIT THE YOKE AND BOWS

In order for the yoke to function properly it must fit the team. Provided the neck yokes fit the team at every stage of their development and use, the neck yoke will function effectively as it has for centuries. The drawback of the neck yoke is that as the animals grow, gain or lose weight they need to have their yoke or at least the bows changed accordingly. Again, like the shoes humans wear, the yoke must fit each individual animal. Failure to heed this advice will result in serious problems.

Figure 25
Oxen that throw their heads up or down are showing their discomfort in the yoke

Watch the animals carefully for any signs of discomfort. Every time the team is yoked, check the fit, and watch the oxen carefully as they begin a workout. The animals will give you signs when the yoke is uncomfortable. These signs can include throwing their heads up or down, twisting their heads back and forth, or being totally reluctant to pull. More subtle signs include one animal not holding its head up, or straining in the yoke even under light work. If any of these signs are ignored the animals will not work effectively. In addition, there may be long term consequences like wounds, bruising and scar tissue development, or an unwillingness to work when poorly fitted or improperly made yokes are used. Properly designing and fitting the yoke is as important as any training you will give the animal. Spending time preparing the yoke and bows for each team will pay great dividends. Easing them into every task and making sure they are properly trained conditioned for the work

demanded of them is also important, but the animal cannot work if they are not properly yoked. Cattle will try to avoid work if they are uncomfortable.

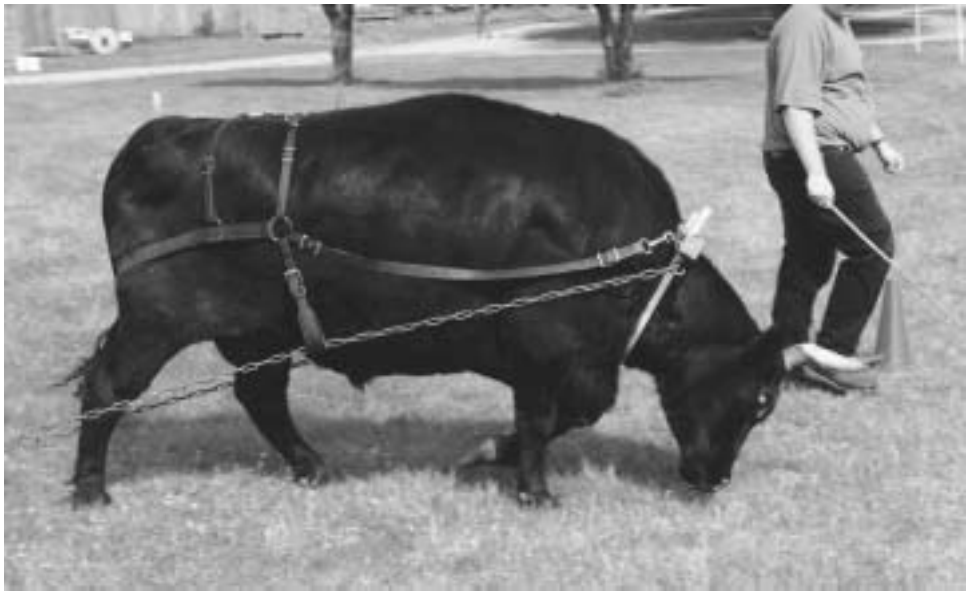

Figure 26
Cattle that carry their heads too low or too high are showing severe discomfort with the yoke

Using the neck yoke begins with fitting the yoke by evaluating the animal's neck size. In New England yokes are sized by their bows. The measurement is taken on the inside of the bow shafts (measuring the thickness of the neck). As the ox wears the yoke, the bow is designed to slip comfortably between the animal's point of shoulder and the base of its neck. This position of the bow is critical to understand and watch. It the bow interferes with the movement of the shoulder, because it is too large it will create sores on the shoulder. If the bow is so tight that it doesn't seat itself in this position at all, but instead stays up on the neck, the animal's skin will be severely pinched and sore. When the bows are fit too deep the bow will press against the front of the sternum or brisket. Finally, if the bow is pulled too high the animal will choke, cough, and develop sores on the bottom of its neck. For many head yoke users these are strong reasons to avoid the system altogether, but the simple solution is just make sure the yoke fits every time it is used.

