Fish Physiology and Genetics in FishBase

FishBase

Contents

1. Fish physiology

2. Genetics

1. FISH PHYSIOLOGY

- In FishBase, fish physiology is covered by 7 different tables:

1. VISION

2. BRAINS

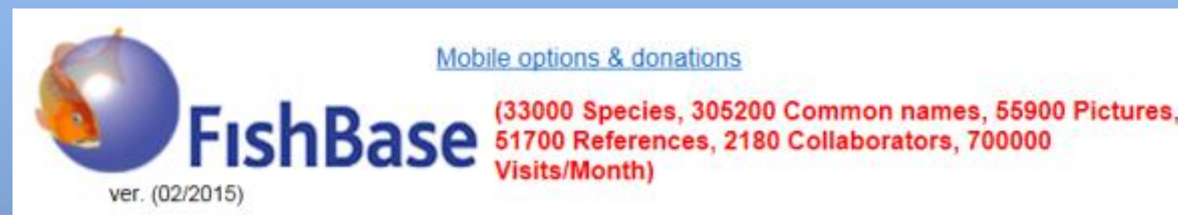
3. METABOLISM

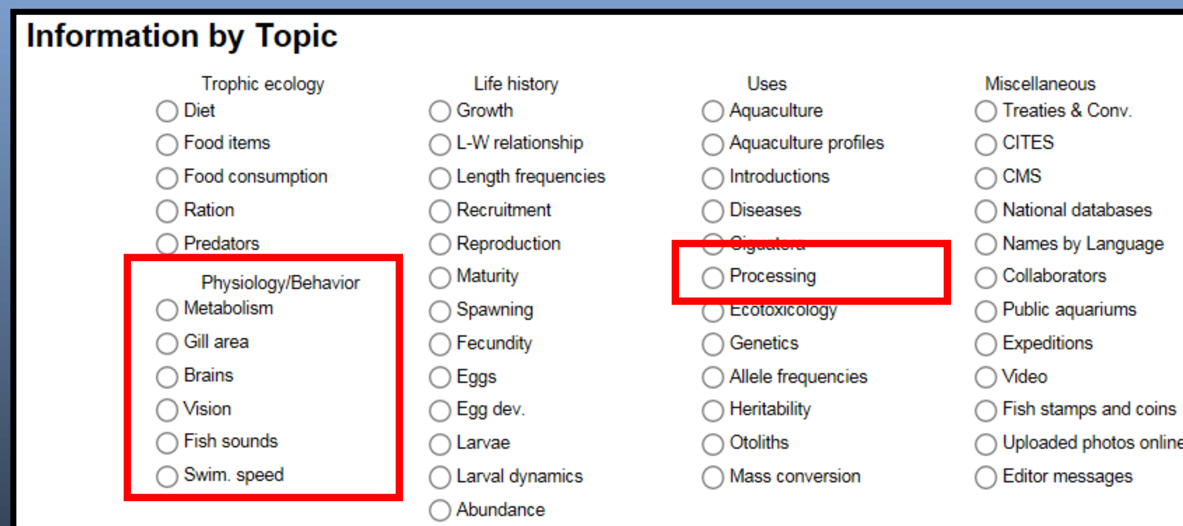
4. SWIMMING TYPE and SPEED

5. GILL AREA

6. SOUNDS

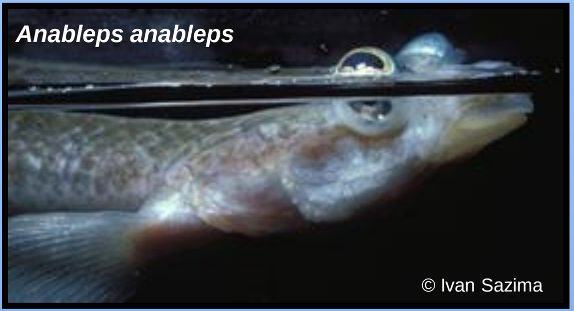
7. (PROCESSING)

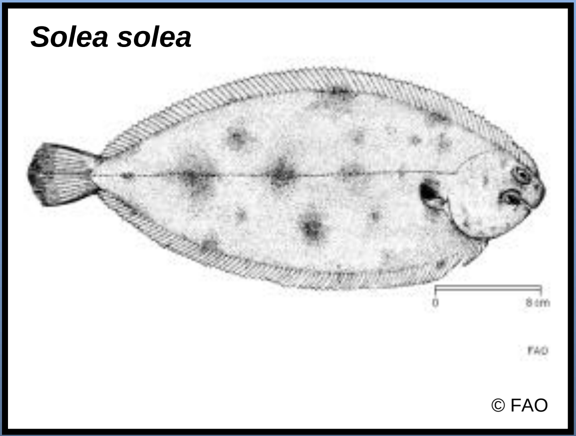


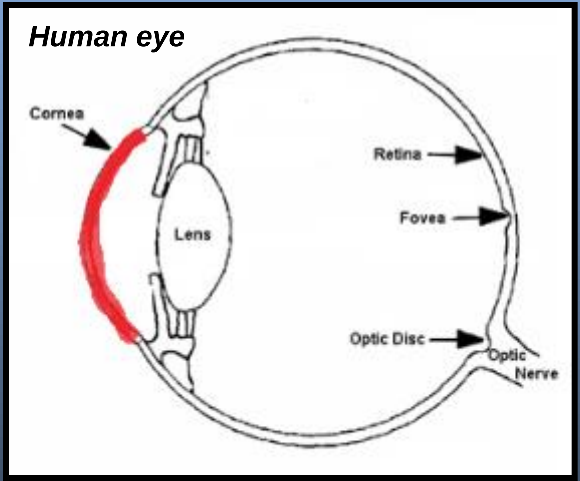


1.1. VISION

- fish have fairly complex **« camera-type » eyes**
- their eyes need to be highly developed: many are **sight-feeders** rather than smell-feeders
- adaptations to habitat
- fish have a more spherical **lense** and flattened **cornea** compared to terrestrial animals







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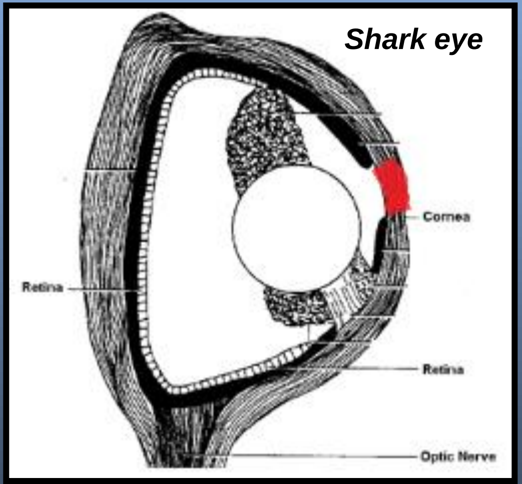

