THE HAEMATOLOGY OF WILD AND LABORATORY ACCLIMATED *LABEO UMBRATUS* (TELEOSTEI; CYPRINIDAE)

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Accepted: February 1978

ABSTRACT

The haematology of the mudfish (*Labeo umbratus*) has been studied in the laboratory and in the wild state. Significant differences between laboratory and field data and also between field data obtained for fish from different localities were observed in several of the parameters studied and the results are considered in relation to the validity of extrapolation of laboratory data to field conditions.

INTRODUCTION

Recent studies on fish have attempted to establish "normal" and "standard" haematological values (McKnight 1966; Farghally *et al.* 1973; Hattingh 1973; McCarthy *et al.* 1973; Van Vuren & Hattingh 1976, etc.). Fish are susceptible to physical and chemical changes in the water which may be reflected in their blood parameters (Blaxhall 1972). Aquarium fish are exposed to experimental conditions and changes may be expected to occur in their haematology after adaptation to this new environment. The different levels of activity, change in diet and accumulation of small quantities of waste products lead to changes in these fish (Love 1970), but the effects of maintaining fish in laboratory aquaria on their haematology *per se* have not yet been investigated and laboratory data are usually thought to apply to wild fish as well. Newly caught, exhausted fish cannot be used for the determination of certain physiological parameters (Love 1970) and some blood values increase after a period of retention (Yamashita 1974). Delayed shock (after 1–2 days) due to capture and transportation influences the blood parameters of *Barbus holubi* (yellowfish) and *Clarias gariepinus* (barbel) and therefore it is essential to use aquarium fish after acclimitization if these effects are to be eliminated (Hattingh 1973).

The present study was planned to investigate any haematological differences between wild and aquarium fish of the same species and also between wild fish from different localities. The effects of laboratory acclimatization as such were not studied but rather the validity of the assumption that laboratory data can be extrapolated to field conditions irrespective of locality and other environmental influences. The experiments were conducted during the same season of the year and in the case of the wild animals blood was sampled immediately after capture. Due to the fact that no transportation was involved, only "capture shock" may have influenced their haematological values and this possibility is fully appreciated. No other way exists at present, however, to obtain blood from wild fish.

MATERIALS AND METHODS

Adult and healthy individuals of mudfish (*Labeo umbratus*) of both sexes were seined in the Saulspoort, Allemanskraal and Verwoerd Dams of the Orange Free State, South Africa, during September 1975, and blood was drawn immediately after capture and stunning with a blow on the head, using only animals that showed no visible signs of shock or exhaustion. Fish obtained from the Tierpoort Dam (also in the Orange Free State) were transported to, and maintained in, the laboratory as described previously (Hattingh *et al.* 1975). In these laboratory acclimated fish, blood was drawn two weeks after seining as this interval is sufficient to eliminate the effects of delayed shock (Coetzee & Hattingh 1977).

In this way, the haematological values obtained from wild fish from three different localities could be compared with those of laboratory acclimated animals of the same species, but from a different locality. The methods used for blood analysis have been described in detail (Hattingh 1973, 1974; Fourie & Van Vuren 1976). Each group consisted of at least eight fish.

TABLE 1.

Statistically significant differences between some haematological data for the blood of *L. umbratus* in the wild state obtained from different localities. S, Saulspoort Dam; V, Verwoerd Dam; A, Allemanskraal Dam.

Parameter	Significance	Locality
Hc	$P < 0,01$	S *vs* V
Erythrocyte count	$P < 0,005$	S *vs* A
	$P < 0,001$	S *vs* V
	$P < 0,01$	A *vs* V
Leucocytes	$P < 0,005$	S *vs* V

RESULTS

Haematological results

The results are presented in Figure 1 and Tables 1 and 2. The mean values obtained from wild fish from the three different localities differed amongst themselves and the blood of aquarium fish showed the highest mean values for the haemotocrit (Hc), haemoglobin concentration (Hb), plasma protein concentration (P.Prot), mean cell volume (MCV) and average cell haemoglobin (ACH). Erythrocyte dimensions were lower in laboratory acclimatized fish (length and width) but the mean cell volume was greater. Statistically significant differences exist between some data obtained from wild fish from different localities (Table 1) and also between some field data and those obtained from aquarium fish (Table 2).

