

## BODY CONFORMATION AND BLOOD PROTEIN / ISOZYME POLYMORPHISMS OF TAMARAW (*Bubalus mindorensis*)

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### Summary

A total of 6 tamaraws were observed for determining coat color and measured for body conformation. Banding pattern of 4 blood proteins and 2 isozymes were analysed from the peripheral blood of two tamaraws. The coat colour of younger tamaraws were observed to be brown and adult was found to be complete black. The body weight, body length, withers height, head length, head width, horn length and tail length of adult male and female tamaraws were: 236 kg and 208 kg; 113.5 cm and 112.5 cm; 19.5 cm and 20 cm; 30.0 cm and 28.5 cm and 36.0 cm and 35.5 cm, respectively. The electrophoretic banding pattern, distance migrated and the allelic frequencies obtained in tamaraws were similar compared with that reported in swamp buffaloes. Although the sample size was very small, results of this study could be an important source of informations based on which a breeding programme can be designed to exploit some of the economic characters of tamaraw.

(Key Words : Tamaraw, Morphology, Blood Protein / Isozymes, Polymorphisms)

### Introduction

Tamaraw is one of the most valuable treasure of the Philippines about which a very little is known. This is the animal species related to water buffalo and resembles a miniature water buffalo of swamp type.

They are endemic to the island of Mindoro, Philippines. Because of its limited distribution the tamaraw's future is of concern to conservationist. The increase in human population, logging and ranching have restricted the tamaraws habitat while hunting has threatened its number.

The tamaraw is known for its hardiness and resilience to heat and humidity as well as its capability to thrive on poor forage and variety environmental condition. These characteristics of tamaraw could be used to improve other related species. Before undertaking any cross breeding programme a detail investigation on their morphology, physiology and genetic characteristics should be performed. Therefore, the present study was aimed to investigate the above mentioned characteristics on tamaraw.

### Materials and Methods

Morphological data and blood samples were collected from tamaraws kept in captivity at the gene pool, Mt. Iglit in Mindoro island. Body measurements were taken from 6 tamaraws and blood samples were collected from 2 tamaraws by trapping them in wooden crate. As the tamaraw is still wild in nature, aggressive and dangerous, it was possible to take data only from 6 animals.

#### Body measurements

Body weight of all animals under study were recorded using digital weighing machine. The different body parts i.e, body length (BL), withers height (WH), hip height (HH) chest girth (CG), cannon circumference (CC), head length (HL), head width (HW), horn length (HnL) and tail length (TL) were measured using tape measure and wooden calipers (figure 1).

#### Blood proteins and isozyme analysis

Ten ml of blood was collected from two tamaraws using heparinized venoject tube and immediately stored in ice box. Upon reaching the laboratory, samples were centrifuged at 1,400 rpm for 10 minutes and the plasma was separated from red cells. Then they were stored separately in a deep freezer at 20°C until electrophoretic analysis.

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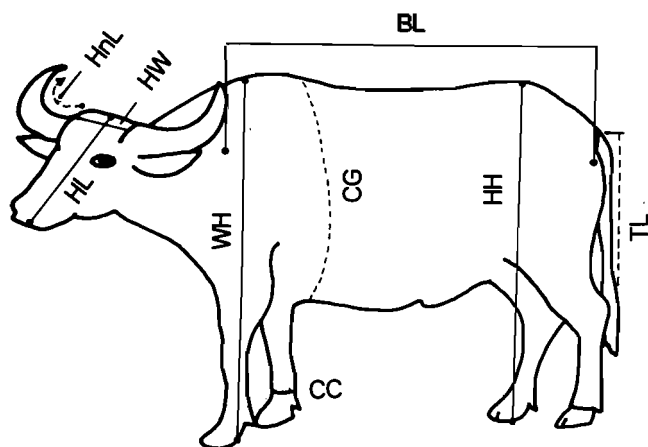


Figure 1. Measurement for the different morphological traits.

### Electrophoresis

Four blood proteins namely Albumin (Alb), Haemoglobin (Hb), slow alpha two macroglobulin ( $S\alpha_2M$ ) and transferrin (Tf) and 2 isozymes-malate dehydrogenase (MDH) and 6 phosphogluconate dehydrogenase were analysed using starch gel electrophoretic technique following the procedure used by Amono et al. (1984).

## Results and Discussion

### Morphological characteristics of tamaraw.

#### Coat colour

Coat colour of young tamaraws was observed to be brown (figure 2). As they were growing up the brown colour was gradually changed to black (figure 3). In the present study, adult tamaraws were found to be deep black (figure 4). This change of colour of tamaraw in different stages may be attributed to the interaction effect of gene and environment.