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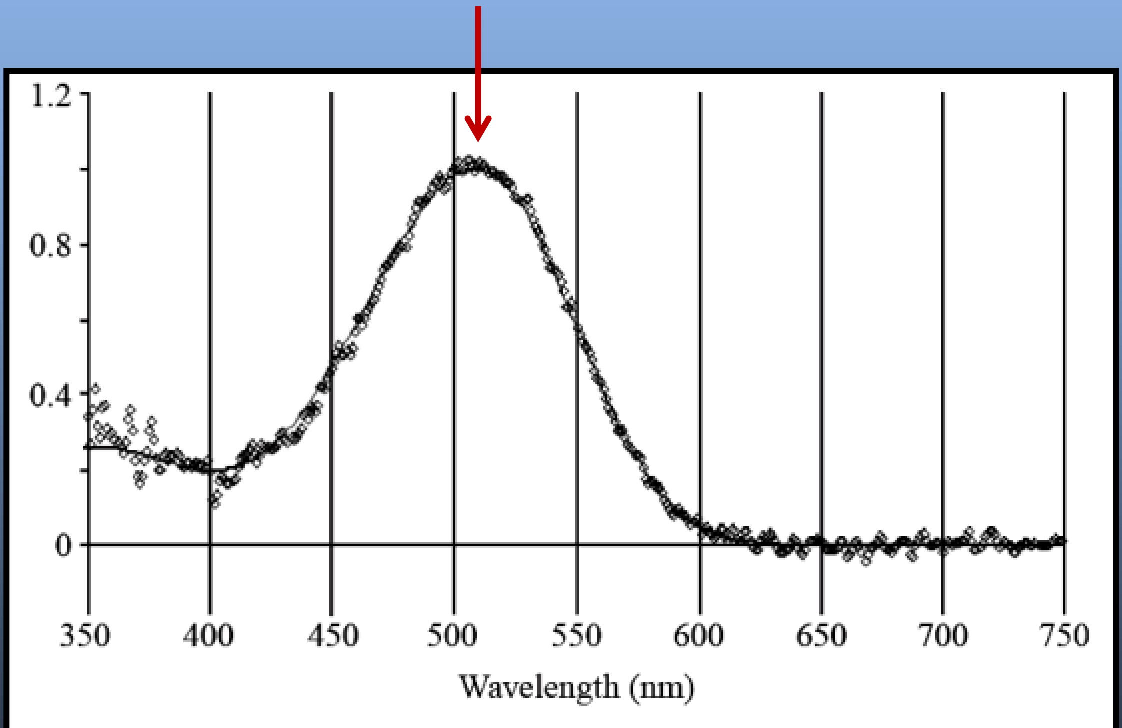
1.1. VISION

- water deeper than 15 meters acts as an optical filter excluding most infrared and ultraviolet light

  ➔ less need for fish to have an extended color vision

- the **sensitivity** of a fish eye is maximal at a certain wavelength (λ_{max}). This value and its 95 % confidence interval are the essential entries for the Vision Table in **FishBase**



(Shand *et al.* 1998, modified)

1.1. VISION

Search Page → **Species Summary Page**

Information by Topic

Trophic ecology	Life history	Uses	Miscellaneous
◯ Diet	◯ Growth	◯ Aquaculture	◯ Treaties & Conv.
◯ Food items	◯ L-W relationship	◯ Aquaculture profiles	◯ CITES
◯ Food consumption	◯ Length frequencies	◯ Introductions	◯ CMS
◯ Ration	◯ Recruitment	◯ Diseases	◯ National databases
◯ Predators	◯ Reproduction	◯ Ciguatera	◯ Names by Language
Physiology/Behavior	◯ Maturity	◯ Processing	◯ Collaborators
◯ Metabolism	◯ Spawning	◯ Ecotoxicology	◯ Public aquariums
◯ Gill area	◯ Fecundity	◯ Genetics	◯ Expeditions
◯ Brains	◯ Eggs	◯ Allele frequencies	◯ Video
◯ Vision	◯ Egg dev.	◯ Heritability	◯ Fish stamps and coins
◯ Fish sounds	◯ Larvae	◯ Otoliths	◯ Uploaded photos online
◯ Swim. speed	◯ Larval dynamics	◯ Mass conversion	◯ Editor messages
	◯ Abundance		

Acaronia nassa (Heckel, 1840)
Bigeye cichlid

Upload your photos and videos
Pictures | Google image

Acaronia nassa
Picture by Hippocampus-Bildarchiv

Add your observation in Fish Watcher
Native range | All suitable habitat | PointMap

This map was computer-generated and has not yet been reviewed.

More information

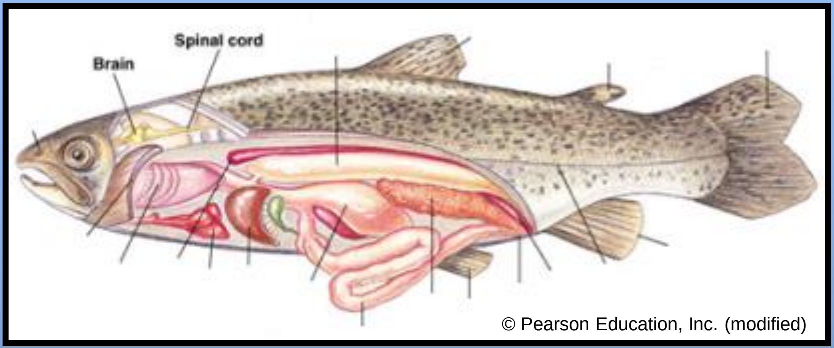
Countries	Common names	Age/Size	References	Collaborators
FAO areas	Synonyms	Growth	Aquaculture	Pictures
Ecosystems	Metabolism	Length-weight	Aquaculture profile	Stamps, Coins
Occurrences	Predators	Length-length	Strains	Sounds
Introductions	Ecotoxicology	Length-frequencies	Genetics	Ciguatera
Stocks	Reproduction	Morphometrics	Allele frequencies	Speed
Ecology	Maturity	Morphology	Heritability	Swim. type
Diet	Spawning	Larvae	Diseases	Gill area
Food items	Fecundity	Larval dynamics	Processing	Otoliths
Food consumption	Eggs	Recruitment	Mass conversion	Brains
Ration	Egg development	Abundance	Vision	

Vision of Acaronia nassa

Main ref.	Ali, M.A. and H.-J. Wagner 1975		
Maximum sensitivity	507.90	Data ref.	Munz, W.R.A. 1973
Confidence interval			
Other pigment(s) present	☐		
Remarks	Ratio: 68.2% A1.		

