INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 2, NO. 2(2007); P. 124 – 126, 1TABLE, 1FIG.

Observations on the poor swimming performance among hatchery-reared catfish *Heterobranchus longifilis* (Val) bagriidae

I. Ewa-Oboho*[1], and G. Horstgen-Schwark[2]

ABSTRACT

The swimming performance, as judged by maximum sustained swimming speed, of African catfish, *Heterobranchus longifilis* (Val) from a fish farm near Port Harcourt, Nigeria was low when compared to previous published values for this species. This is ascribed to a localized peculiarity resulting from hatchery selection and rearing procedures.

INTRODUCTION

In a recent study on the gill damage on the swimming performance of African Catfish *Heterobranchus longifilis* (Duthie, 1992) maximum sustainable swimming speeds of control fish (no gill damage) seem low in comparison to majority of values in literature for this species. However values obtained by Nwadukwe (1995) are similar to those obtained by Ewa-oboho and Enyenihi (1999). In both studies fish were obtained from the same hatchery in ARAC (African Regional Aquaculture Center) Port Harcourt, Nigeria, possibly indicating a localized peculiarity in performance capability.

By measuring the swimming speed-oxygen consumption relationship in a respirometer (Beamish, 1985), the present study attempts to provide confirmation of low maximum sustainable speeds among this particular stock. A quantitative comparison between different studies has been made, values being allometrically adjusted to accommodate size related effect on swimming performance.

MATERIALS AND METHODS

African Catfish, *H.* longigilis (Mean ± S.D, length 30.1 ± 0.5cm, weight 278 ± 25g (N=58) obtained from two farms near Port Harcourt, Nigeria were maintained for at least one week prior to swimming trials in stock tanks in IOC farms, University of Calabar in which positioning of aerated water inflows generated a circular flow (8-10cms^{-1}) stimulating swimming activity. Fish were fed every other day with commercial trout pellet (Pinewoods Silver Cup) and weekly with locally compounded feed, trash and fish blood meal and starved for 48 hour prior to experimentation.

Water temperature was 23 ± 0.2^{0}C, and swimming trials were conducted at that temperature. Following light anesthesia (MS 222; 0.05gl^{-l}) fish were transferred to a respirometer and left overnight in a flow of 15cms^{-1}. The following morning, velocity increments of 0.2 body lengths per second ($1s^{-1}$) of 30 min duration were successively imposed until the fish was unable to remove itself from the retaining grid. Maximum sustainable speed (Ucrit) was calculated as described in Beamish, (1985), and corrected for solid blocking, (Webb, 1985).

Oxygen consumption ($V0_2$) was calculated from the difference between inlet and outlet 0_2 tension, replenishing waters flow rate and solubility coefficient (0.0853 at 23^{0}C). A correction for lag was applied (Nimi, 1978).

Swimming speed is related to length of fish, (Beamish, 1985). Therefore quantitative comparison of maximum sustainable speed (Ucrit) from the present study with published values necessitates allometric adjustment to a standard length. Values were adjusted to fish of 30cm using:

$$\text{Ucrit}(30) = \left(\frac{30}{L}\right) b \times \text{Ucrit (exp)}$$

where Ucrit (30 = adjusted speed (cms^{-1})

Ucrit (exp) = measured speed (cms^{-1})

L = length of fish (in cm) and

b = scaling factor for *Heterobranchus* of 0.6,(Fry, 1984)

*Corresponding author. Email: ita_ewa_oboho2005@yahoo.co.uk
Manuscript received by the Editor April 3, 2007; revised manuscript accepted August 21, 2007.
[1]Institute of Oceanography Marine Biology Department, University of Calabar, Calabar, Nigeria
[2]Institute of Animal Husbandry and Genetics, George-August University, Gottingen, Germany

RESULTS

Figure 1 shows the relationship between swimming speed and oxygen consumption in African catfish *Heterobranchus longifilis.*

U and $V0_2$ were closely related (Fig 1) and best-fitted by the relationship

Log $V0_2$ = 0.4U + 1.95 (r = 0.927, P < 0.001).

Ucrit was 1.58 ± 0.121^{s-1}, maximum oxygen consumption ($V0_2$ max) was 458 ± 62mg 0_2kg^{-1} h^{-1} and standard oxygen consumption ($V0_2$ stand) as calculated by regression extrapolation to zero, U was 92 ± 11mg 0_2kg^{-1} h^{-1}.