Figure 2. One year old tamaraw calf.

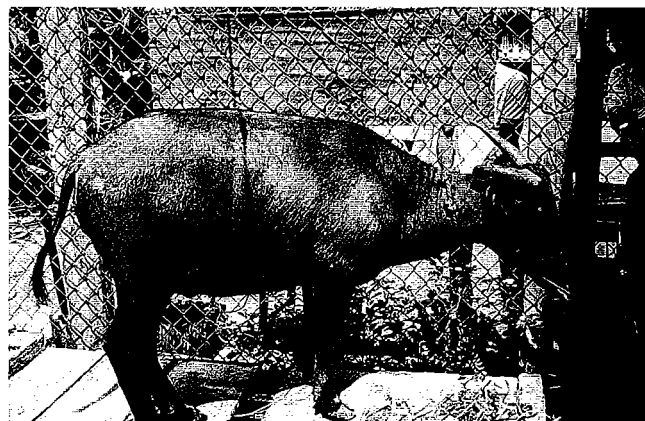


Figure 3. Three years old tamaraw heifer.



Figure 4. Ten years old male tamaraw.

### Body measurement

Body measurements of different age groups of male and a female adult tamaraws are presented in table 1. Body weight of an one year old male tamaraw was 64 kg, a 3-year old male was 166 kg and average BW of above 4-year old tamaraw was 236 kg. These results were much higher than that reported by NAP (1983). Height at withers of above 4-year old male tamaraw was 99.50 cm which was similar to the value reported by NAP (1983), but lower than that (120.00 cm) reported by Rabor (1977). Head length, head width and horn length of adult tamaraws in this study were 39.5 cm, 19.5 cm and 30 cm, respectively. These results were similar with the reports of Rabor (1977) and NAP (1983). Measurements of other morphological characteristics of adult tamaraw: body length (113 cm), hip height (107 cm), chest girth (157 cm) and tail length (35.50 cm) were not reported else where. Measurements of all morphometric characteristics in three different age groups were found much different.

TABLE 1. AVERAGE BODY MEASUREMENTS OF TAMARAW IN DIFFERENT SEX WITHIN DIFFERENT AGE GROUPS

| Age                        | Sex | N | BW (kg) | BL (cm) | WH (cm) | HH (cm) | CG (cm) | CC (cm) | HL (cm) | HW (cm) | HnL (cm) | TL (cm) |
|----------------------------|-----|---|---------|---------|---------|---------|---------|---------|---------|---------|----------|---------|
| Calf (1-2 yr.)             | M   | 1 | 64      | 80      | 72      | 74      | 96.5    | 15      | 25      | 13      | 9        | 17.5    |
|                            | F   | — | —       | —       | —       | —       | —       | —       | —       | —       | —        | —       |
| Bull/heifer calf (3-4 yr.) | M   | 1 | 166     | 100     | 91.5    | 91      | 137     | 17      | 35      | 15      | 26       | 37      |
|                            | —   | — | —       | —       | —       | —       | —       | —       | —       | —       | —        | —       |
| Adult (above 4 yr.)        | M   | 3 | 236     | 113.5   | 99.5    | 107     | —       | —       | 39.5    | 19.5    | 30       | 36      |
|                            | F   | 1 | 208     | 112.5   | 99.5    | —       | 157     | —       | 39      | 20      | 28.5     | 35.5    |

Note : BW = Body Weight, BL = Body Length, WH = Withers Height, HH = Hip Height, CG = Chest Girth, CC = Cannon Circumference, HL = Head Length, HW = Head Width, HnL = Horn Length, TL = Tail Length.

### Blood protein and isozyme polymorphism in tamaraw

The starch gel electrophoresis separates molecules of different charges. The protein and isozyme migrations proceeded from cathode region to the anode region since the isoelectric points (PI) of the proteins and isozymes ranged from pH 4.5 to 5.35 and so they were negatively charged.

A total of 6 genetic loci were examined and all of them were found polymorphic. Polymorphisms were determined by the different kinds of genotype appearance in the gel. Variation in the genotype was identified by the banding pattern and the staining intensity of these bands that appeared in the gel.

### Blood proteins

#### Albumin (Alb)

In tamaraw, two heterozygous genotypes, Alb<sup>AB</sup> and Alb<sup>BX</sup> were found (figure 5). This Alb locus was identified to be controlled by three alleles Alb<sup>A</sup>, Alb<sup>B</sup> and Alb<sup>X</sup>.