Once a dimension of the neck has been estimated for each animal you are ready to begin the yoke making process. The neck of each animal must be measured. If the animal's necks are different sizes the yoke must be made to accommodate each individual animal. Fit the yoke to the ox, not the ox to the yoke.

Designing Neck Yokes for Oxen

Designing and building a neck yoke for oxen is not difficult, but there are a number of important considerations. For the basic ox yoke, each side of the ox yoke should be uniform in weight, shape and size from the center point of the piece of wood. If there are differences in the animal's neck sizes, the center of the neck seat on both sides should also be the same distance from the center. This will ensure that the two animals do the same amount of work while in the yoke. The most attractive yokes in shape and design have many admirers, but the

most outwardly beautiful yokes may not function at all if the animal's needs are ignored. The neck seat, bows and the dropped hitch point are the most important parts of the yoke.

Figure 27
The neck seat, bows, and dropped hitch point are critical if adopting the neck yoke design.

Selecting Wood for a Yoke

Selecting wood for the yoke can be a challenge. The best woods for an ox yoke are hardwoods that are difficult to split. Numerous softwoods can be used for yokes, but their strength is limited. The best log is one that is free of knots, and two to three times the diameter needed. This will allow the yoke beam to be quarter sawn or split out of a large log, reducing the amount of center grain in the yoke. The center grain is the weakest part of the wood, and also the section of the log that is most prone to cracking. Many yokes are successfully made from smaller logs, but the ideal yoke wood comes from a quarter sawn or split log.

The size of the animals will determine the size of the wood needed and the tasks the animals are going to be doing will impact what type of wood is selected. In general the length of the beam should be about 6.5 to 7 times the bow width. Thus for a 7 inch (17.5 cm) yoke the total length of the yoke beam should be about 46-49 inches (115-124 cm). This is a guide that seems to work for most yokes, although what the animals will be used for will impact this dimension. If the animals are used almost exclusively on a cart, the longer dimension is better, as it will allow the animals to more comfortably make turns and maneuver the cart. For plowing and logging, the heaviest work, having the animals closer together will allow them to work more effectively. For weeding sometimes yokes are designed to span the rows of crops, but this yokes style is less versatile, as its length increases the chance that one ox will generate more leverage than the other.

Figure 28
The neck yoke can be made with local woods and simple tools.

Making an ox yoke begins by deciding on a size and design. Tracing the shape of a yoke that has been successfully used on other oxen is recommended. Make sure that both sides of the yoke are equal in size and shape. Many yoke makers design a pattern that is actually a tracing of only half of a yoke. This pattern is used to trace lines on one side of the yoke beam and then it is flipped over to trace the other side of the yoke. Center lines on the pattern are important so that the two halves of the yoke are lined up with a center line marked on the yoke beam. The pattern should include both a tracing for the side view of the yoke, as well as, the top view, including bow holes.

However, getting the animals too close together increases the chances of them interfering with each other in the yoke. Having them too far apart will result in animals see-sawing back and forth at work, as they try to maintain their position in yoke. It is also very important to also leave enough wood in the yoke beam to maintain its strength and integrity. Cutting a deep curve on the top of the yoke to reduce the weight and add to the shape will often reduce the amount of grain that runs from one end of the yoke to the other. Maintaining the grain that runs through the piece of wood is important to maintaining its strength. Finally, it is important to have a yoke that is designed for the task at hand and the animals that will be wearing it.