1.2. BRAINS

- most fishes have **small brains**, at least when compared to warm-blooded vertebrates



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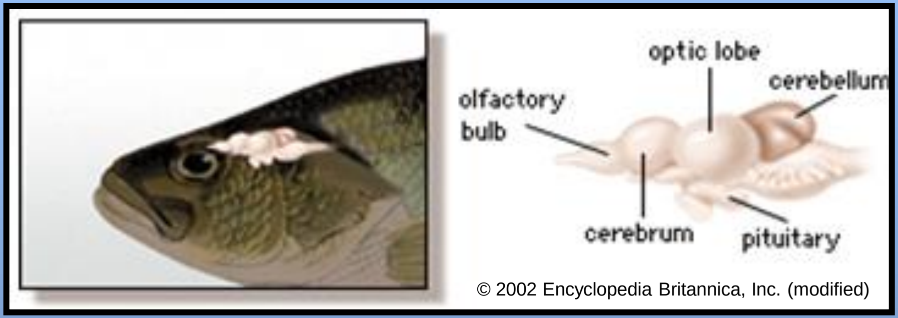

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- fish have evolved the brain size they need; difference in brain size between species of fish can be used to draw inferences on their ‘needs’ (i.e. on their niche) and behavior

- Roland **Bauchot** and his collaborators developed a brain size database (Bauchot and Bauchot 1986; Bauchot *et al.* 1989)
  - because juveniles have larger brain relative to body weight than adults, it was mostly **adult fishes** which were used for comparative studies
  - available in **FishBase**

Environmental Biology of Fishes Vol. 25, No. 1–3, pp. 205–219, 1989
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The brain organization of butterflyfishes

Roland Bauchot[1], Jean-Marc Ridet[1] & Marie-Louise Bauchot[2]
[1] *Laboratoire d'Anatomie Comparée, Université Paris 7, 2 Place Jussieu, 75251 Paris Cedex 05, France*
[2] *Laboratoire d'Ichthyologie générale et appliquée, Muséum National d'Histoire Naturelle, 23 rue Cuvier, 75231 Paris Cedex 05, France*

1.2. BRAINS

Search Page

Species Summary Page

Relationships between fish brain weights and body weights for *Scorpaena scrofa*

Roland Bauchot, Monique Diagne, Roland Platel, Jean-Marc Ridet and Marie-Louise Bauchot
Universit� Paris 7 Laboratoire d'anatomie compar�e

[n = 4]

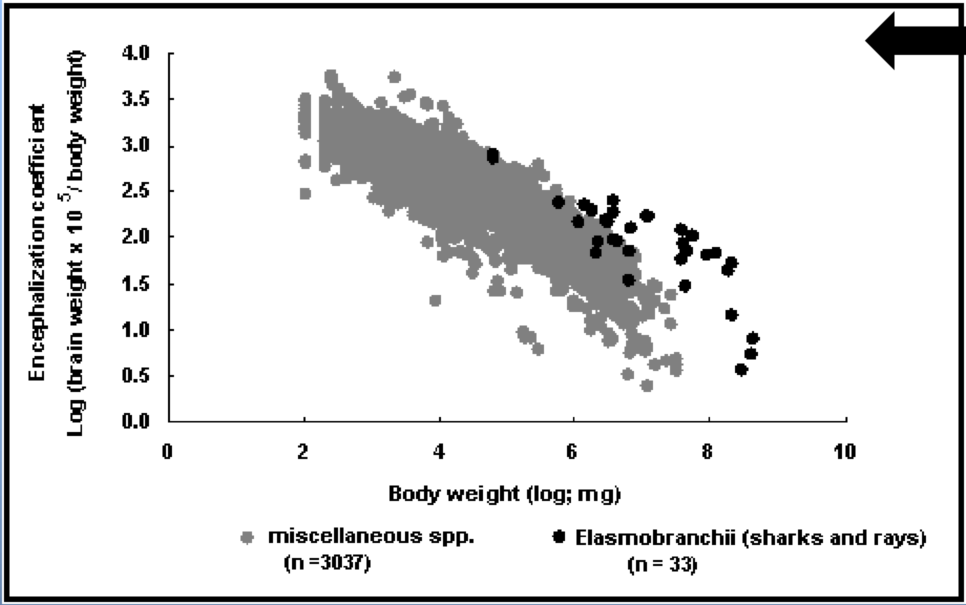
Sort by : Body weight Brain weight SL TL Ref.

Relative brain weight graph (loading may take 2-3 min.)

Body weight (W; g)	Brain weight (B; mg)	Encephalization coefficients		SL (cm)	TL (cm)	Ref
		(B/W)	(B/W^2/3)			
130	105	0.8080		15.3	19	
185	125	0.6760		17.8	22.3	
240	155	0.6460		19.8	24.8	
620	170	0.2740		25.7	32	

Second encephalization coefficient, standardizing for body weight

1.2. BRAINS



Relationship between relative brain weight and body weight

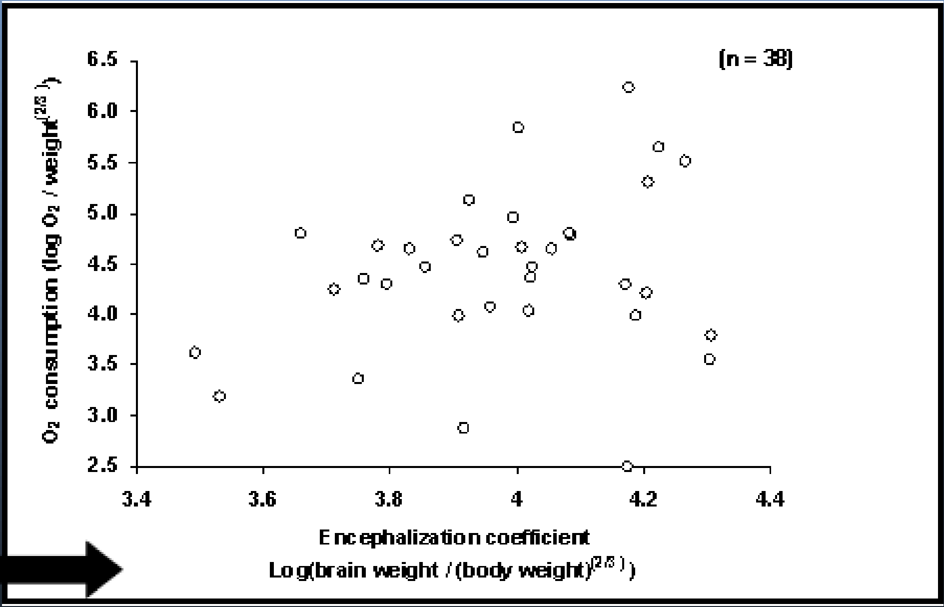
Grey dots: data from different species in FishBase

Black dots: data for sharks and rays, which have large brains, possibly to support their electro sensing ability.