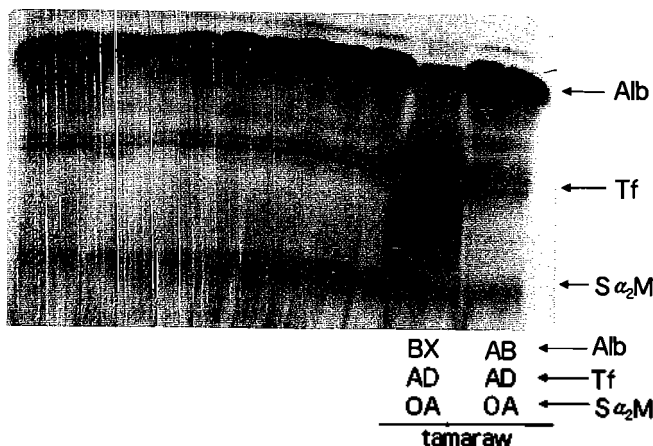


Figure 5. Starch-gel electrophoretic banding pattern of transferrin (Tf), albumin (Alb) and S $\alpha_2$  macroglobulin in tamaraw.

### Hemoglobin (Hb)

A single type of hemoglobin pattern was obtained in tamaraw in this study (figure 6). Only one heterozygous genotype Hb<sup>AB</sup> was observed in both the samples. Banding pattern and the distance travelled were found similar with that in the swamp buffalo (*Bubalus bubalis*) as reported by Majid (1992), Basavaiah et al. (1975), Amano et al. (1984), Selvaraj et al. (1989).

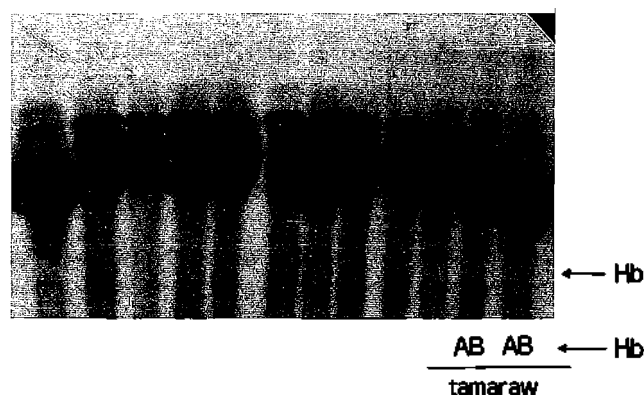


Figure 6. Starch-gel electrophoretic banding pattern of hemoglobin (Hb) in tamaraw.

### Macroglobulin (S $\alpha_2$ M)

Alpha two macroglobulin is migrated very slowly in the electrophoretic gel, hence it was named as slow alpha two macroglobulin (S $\alpha_2$ M) (Amano et al., 1984). Only the heterozygous genotype, S $\alpha_2$ M<sup>OA</sup>, which was consisted of a faster major band and a slower major band present in the tamaraw. This banding pattern was similar with that found in case of swamp buffalo which was reported by Majid (1992) but dissimilar with findings of Amano et al. (1984).

### Transferrin (Tf)

Tamaraw distinctly exhibited the presence of heterozygous transferrin genotype Tf<sup>AD</sup>. Banding pattern

was found to be similar with that in the swamp buffaloes as reported by Amano et al. (1984) and Majid (1992). Allelic frequencies of  $Tf^A$  and  $Tf^B$  were found 50:50 respectively. These two codominant alleles were expressed in three phenotypes in the gel. This result is consistent with the finding of Abe et al. (1969).

### Isozymes

#### Malate dehydrogenase (MDH)

The banding pattern of malate dehydrogenase (MDH) was observed to be similar with swamp buffalo. The faster homozygous genotype ( $MDH^{2-2}$ ) was identified in two tamaraw samples which consisted of a thick major band and a faint minor band. This banding pattern was consistent with the findings of Majid (1992) and Selvaraj et al., (1989) and contrary with that obtained by Amano et al. (1984).

#### 6 Phosphogluconate dehydrogenase (6PGD)

A single heterozygous genotype ( $6PGD^{AB}$ ) was observed to be present in tamaraw. Banding pattern of this genotype was similar with that found in the Philippine carabao (Majid 1992). Frequency for the allele  $6PGD^A$  was 0.5 and for  $6PGD^B$  was 0.5. The locus was identified as polymorphic. No genetic variants for 6PGD was reported elsewhere. Amano et al. (1984), Selvaraj et al. (1989), and Chew et al. (1989) reported 6PGD as a monomorphic locus in swamp buffaloes.

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