Drilling Holes for the Bows

Once the yoke beam has been squared either with hand tools or a saw, and the pattern has been traced onto the yoke, holes for the bows or skeis will have to be made. These can be done with a chisel or with a drill. A square yoke beam will allow the holes to be drilled more accurately than one that has been partially finished and wobbles in multiple directions on the work bench

The diameter of the holes for the bows must match the size of the bows. Generally the bow holes are drilled slightly larger than the bows themselves. This will allow the bows to slip easily in and out of the yoke. If this cannot be done the bows will have to be shaved to fit into the holes, which may weaken the bows. It is important that the bow holes be drilled in

the center of the yoke and be as straight as possible. If the bows are off center, one bow shaft may put pressure on the neck and shoulders of the ox more than the other, leading to problems. In addition bow holes that are drilled off center may weaken the yoke.

Figure 29
A student at a vocational school demonstrates yoke making for farmers

Shaping the Yoke Beam

Every craftsman develops their own technique for making ox yokes. There are many possibilities in tool selection for the job. Hand tools such as the adze, ax, and chisel can be used to rough out the yoke beam. These tools work best in wood that is green and easy to work. Once roughed out, the yoke will need to be smoothed with a plane, drawknife, spoke shave, or even a rasp. The time spent on the yoke can be enormous depending on the condition of the tools and the skills of the wood carver. In areas where power tools are available chainsaws, bandsaws or other power equipment can be used for this task of shaping the yoke beam

The most critical part of the yoke is the neck seat. The neck seat must be free of cracks, splinters and rough spots. The palm of your hand is a wonderful gauge of the neck seat's design and finish. It should be smooth and evenly curved. The finished neck seat should be as smooth as glass. It should be uniform in shape from front to back and side to side. Just like the neck of the ox, the neck seat resting on top of the neck must be made to be uniform and fit the animal comfortably. The exact shape of the neck seat is often debated. Most ox teamsters agree as long as it is not too sharp on the edge nearest the animal's withers, and it has some curve similar to the animal's neck it will function for light work. As a teamster's demands increase, so does the requirement for the comfort of the neck seat.

Figure 30
The most important part of the yoke is the neck seat which is in direct contact with the animal, or in a head yoke the "horn box" which is carved to fit each horn.

Many oxen in Africa or Asia may work with a debarked small tree trunk as their yoke. The round shape of the tree does not fit comfortably on the animal's neck or withers. In fact some offers so little surface area contact that the animals quickly develop wounds from too much pressure on a small area of skin. The other extreme would be a yoke that is square on the edge, but cut to fit over the neck, as it might be shaped with a band saw. While this might offer more surface contact with the neck, the sharp edge doesn't accommodate the movement of the yoke back and forth, nor does it accommodate the fact that the yoke often pulls down into the top of the neck in heavy work like moving an overloaded cart.

Therefore, a yoke should have beveled and rounded edges on the front and back which allow the yoke to slide forward and back without cutting into the skin. In making the neck seat it is critical to leave enough wood to get the right curves. This is often best done with hand tools or small sanders that are easily controlled. The time spent on the neck seat is critical, even though the more visible parts of the yoke often receive more attention. In carving the neck seat a sharp straight edge from a steel tool or even broken glass can be used to smooth the neck seat. The importance of this point of contact on any yoke cannot be overemphasized. I will not buy into the notion that an ox teamster or yoke maker does not have the resources to properly construct his part of the yoke.

Figure 31
Poorly designed yoke on a young team with a heavy tongue on the cart

There are many possible designs and final shapes of an ox yoke. The first priority is to make a yoke that fits the animal. Make sure the neck seat is smooth, uniform in shape and all the corners are rounded and designed with maximum comfort for the animal in mind. After the animal's comfort is assured, then begin smoothing and finishing the outside edges of the yoke.

Figure 32
Withers yoke showing square edge against the ox, a poor design that can easily be remedied with a machete, a broken bottle or knife.

All corners and edges should be beveled or rounded. Sand, rasp and smooth all flat surfaces and cover the yoke with polyurethane, linseed oil, or paint. This will protect the yoke from the weather, give it a smooth attractive appearance and prevent any rapid moisture escape and cracking.