The 6 dots below the cloud belong to lampreys.

Petromyzon marinus

© Edmonson and Chrisp



This table shows that large brains require more oxygen, and are therefore common in more active fish with higher metabolic rates.

1.3. METABOLISM

Search Page → **Species Summary Page**

Metabolic rate is usually measured by the rate of respiration, i.e. the rate of **oxygen consumption**.

Useful information for fish culture and fishery management a.o.

Documents the oxygen consumption of species, based on experiments published in literature. 7,000 records for over 300 species

Oxygen Consumption Studies for ***Oreochromis niloticus***

n = 52

Relative oxygen consumption graph (loading may take 2-3 mins.)

Oxygen consumption (mg/kg/h)	at 20°C	Weight (g)	Temperature (°C)	Salinity	Activity	Applied stress
46	30.4	228.00	25.0	0	routine	hypoxia
52	34.1	144.70	25.0	0	routine	hypoxia
53	34.9	195.00	25.0	0	routine	hypoxia
53	34.9	229.30	25.0	0	routine	hypoxia
53	35.3	250.30	25.0	0	routine	hypoxia
56	37.2	203.10	25.0	0	routine	hypoxia
57	34.7	310.00	26.0	0	standard	none specified
73	48.2	80.40	25.0	0	routine	hypoxia
81	53.4	39.60	25.0	0	routine	hypoxia
88	58.2	101.40	25.0	0	routine	hypoxia
93	61.5	77.00	25.0	0	routine	none specified
94	57.4	310.00	26.0	0	routine	none specified
94	62.4	47.00	25.0		standard	none specified
104	68.5	30.00	25.0	0	routine	hypoxia
104	68.8	80.00	25.0	0	standard	none specified
107	70.9	23.50	25.0	0	routine	hypoxia
111	49.4	310.00	30.0	0	standard	temperature
112	74.3	28.00	25.0	0	routine	hypoxia
118		310.00	35.0	0	standard	temperature
122	80.8	29.90	25.0	0	routine	hypoxia
123	81.4	16.60	25.0	0	routine	hypoxia
124	81.7	22.80	25.0	0	routine	hypoxia
134	88.7	80.00	25.0	0	standard	none specified
135		310.00	35.0	0	routine	temperature
142	94.2	9.50	25.0	0	routine	hypoxia
143	63.3	310.00	30.0	0	routine	temperature
156	103.1	17.10	25.0	0	routine	hypoxia
173	114.5	83.89	25.0	12	routine	none specified
186	123.0	9.20	25.0	0	routine	hypoxia
199	131.7	82.66	25.0	23	routine	none specified
214	141.6	83.89	25.0	12	routine	none specified
219	144.9	88.84	25.0	8	routine	none specified
220	145.6	77.10	25.0	0	routine	none specified
246	162.7	2.10	25.0	0	routine	hypoxia

1.3. METABOLISM

- available are the factors known or likely to affect the metabolic rate: body weight, temperature, salinity, oxygen concentrations, activity level, swimming speed, applied stress, …

Oxygen Consumption Studies Summary for *Oreochromis niloticus*

Main Ref.	Becker, K. and L. Fishelson, 1986
Species (OXYREF)	Oreochromis niloticus Ref. Becker, K. and L. Fishelson, 1986
Weight (g)	310.0
Sex	unsexed
Number	4
Temperature (°C)	30.0
Salinity (ppm)	0
100% oxygen (mg/l)	
Oxygen	
Saturation %	
Oxygen consumption (mg/kg/h)	111.4
at 20�C (mg/kg/h)	49.4
Activity level	standard
Applied stress	temperature
Swimming speed (BL/s)	
Comments	

1.3. METABOLISM

- ***Oxygen*** = O_2 concentration of the test water (mg/l)
- ***Saturation*** = actual oxygen concentration of the test water as percent of the maximum possible oxygen content.
- ***Activity level* =** standard (resting fish), routine (spontaneously active fish) and active (swimming fish)

Oxygen Consumption Studies Summary for *Oreochromis niloticus*

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Activity level	standard
Applied stress	temperature
Swimming speed (BL/s)	
Comments	

1.3. METABOLISM

- ***Applied stress*** = pertains to stress applied before or during an experiment (none specified, temperature, photoperiod, feeding, starvation, toxins, hypoxia, hypercapnia, (changes in) salinity, high or low pH, sedative, transport and other stress

- ***Swimming speed*** = another index of activity; reported as/converted to BL/s (BL = fork length or total length)