Plasma protein electrophoresis

Polyacrylamide gel electrophoresis on 5 per cent gels at pH 8,5 of the plasma proteins of wild fish showed 21 fractions while 20 fractions appeared from fish under laboratory conditions. (Fractions were numerically numbered from the point of application). Fractions 2, 3, 4, 5, 12, 14, 16, 17 and 18 all showed higher mean concentrations in laboratory fish but only fractions 17 and 18 were significantly different from the corresponding field fractions. Fraction 8 diminished in concentration in the laboratory to a level lower than was found in field fish. The general pattern of electrophoresis was very similar, however, in all fish studied (Figure 2; Table 3).

TABLE 2.

Statistically significant differences between laboratory and field data for the blood of *L. umbratus*.

Parameter	Significance	Locality of field fish
Hc	$P < 0,01$	Verwoerd Dam
	$P < 0,05$	Allemanskraal Dam
Erythrocyte count	$P < 0,01$	Saulspoort Dam
Leucocytes	$P < 0,05$	Saulspoort Dam
Hb	$P < 0,05$	Verwoerd Dam
	$P < 0,01$	Saulspoort Dam
Erythrocyte dim. (Length)	$P < 0,01$	Verwoerd Dam
MCV	$P < 0,01$	All localities
ACH	$P < 0,01$	Saulspoort Dam

