REVIEW PAPER

Breaking wind to survive: fishes that breathe air with their gut

J. A. Nelson

D . . B . S . , , , MD 21252-0001, .S.A.

EVOLUTION OF AIR BREATHING IN FISHES
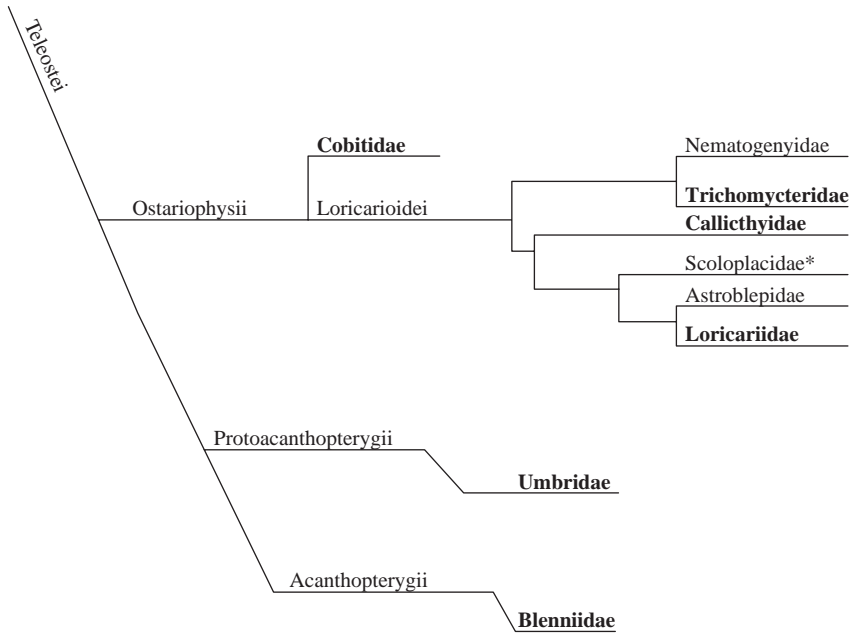
ABLE

Teleostei

Ostariophysii

Cobitidae

Loricarioidei

Nematogenyidae

Trichomycteridae

Callicthyidae

Scoloplacidae*

Astroblepidae

Loricariidae

Protoacanthopterygii

Umbridae

Acanthopterygii

Blenniidae

FIG. 1. [illegible caption text] (…, 2009).

[Several paragraphs of body text are illegible.]
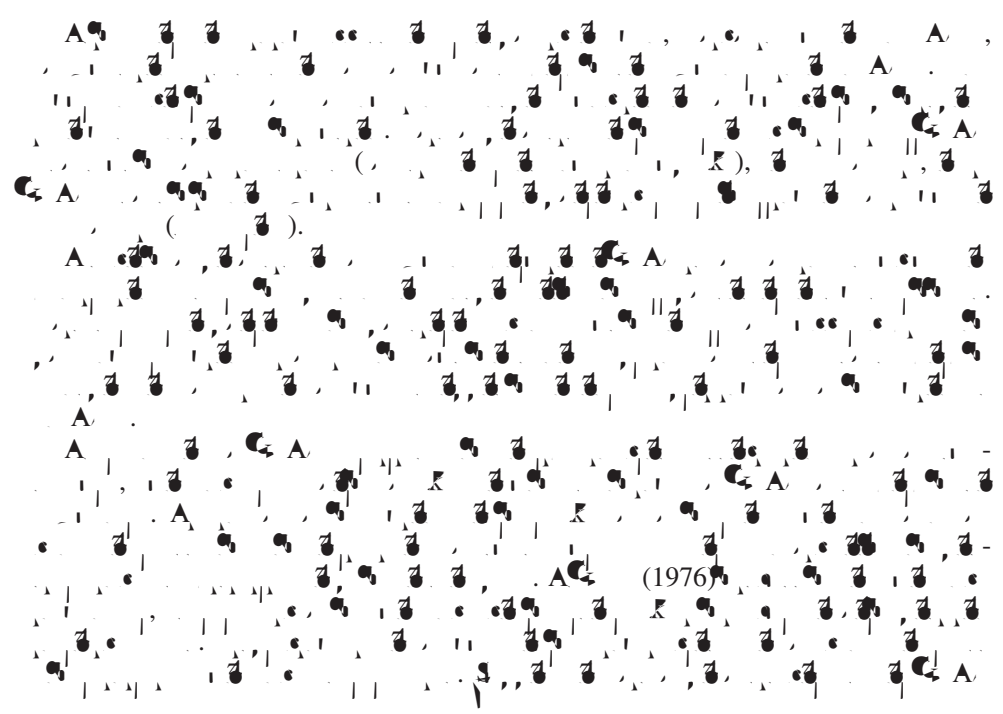
. A… (1976) …

MORPHOLOGICAL INDICATORS OF THE GUT AS AN ABO

FIG. 2.

(3)

(4)

(5)

(1971, 1974) (1982; 1988)

1880,

(1974)

<1

1766 (1758) (1971;

(1974).

(1758), (1982),

(1982)

ABLE ... (... & ... , 2011)

	D ...	$<1\,\mu$		... (1971)
	A ...	$0{\cdot}6\,\mu$	$7/100\,\mu$	... (1998)
	H ...	$0{\cdot}25\,2{\cdot}02\,\mu$; $= 0{\cdot}86 \pm 0{\cdot}00\,\mu$ $\pm$ S.E.	$3\,4\,100\,\mu^{-1}$	... & ... (2003)
	P ...	$= 0{\cdot}40\,0{\cdot}74\,\mu$; $= 1{\cdot}52 \pm 0{\cdot}07\,\mu$ $\pm$ S.E.		... (2009)
...	H ...	$1\,2\,\mu$		... & ... (1978)
	C ...	$0{\cdot}24\,3{\cdot}00\,\mu$		... & ... $1\,2\,\mu$ (200296-1.1 ...)

8

, 1997, 2011).

(A)

2.

A

(;),

(P_2)

(50) , 1979, , 1997; M ., 1999). A , 1983, 1985; & , 1983; ., 1990),

A .((1979) M & (1994)

A (., 1979; ., 1979; /., 1984). H'(/., 2004). L A (. 2). A 1976; & , 1986; , 2011).

& A..., A. A. (2001). ... J ... F B 58, 832 847.

H... & C... (1980). ... (A..., M. A., ...), ... 7. 32. ... E ... P ...

H... , F. & ... C... (1978). H... ... H ... (...). J ... M ... **157,** 301 328.

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..... ,...., ..., .../ .... / .... / ...... / ..../ .... /
....., ..., ... & ,...., ...(2011). *F.... B/..........*