Oxygen Consumption Studies Summary for *Oreochromis niloticus*

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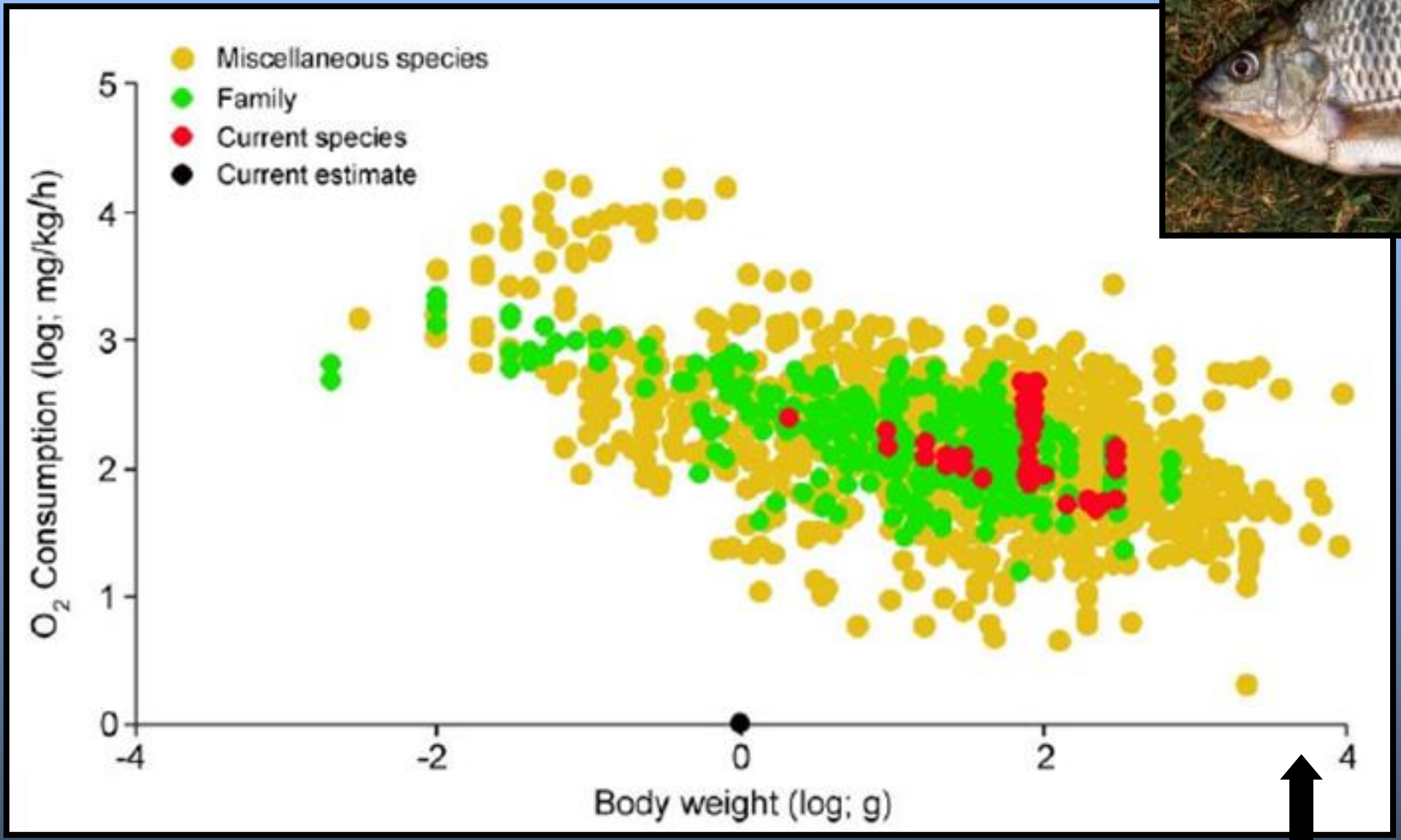
Swimming speed (BL/s)	
Comments	

1.3. METABOLISM



Relative oxygen consumption of *Oreochromis niloticus* (**red**) compared with miscellaneous species (**orange**). Note the relatively straight descending line and the vertical series of values cause by stresses applied.

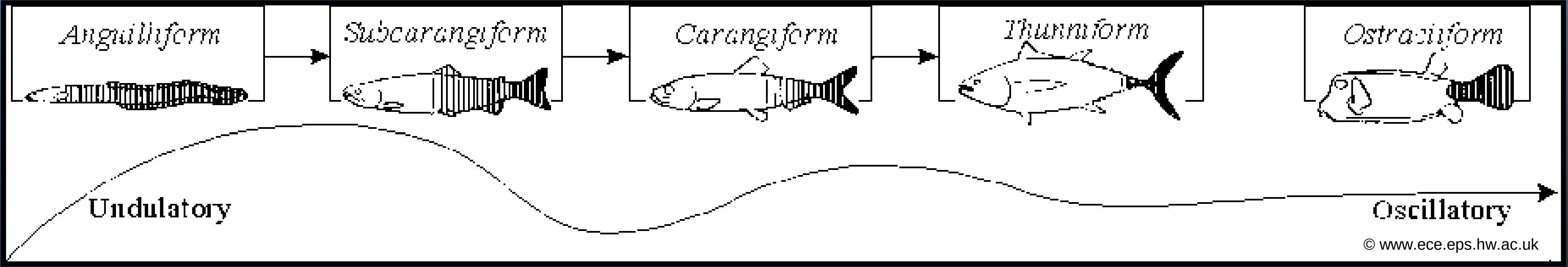
1.4. SWIMMING MODE and SPEED

- The classification of swimming modes of fish consists of two levels (Lindsey 1978):
  - the first (Roman numerals) describe what may be called as the swimming "***type***"
  - the second (bullets) describe the swimming "***mode***" proper

I. Movements of the body and/or caudal fin:

- Anguilliform
- Subcarangiform
- Carangiform
- Thunniform
- Ostraciiform

The modes in I imply a gradual transition from **undulation** of the **entire body** (including trunk) being used for propulsion to propulsive forces being generated only by **oscillating caudal fin.**



1.4. SWIMMING MODE and SPEED

II. Undulation of median or pectoral fins:

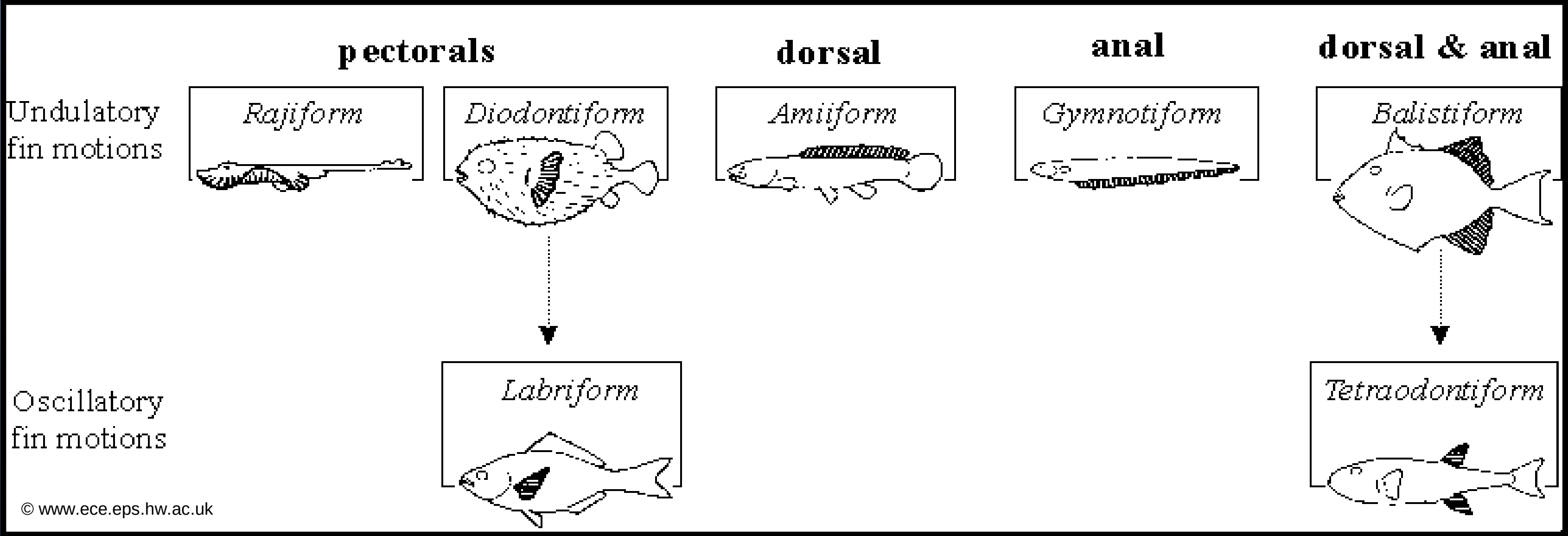
- Amiiform
- Gymnotiform
- Balistiform
- Rajiform
- Diodontiform

