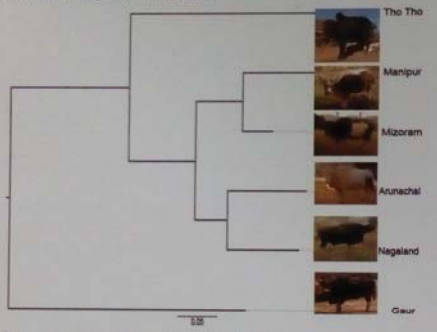
0.065 in gaur. The study provided valuable information on the present genetic status of mithun and gaur populations. Based on the microsatellite study, phylogenetic tree was prepared to show the genetic status of four mithun strains with wild gaur and Tho tho cattle:



Some unique/desirable traits of a good Mithun

- Body weight – ideal size 400-450 kg for male, 350-400 kg for female
- Head – Broad head, white strip/marking on forehead
- Horn – Should be broad based, straight, should not be curved inward.
- The base of the horn becomes yellow in relatively old/matured animals (7-8 yr age) – preferred for sacrificial purpose
- Dewlap – Should be widely hanging type
- Neck – Should be broad, wide, muscular
- Hump – Should be big, height should be more
- Coat color – Should be smooth jet-black, no other color markings
- Fetlock – Should be white (white-stocking)
- Tail – Should be long
- Twitch Hair should be dark, long, smooth, free from ticks
- Body conformation – Should be bit flat, not round, well balanced, should be free from any anatomical deformity.

Socio-economic importance

- Mithun plays an important role in socio-economic life of the tribal populations of the region.
- The history of this animal with the ethnic and cultural life of tribal people of the North- East hill states is several hundreds years old.
- However, the production potential of this species has been realized in recent years and found to be promising.
- The animal has got a great potential for quality meat, milk and leather productions and there is a great scope to promote this animal as an organic meat and milk producer.
- Being a meat animal the growth rate of mithun is the prime concern of farmers. With adequate feeding, the growth rate of this animal varies from 200 to 600 g/day.
- Under free range condition, farmers practice rotational grazing by shifting their animals from one hill to another.
- Day to day health care and disease prevention measures are not the usual practices in existing mithun husbandry system. Due to denudation of free range along with the biotic and abiotic stress, there is urgent need of scientific intervention for proper management as well as conservation of this beautiful hill animal through implementing an effective conservation and improvement programme.
- With semi-intensive system of management, will not only be helpful to preserve this animal but also help thousands of poor farmers to keep themselves away from the protein hunger.
- There is immense scope to increase meat production to meet the demand of the fast growing population by exploiting the rate of reproductive potential of mithun through judicious application of biotechnology.

Conclusion

- Genetic improvement of livestock is a continuous and complex process. There is urgent need to devise a suitable breeding programme and its planned implementation in the Mithun population.
- For last several years National Research Centre on Mithun has been engaged in various activities to save this precious germplasm from further deterioration.
- A sustainable and financially viable Mithun farming, which will generate wealth and self-employment through entrepreneurship, is the need of the day.
- This would require creating an environment in which Mithun owners will increase investment to improve productivity and building participatory institutions.

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Mithun (*Bos frontalis*)

The sacrificial ox of the North East Hill People

A Genetic Perspective

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Introduction

Mithun (*Bos frontalis*), a ruminant species belonging to family *bovidae* and assumed to be the domesticated form of wild gaur *(Bos gaurus)* is indigenous to the eastern Himalayas and has been referred to as 'sacrificial ox' of the North Eastern region of India. It played an important role in the traditions and rituals of the vast tribal population of this region. Mithuns live at elevations between 300 to 3000 m in the hilly terrains of North East India.

Mithun is often referred to as the 'ship of highland' and is a good example of integration of agro-ecology, subsistence livelihood, culture and livestock rearing. These animals are of special importance in the hills, at an altitude above 2000 msl. They are also considered as almost sacred in view of their ability to survive those harsh conditions and multiple use (Rangnekar, 2006)

Geographical Distribution and Population Status of mithun

Mithun is distributed within a limited geographical boundary. It is mainly found in the North- Eastern region of India (Arunachal Pradesh, Nagaland, Manipur and Mizoram), Myanmar, China, Bangladesh and Bhutan. It is difficult to ascertain the total population of Mithun, as no systematic population record of mithun is available in the mithun inhabited areas except India. Mithun population in India over the various Livestock Census is given below -

Table : Distribution of Mithun population in India over the years (figures in parenthsis indicate percentage)