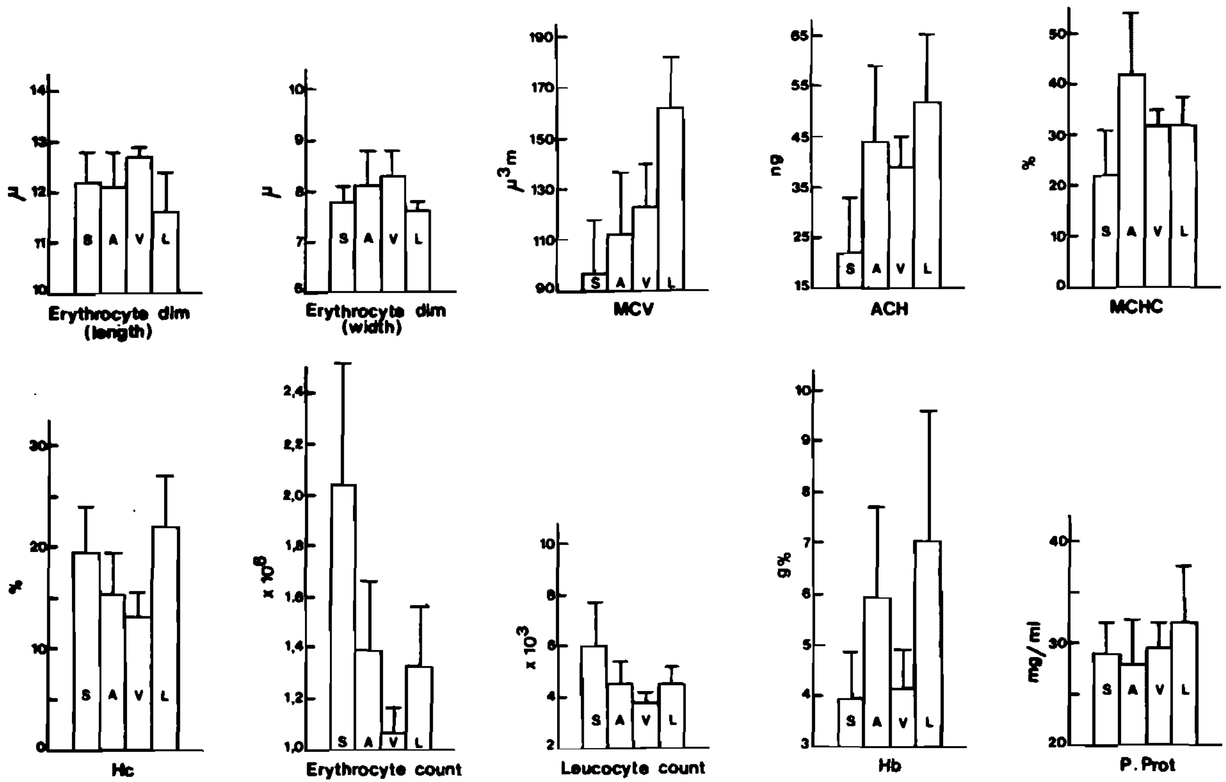

FIGURE 1.

Haematological values (Means ± SD) for *Labeo umbratus* in the field and laboratory. S, Saulspoort Dam; A, Allemanskraal Dam; V, Verwoerd Dam; L, Laboratory; MCHC, Mean corpuscular haemoglobin concentration per cent.