III. Oscillations of median or pectoral fins:

- Tetraodontiform
- Labriform

Ranking of modes in I and II to III implies gradual transition from **undulations to oscillations** as the movements generating major propulsive force.

Fish may have two swimming modes!



1.4. SWIMMING MODE and SPEED

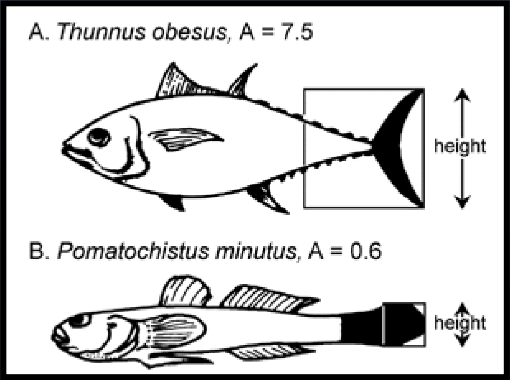
- note that this table presently pertains only to juvenile and adult fish; fish larvae have limited repertoire of swimming types and modes

Species Summary Page

Swimming mode for *Esox lucius*

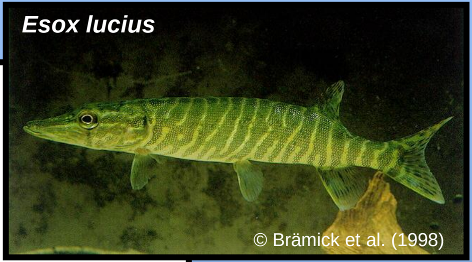
Main ref.	9574				
Swimming type	undulation of median or pectoral fins	Swimming mode	diodontiform	Ref.	
Aspect ration of caudal fin	1.5			Ref.	12676
Comments					

- the aspect ratio of the caudal fin closely correlates with its average level of activity (Pauly 1989)
- it is calculated from **A = h²/s**, where **h** = height of caudal fin and **s** = its surface area



1.4. SWIMMING MODE and SPEED

Search Page → **Species Summary Page**



Swimming speeds of *Esox lucius*

[n = 6]

Sort by : Speed (m/s) (Lengths/s) Mode Length type Length

Speed (m/s)	(Lengths/s)	Mode	Length type	Length
1.44	3.9	sustained	TL	37
1.47	7.37	burst	SL	20
1.5	7.5	burst	TL	20
2.03	12.7	burst	TL	16
2.08	13	burst	SL	16
2.86	6.5	burst	SL	44

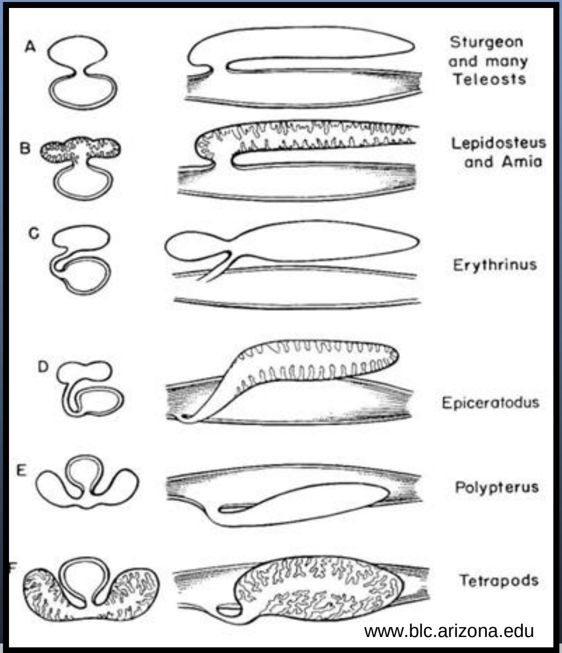
Swimming speed for *Esox lucius*

Main ref.	Bainbridge, R. 1958
Data Ref.	
Length (cm)	16 TL
Speed (m/s)	2.032
Speed (L/s)	12.7
Comments	

- mode = describes mode of swimming as sustained, burst or other
- transformation to SL/s and m/s allows comparison

1.5. GILL AREA

- this table presents measurements of the **gill area** in fishes so far published
- ***Gill area*** = surface area that limits the oxygen intake and hence the metabolic rate and growth rate of fishes
- species-specific differences in gill area can be related to swimming mode, activity level (caudal fin aspect ration), …
- some species have air breathing organs allowing to take oxygen directly from the air (intestine, lung-like structures, modified gas bladders, …)