State	1987	1997	2003	2007
Arunachal Pradesh	98540 (74%)	124194 (70.21%)	192000 (69.06%)	218931 (82.89%)
Nagaland	13496 (10.12%)	33445 (18.90%)	40000 (14.39%)	33244 (12.59%)
Manipur	19895 (15%)	16660 (9.42%)	20000 (7.19%)	10024 (3.79%)
Jammu & Kashmir	-	-	24,000 (8.63 %)	-
Mizoram	1435 (1%)	2594 (1.47%)	2000 (0.73%)	1939 (0.73%)
Total	133366	176893	278000	264138

Phenotypic and Genetic Characterization - Performance of Mithun

Farm animal genetic resources (FAnGR) include all animal species, breeds and strains (and their wild relatives) that are of economic, scientific and cultural interest to humankind in terms of food and agricultural production for the present or in the future (Rege and Gibson, 2003). Mithun is a part of this animal genetic resource, which is one of the most important livestock species in the north eastern part of our country as well as in south east Asia.

The data on various morphometric and economic traits of Mithun kept at the Institute farm as well as collected from the field was recorded and is analyzed statistically (least square analysis of variance). These are presented here:

Sl. No.	Performance Traits	Least Square Means ± SE
1	Birth Weight	21.58 ± 0.24 kg
2	Stock Weight	305.67±5.89 kg
3	Height at Weither	114.21±1.18 cm
4	Body Length	157.91±1.91 cm
5	Heart Girth	154.48±1.75 cm
6	Face Length	35.79 ± 0.46 cm
7	Tail Length	70.17 ± 1.06 cm
8	Neck Circumference	81.78 ± 1.78 cm
9	Neck Length	37.69 ± 0.72 cm
10	Ear Length	19.53 ± 0.70 cm
11	Point of Shoulder to pin-bone	70.9 ± 0.89 cm
12	Horn Length	18.66 ± 0.54 cm
13	Horn Circumference	23.84 ± 0.55 cm
14	Age at First Calving	1398.52 ± 23.66 days
15	Calving Interval	667.82 ± 25.00 days
16	Service Period	189.56 ± 36.70 days

The physical coat colour of mithun is also studied and it is found that Nagaland and Mizoram mithuns are predominantly jet black. One of the most distinguishing features of mithun is 'white stocking' of fore-legs and hind legs irrespective of their sex.

Data on growth, nutritional performance and carcass traits of mithun are also analyzed and found that the marbling and average fat thickness in mithun meat is moderately abundant, whereas the Rib eye area is comparatively larger indicating the better meat quality of mithun.

S.No.	Carcass Traits	Mean ± SE
1.	Live Weight	367.66 Kg
2.	Slaughter Weight	349.33 Kg
3.	Carcass Weight	198.33 Kg
4.	Carcass Length	49.66 Inches
5.	Carcass Oblique Length	52.16 Inches
6.	Round Weight	16.33 Kg
7.	Round Length	16.66 Inches
8.	Round Width	16.5 Inches
9.	Round Circumference	37.5 Inches
10.	Fat Thickness	0.74
11.	Rib Eye Area	84.29 cm. square
12.	Dressing Percentage	56.42%
13.	Shrinkage	5.00%
14.	Degree of marbling	Moderately abundant
15.	Texture of Marbling	Fine
16.	Colour of lean	Dark Red
17.	Firmness of lean	Slightly soft
18.	Texture of lean	Fine
19.	Average daily gain	0.396 gm /day
20.	Body condition score	2.5

Mithun Cytogenetics

The whole blood lymphocyte culture technique was used for preparing the metaphase spreads and mithun karyotypes (2n=58) prepared. All the cytogenetic information of mithuns has been compiled and documented in the form of a **"Digital Album"** for each animal.

Microsatellite characterization

Cattle microsatellite markers were tested on Indian mithun and wild gaur and subsequently, genetic diversity of these species was investigated using 30 cattle-specific microsatellites. The analysis revealed some unique alleles with high allelic frequencies. Nineteen (63%) microsatellite markers successfully amplified the genomic DNA of mithun and wild gaur; where 15 (79%) of these loci were highly polymorphic in mithun and gaur, respectively with Polymorphic Information Content (PIC) greater than 0.50. The number of allele ranged from eight to 25 in mithuns and two to seven in gaur. Observed heterozygosity (H_o) and Nei's expected heterozygosity values (H_e) ranged from 0.15 to 0.94 and 0.31 to 0.89 in mithun and 0.01 to 0.99 and 0.36 to 0.83 in gaur. The average estimates of H_o, H_e and PIC across 19 microsatellite loci were 0.48, 0.66 and 0.63 in mithun, and 0.62, 0.71 and 0.61 in gaur, respectively. Intra-population inbreeding level (F_{is}) was 0.30 in mithun and