Table 1 summarizes known Ucrit (30) values for *Heterobranchus longifilis*. With the exception of studies carried out by Taege, (1988), that obtained in the present study is 35-48% lower than previously reported. The Ucrit (30) from the work of Taege, (1988) using fish from same locality as the present study is less than 12% higher.

Table 1. Ucrit (30) values for *Heterobranchus longifilis* calculated from cited sources

Ucrit (30) (cm/s^{-1})	Ucrit (30) (cm/s^{-1})	Source
3.61	109	Bash (1972)
3.29	95	Milleman (1986)
1.96	103	Taege (1988)
2.12	101	Okoro (1996)
3.09	135	Nodeme (1993)
1.56	98	Present study

DISCUSSION

Confirming the data of Taege, (1988) and the work of Okoro, (1996), this study emphasizes the relatively low performance capability of African catfish *Heterobranchus longifilis* from this particular hatchery. Slight variations in methodologies employed in studies of this kind, such as differences in magnitude and duration of velocity increments do not explain the discrepancy since Ucrit is apparently not affected by velocity increments between one fourth and one-ninth critical speed, or by time interval between 30-65 min range, (Nodeme, 1993). Further any temperature effect on swimming performance, (Brett, 1965), has been minimized by only considering studies conducted between 20-24^{0}C.

Despite the temporal separation between the present study and that of Taege, (1988), the similarity in Ucrit (30) values may indicate genealogical continuity of stock, but reticence by the fish farmers to impart information on past and present management practices precludes quantitative assessment. The reasons for the relatively poor performance is unknown and cannot immediately be explained. Limitations could stem from reduction in respiratory exchange capacity, reduced cardiac performance and/or reduction in uptake and utilization of oxygen and substrates by the tissues and impaired removal of metabolic products from the tissues. The paucity of studies that have simultaneously measured U and $V0_2$ for this species does not allow comparisons for $V0_2$ max and aerobic metabolic scopes, (Fry, 1984). Hence it is not possible to asses whether these catfish incur abnormal locomotory costs Ucrit of these catfish though fresh waters species, approaches that of marine flatfish generally regarded as poor sustained swimmers (Priede, and Holiday, 1980; Duthie, 1992, Duthic, 1986). Such a situation may have arisen through management practice.

Propagation through generations with minimal external gene input may encourage maladaptive trait persistence. For example cultivation of catfish at ARAC near Port Harcourt has occurred since 1959 and it is possible that inbreeding in this particular farm may have occurred soon after their introduction to the farm. Artificial selection favouring sedentary individual may occur in the belief that energy intake will be directed towards growth rather than wasted on activity. Cultivation in ponds with low flow rates may reduce overall activity levels, reducing activity of fatty acid oxidation enzyme (Duthic, 1986), in slow and fast muscle. (Johnstone, and Moon, 1980). Other abnormalities observed in this species though published else where include low haematocrit (Ofor, 1996), reduced pectoral fins and variation in growth leading to the appearance of jumping fish individuals, (Johnstone and Moon, 1980). Long-term hatchery selection procedures may have produced a stock with distinct localized characteristics.

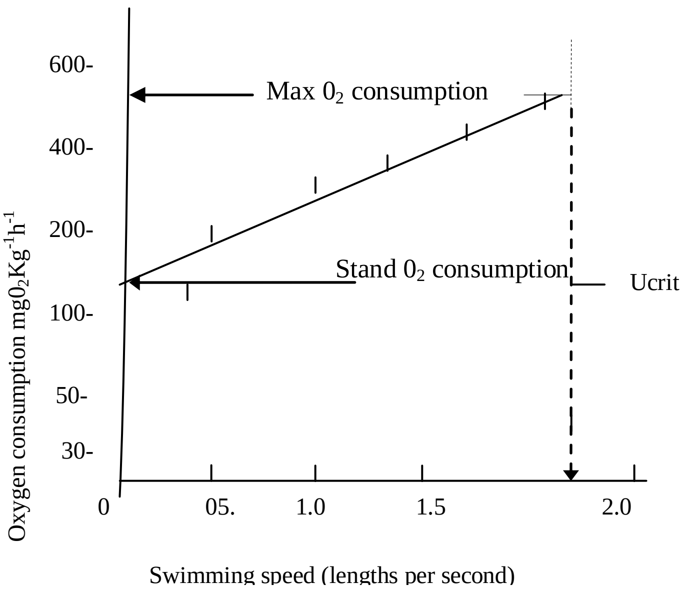

Fig. 1 Relationship between swimming speed and oxygen consumption for *Heterobranchus longifilis.*

CONCLUSION

The study observed that prolong hatchery selection procedure could generate *Heterobranchus longifilis* stock with distinct localized peculiarity. This could be averted by rearing stock from many localities by mass selection procedures.