1.5. GILL AREA

Search Page → **Species Summary Page**

Relative gill area studies for *Oreochromis niloticus niloticus*

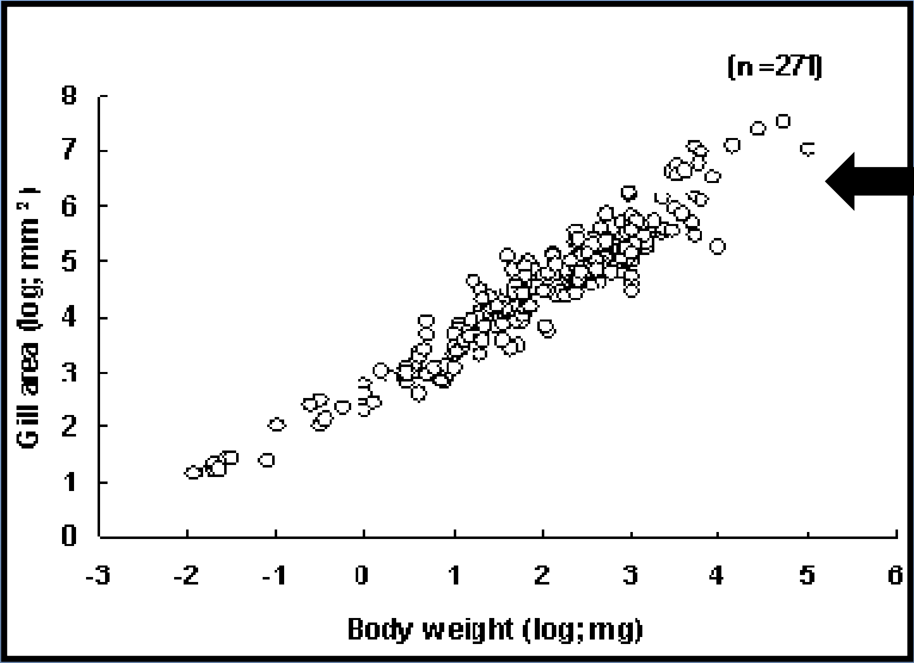
Gill area vs body weight graph (loading may take 2-3 min.) [n=1]

Body weight	Gill area	Gill area / weight	Ref.	Blood/water distance	Ref.
(g)	(cm^2)	(cm^2/g)		(µm)	
1000.00000	1024.83997	1.02			

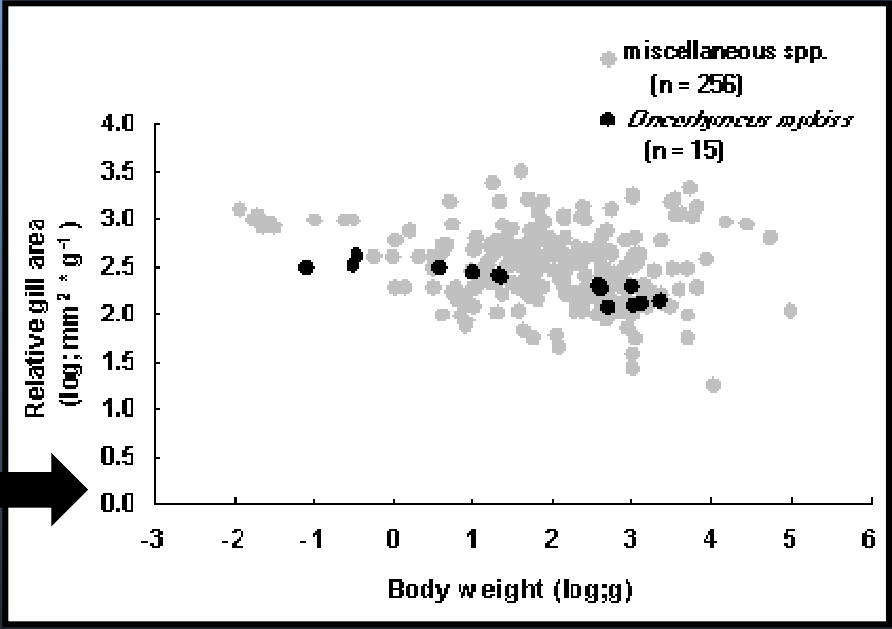
Gill Area Summary for *Oreochromis niloticus*

Main Ref:	Narcisco Fernandes, M., 1996
Body weight (g):	1000.00000
Gill area (cm□):	1024.83997
Gill area / weight (cm□/g):	1.02
Blood/water distance (□m):	
Comment:	
Entered by: *Froese, Rainer* ***- 18.12.98***	**Back to Search**

1.5. GILL AREA



Gill area in fishes increases with body weight; slope of log-log plot is less than 1 which implies that relative gill area must decrease with body size. This is shown in the graph below.

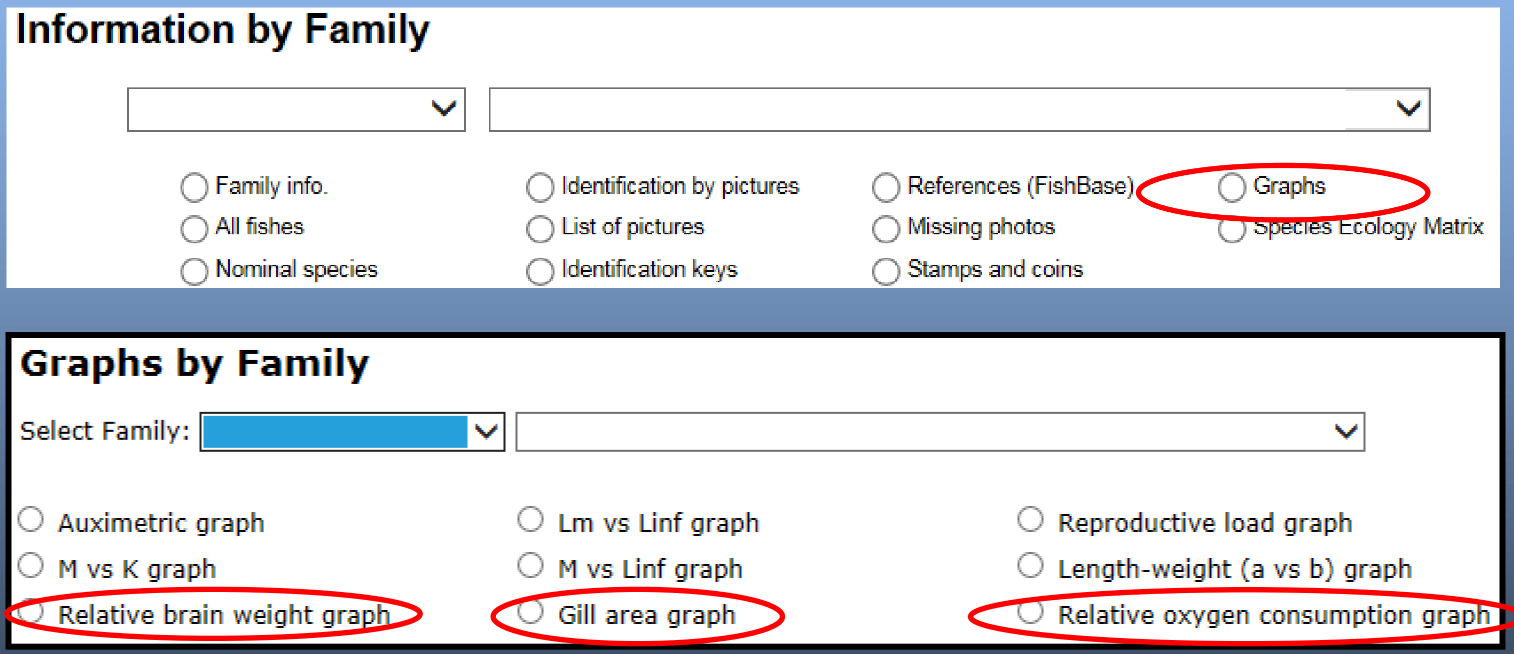


This log-log plot show that the relative gill area declines with body weight, with a slope of about -0.2.