Figure 33
American neck yoke showing the features of a smooth neck seat, dropped hitch point and wooden bows.

Bows

In New England, there are only a few woods that are considered strong enough for making bows. The favorite in New England is the Shagbark Hickory (Carya ovata), a very dense and strong wood that is the top choice by most ox teamsters. Almost as good, but not nearly as popular is the White Oak (Quercus alba L.), and even less commonly used, but functional is the White Ash (Fraxinus americana L.). All three of these woods are strong, heavy woods can be found with relatively straight grain, and have a fibers and resin that will loosen when heated. There may be woods in other areas that are just as appropriate. Australian ox teamsters traditionally made the bows of steel (Braden 1970, Cannon 1986).

The bows used in New England generally have a shape that is similar to the partial radius of a circle. Some ox teamsters consider this the most desirable shape for a bow. However, the most successful ox teamsters understand that not all cattle are shaped the same. The bow must fit neatly and comfortably into the shoulders of an ox that pushes against the bow. Some cattle are narrow in the shoulder, others are wide in the shoulder. Some have narrow necks like a cow, others are shaped more like a bull. Evaluate the animals and test different bows shapes on the animals during heavy work. The animals will quickly indicate, through their behavior, the most comfortable bow design.

In order for a bow to be worn comfortably while pulling, it must not be too wide as to interfere with the movement of the points of the shoulder nor should it be too pointed as to cut off their wind or pinch their neck. The shoulders of an ox are much more prominent than those of a horse or mule. Thus the horse collar or driving harness is totally inappropriate for an ox pulling anything substantial. The horse collar puts pressure on the prominent shoulders of the ox and requires him to push into the collar one shoulder at a time. The driving harness constricts the shoulders, making it difficult to use in a sustained heavy pull.

Yoke Comfort and Fit

The neck yoke can be used to comfortably capture huge amounts of power from trained oxen. Yet, the neck yoke will work only if it fits the animal. Constantly watching the animals for signs of discomfort will greatly aid in top performance.

Figure 34
The constant contact with the soft tissue in the shoulders and on top of the neck, allows the shoulders to move freely, maximizing the yoke surface and bows surface with every step.

If the bows are too loose they will interfere with the movement of the shoulder. The animal will struggle to pull on an angle minimizing the pressure on their prominent and bony shoulder points. If the bow is too tight it will pinch the neck. Pinching the neck will create bruises leading to “bow bunches” or scar tissue on the neck. These may at first appear as soft swellings, but they can quickly become permanent scar tissue and distract from the appearance of the ox, and his ability to function adequately in the yoke. The animal will twist its head side to side if the bow is too tight, as they try to find a comfortable position for the bow. Once sore, the animal may become totally reluctant to work. Every ox requires a bow that fits him individually. If there is a lot of variation between the two oxen in a pair, the yoke should be designed accordingly. The importance of fitting the neck yoke to the animal’s means this system is more challenging to use in areas where the level of ox training and handling is low.

In addition, the neck yoke has other drawbacks. The flexibility it gives the animals over the head yoke can create problems if the animals learn to turn the yoke (swinging their rear ends away from one another and flipping the yoke upside down, or pulling away from one another when in the yoke (hauling out) because the system rigidly keeps the animals together. However, careful training and a good yoke fit will prevent these problems.

Figure 35
The neck yoke is a poor design if animal training and skill levels are low. Here the cattle are learning to pull away from each other in the yoke, which is not possible in the withers or head yoke designs.

Whatever variations were adopted this style of yoke allows the animals to have substantially more flexibility and freedom compared to the head yoke. For this reason it has never been as good a restraint or training aid, especially when working with wild or unruly cattle. The neck yoke also allows the yoke to be easily transferred from one animal to another, and is faster to put on and take off. For plowing or using the animals on uneven terrain, using cattle with no horns, the neck yoke design worked better than the head yoke.