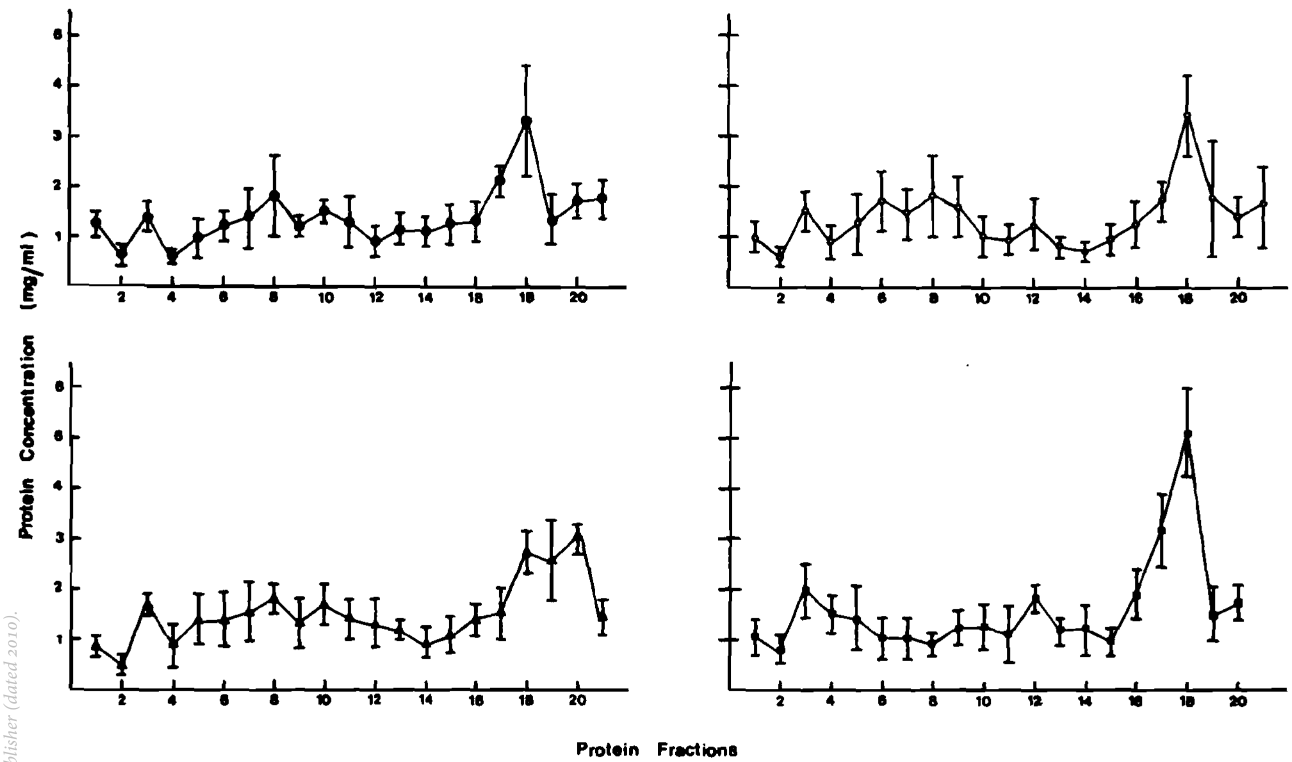

FIGURE 2.

Plasma protein fraction concentrations obtained from the plasma of *Labeo umbratus* (Means ± SD).

●——●, Saulspoort Dam; ○——○, Allemanskraal Dam; ▲——▲, Verwoerd Dam; ■——■, Laboratory.

TABLE 3.

Statistically significant differences between certain plasma protein fractions of laboratory and field fish.

Protein fraction	Significance	Locality of field fish
2	P < 0,01	Verwoerd Dam
4	P < 0,01	All the dams
8	P < 0,05	Allemanskraal and Saulspoort Dams
	P < 0,01	Verwoerd Dam
10	P < 0,01	Verwoerd Dam
12	P < 0,05	Allemanskraal Dam
	P < 0,01	Verwoerd and Saulspoort Dams
13	P < 0,01	Allemanskraal and Verwoerd Dams
14	P < 0,05	Allemanskraal Dam
16	P < 0,05	Allemanskraal and Verwoerd Dams
17	P < 0,01	All the dams
18	P < 0,01	All the dams

DISCUSSION

Much time and expertise have been spent in recent years in order to obtain "standard" and "normal" haematological data for fish. In many instances the work has been done on laboratory acclimated animals and the results are then usually thought to reflect the situation in wild fish of other localities too. Due to the problems encountered when capturing and transporting fish (Bouck & Ball 1966; Mehl 1974) this has been a necessary procedure in order to obtain relatively constant results (Hattingh *et al.* 1975). In the present study the haematological values of wild fish were studied, and in an effort to minimize the effects of "capture shock" relatively small numbers of animals were netted to overcome possible effects of overcrowding and asphyxiation in the nets, etc., and investigated as soon as they left the water. It is, however, not possible with the present means of seining fish to eliminate this effect altogether and as anaesthetization may influence the haematological parameters of these animals (Wedemeyer 1970; Sovio *et al.* 1974*b*), this method is probably the closest approximation to the normal situation. Laboratory acclimated animals are subjected to a lesser degree of stress due to the fact that they may be caught rapidly and individually for blood sampling. The effect, however, is probably still there and the inherent experimental error common to all groups of fish used has to be accepted.

The results obtained show that laboratory data cannot be assumed to apply to the situation in wild animals. Furthermore, it is now also apparent that the same species of fish taken from different "wild" localities yields different values for its haematological parameters. A very probable explanation of this observation lies in the fact that fish are very closely associated with their environment (Blaxhall 1972) and may thus show marked haematological variation depending on locality and on the characteristics of their medium. Such an eco-physiological approach to fish haematology has rarely been pursued in the past and should be seriously considered. This implies that when fish blood is obtained for analysis, the water from which the animals came should also be investigated. In addition the effects of laboratory acclimitization on fish haematology should be investigated. In this way it may be possible to correlate differences observed in blood parameters (as in this study), with different water compositions, etc. It has been shown in certain studies that temperature, salinity, oxygen tension, etc. influence haemoglobin concentration, haematocrit and other parameters (Farghally *et al.* 1973; Swift & Lloyd 1974; Sovio *et al.* 1974*a;* Zeitoun *et al.* 1974) but this knowledge has not been applied in an eco-physiological study. Once this has been done, the large variation in fish haematological results may be understood.

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