REFERENCES

Bash, E.D. (1972). Oxygen consumption of African catfish *(Heterobranchus longifilis)* in relation to activity and salimity. *Can J. Zool.* 48:721-786.

Beamish, F.W.H. (1985). Swimming capacity. In: Fish Physiology,Volume 7(W.S. Hoar and D.T. randall, eds), Academic Press, New York. 161-187.

Brett, J. R. (1965). The relation of size to rate of oxygen consumption and sustained swimming of Sockeye Salmon *(Oncorhynchus nerka)*. J. *Fish Res.* 22:1491-1501).

Brett, J. R. and Glass N.R. (1973). Metabolic rates and critical swimming speeds of fish in relation to size and temperature. *J. Fish Res.* 30:379-387.

Brett, J.R. (1984). Respiratory metabolism and swimming performance of young catfish species *J.Fish Res.* 21:11885-1226.

Duthic, G.G. (1986). The respiratory metabolism of temperature – adapted flatfish at rest and during swimming activity and the use of anaerobic metabolism at moderate swimming speeds *J. exp. Biol*. 97:359-373.

Duthie, G.G. (1992). Swimming performance among hatchery bred rainbond trout Salmo gairdneri *J. Env. Biol. Fishes* 18: 309 – 311.

Ewa-Oboho, I.O. and Enyenihi, U.K.(1999). Aquaculture Implications of growth variation in the African catfish *Heterobranchus longifilis* (Val) reared under controlled condition J. *Appl. Ichthyol* 15:111 – 115.

Ewa-Oboho, I.O. and Enyenihi, U.K (2000). Genetics of size variation in the Juvenile African catfish *Heterobranchus longifilis* (Val) present in West Africa lentic systems. *J. Aqua Trop* 15: 391 - 404.

Fry, F.E.J. (1984). Effect of Environment on animal activity. University of Toronto Studies in Biology Series 55:1 – 62.

Johnstone, I.A. and Moon, T.W. (1980). Exercise training in skeletal muscle of bvrook trout (Salvenlinus frontinalis). *J. exp. Biol. 91* :177– 195.

Milleman, E.A.(1986) Brackish water catfish: A resource, its ecology, conservation and management. Oliver and Boyd, Edinburgh 351pp.

Nimi A.J. (1978). Lag adjustment between estimated and actual physiological responses conducted in flow through system. *J. Fish Res.* 35:1265 – 1269.

Nwadukwe F. (1995). Hatchery propagation of five hybrid groups by artificial hybridization of *Clarias gariepinus* (B) and *Heterobranchus longifilis* (Val) using dry powdered carp pituitary hormone, *J. Aqua Trop*. 10:1-11.

Nodeme, E.J. (1993). Preliminary results of swimming studies of five African species of subgenus Clariae. *J. Nat. History* 6:428 – 451.

Ofor, C. (1996) Seasonal changes in sexual maturity and fecundity of HCG-induce breeding of catfish, *Heterobranchus longifilis* (Val) Clariidae reared in controlled pond. Ph.D Thesis, University of , Calabar , Nigeria 126pp.

Okoro, C. (1996). Studies on activities of African catfish *Heterobranchus longifilis* (Val) under controlled conditions. Technical paper No. 6. ARAC.

Priede, I.G. and Holiday, F.G.T. (1980). The use of new tiling tunnel respiratory to investigate some aspects of metabolism and swimming activity of the plaice. *J. exp*. Mar Biol. 82:295-309.

Teage, M. (1988). Swimming performance among African catfish Species. *Env. Biol. Fish* 12:402 – 410.

Webb, P. W. (1985). The swimming energetic of trout 11. oxygen consumption and swimming efficiency. *J. Exp. Biol.* 55:521 – 540.