Compared to the withers yoke, the neck yoke offers more control, a stronger yoke for large cattle during training or heavy work, and offers substantially more surface area on the top of the neck and against the shoulders. This can lead to greater performance. However, the condition of the animals and their preparation for heavy hauling are both influenced by training.

Conditioning Animals to Work

Oxen have to be trained and conditioned to work, in order to get top performance. The yoke has a significant influence on the animal's willingness to work (Roosenberg 1992a and Conroy 2001). However, without prior and adequate training for any task the animal's willingness to put forth the effort necessary to accomplish difficult tasks is greatly diminished. There is also a period of acclimation when an animal trained to use one yoking system changes to another yoking system. For a more comfortable design, such as a crude withers yoke to a more comfortable neck yoke, animal performance may increase immediately. Moving from a head yoke to a neck yoke or vice versa will require the animals to become acclimated to having a new part of their anatomy expected to carry the load. This transition may take hours, days or even weeks depending on the teamster's skill and interest in making the transition to a new yoking system.

Animal Welfare

The ox yoke has been used effectively on all continents except the Antarctic. Its success cannot be dismissed because some farmers ignore the animal's anatomy and then

design yokes without adding a few final touches to make the system as effective as possible. The success of the American ox teamsters in effectively capturing the power of an ox can be applied all over the world. This is not to say that all farmers should adopt the neck yoke. However, the principle of maximizing a comfortable surface area on the animal, with any given yoke design, without interfering with the normal movement and anatomy of the animal is possible with all yoking systems. It has been so often suggested that a harness be adopted for oxen as well (Minhorst 1991 & 1997). The issue of the three pad collar harness for the ox is not one of function, but rather one of complexity, cost and construction. Almost any farmer can find a suitable piece of wood to design a yoke of some sort. The tools necessary can be as simple as a machete, and the result can be a comfortable, functional and effective yoke.[iv]

Figure 36
A Pair of Chianinas pulling 6045 kg. on dry sand, a typical performance for working oxen in New England, displaying that the yoking system is comfortable and effective.

Conclusion

The physics involved in yoking oxen is simple, but many farmers and trainers have ignored the importance of the yoke design and fit, instead focusing on other equipment, training the animals or other pressing issues small farmers face all over the globe as they adopt and use animal traction. There is no need to propose to abandon the ox yoke because of animal welfare concerns. Instead there needs to be focus on increasing the training and awareness of ox yoke design, animal behavior and comfort, as well as culturally appropriate improvements to existing systems.

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[i] I must admit that prior to 1993, my experience was almost exclusively with the neck yoke. However over the last decade, with the influence of Paul Starkey, Richard Roosenberg of Tillers International, and my Ph.D. research in East Africa my experience has been greatly expanded and my appreciation for other yoking systems and the limitations of the neck yoke have been explored in detail.

[ii] This cultural phenomenon intrigued me from the first time I saw Canadian head yoke teams as a boy at a fair in New England. Working in Uganda, 20 years later, the cultural implications of ox yokes continued to intrigue me. Finally, in 1994, one of my own oxen became injured because of a poorly fitted neck yoke. I had heard of an American ox teamster from Massachusetts who had switched to the head yoke for the same reason. Apparently he was very happy with the results. Speaking with Nathan Hines I began to understand that my own bias toward neck yokes was based on purely cultural reasons.

[iii] I estimate about 3000 teams exist today in the United States

[iv] In Uganda in 1995, I worked on a USAID supported project to train extension officers and other mid career trainers. The first thing I was told was that they did not have the resources to design and make improved yokes. I immediately decided to make yokes using only local materials, a machete and broken glass. The resulting yokes were nearly identical in comfort and quality to the yokes I make on my own farm in the U.S.A. My point was that with just a little knowledge about how to make the animals comfortable, simple, inexpensive and comfortable yokes can be manufactured locally.