1.5. GILL AREA

- selecting “**Graphs**” in the “Information by Family” section of the Search Page allows the user to create Relative brain weight, Gill Area and Relative oxygen consumption graphs for different families

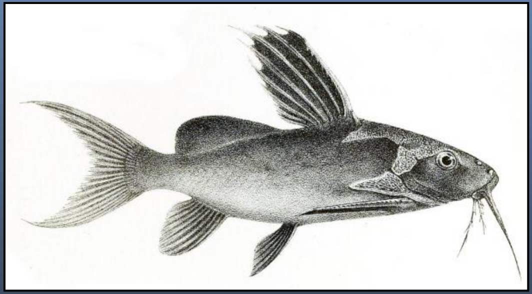
Search Page



1.6. SOUNDS

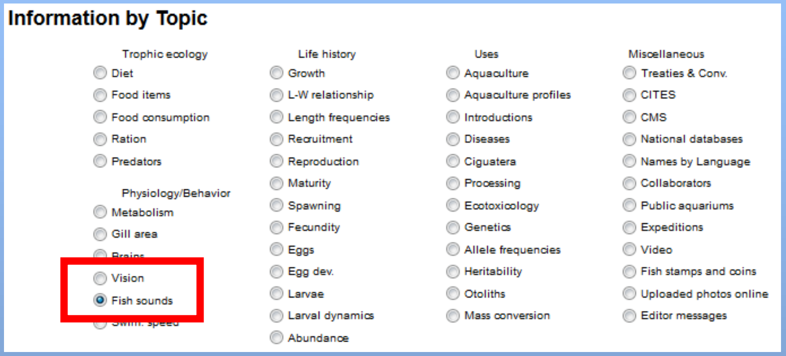
- sounds are ideal for animals to communicate in water. Fishes produce sounds in **different behavioral contexts**:
    - intraspecific competition, territorial behavior, …
    - mating
    - foraging
    - …
- sounds can be produced **passively** (‘mechanical sounds’, byproducts of foraging, moving, ….) or **actively** (‘biological sounds’, using organs initially developed to perform other functions)
- fishes can make different **types of sounds**:
    - grunts
    - croaks
    - clicks
    - snaps
- fish sounds are produced by:
    - rubbing or striking together skeletal components or teeth *(stridulating)*
    - using muscles (sonic muscles) on or near swim bladder *(drumming)*
    - quickly changing speed and direction while swimming *(hydrodynamics)*

Synodontis melanopterus



1.6. SOUNDS

Search Page


Information by Topic

Trophic ecology	Life history	Uses	Miscellaneous
Diet	Growth	Aquaculture	Treaties & Conv.
Food items	L-W relationship	Aquaculture profiles	CITES
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Vision	Egg dev.	Heritability	Fish stamps and coins
Fish sounds	Larvae	Otoliths	Uploaded photos online
Swim. speed	Larval dynamics	Mass conversion	Editor messages
	Abundance		

Sounds available for 90 fish species

Species Summary Page

List of Sound for *Caranx hippos*

n = 2

Main Ref.	Sound File	Type	Production
35830	CAHIP_S1	grunts	yes, active sound production
35830	CAHIP_S2	croaks	yes, active sound production

1.6. SOUNDS

Sounds Made by ***Caranx hippos***

Picture by Carvalho Filho, A.

Please be patient while sound file is loaded. You may have to increase volume settings.

If you did not hear the sound. Click here to download sound file.

Sound produced	yes, active sound production
Type of sound produced	croaks
Sound production organ	teeth & swim bladder
Sound mechanism	stridulation of well-toothed mouth reinforced by large swim bladder
Behavioural context	spontaneous, sustained croaking during capture in net, sounds easily stimulated with mild manual stimulation (continued production even out of water)
Reference	Fish, M.P. and W.H. Mowbray, 1970
Remark	

Synodontis squeaking

https://www.youtube.com/watch?v=Z0P3rNl0FeI

1.7. PROCESSING

- this table is an attempt to incorporate fish as a consumable product in FishBase

Search Page → **Species Summary Page**

Proxims for *Scomber scombrus*

Sort by : ◉ Country ○ Locality ○ Ref

Country	Locality	
(Not available)	Georges Bank, Sable	
(Not available) ←	Gulf of Mexico	[illegible]
(Not available)	North American coast	4883
(Not available)	Patagonian shelf	4883
(Not available)	Strait of La Manche and North Sea	4883
(Not available)	Not specified	9988

1.7. PROCESSING

Proximate Analysis of Scomber scombrus

Mainly from V.P. Bykov (1983, Ref. 4883)

Main ref.	Bykov, V.P., 1983
Country	
Locality	Patagonian shelf
Remark	The meat of this mackerel is soft and tasty. Depending upon the fat content of the fish, taste properties vary from satisfactory to good. Canned and smoked products should be made from this mackerel.
Weight proportions	
Chemical composition	

Body parts	Moisture %	Protein %	Fat %	Ash %
Meat/Fillet	73.3 - 0	24.2 - 0	0.9 - 0	1.6 - 0
Liver	60.4 - 71.8	17.7 - 19.4	5.5 - 16.4	1.3 - 2
Roe	72.1 - 80.3	19.1 - 0	0.6 - 5.1	1.6 - 0
Viscera	73.2 - 79.1	13.4 - 14	4.2 - 7.9	2 - 2.3
Head/bone/fins	89.6 - 97.1	19.9 - 24.5	21.5 - 29.5	7.3 - 8.2
Waste/offal	0 - 0	0 - 0	0 - 0	0 - 0

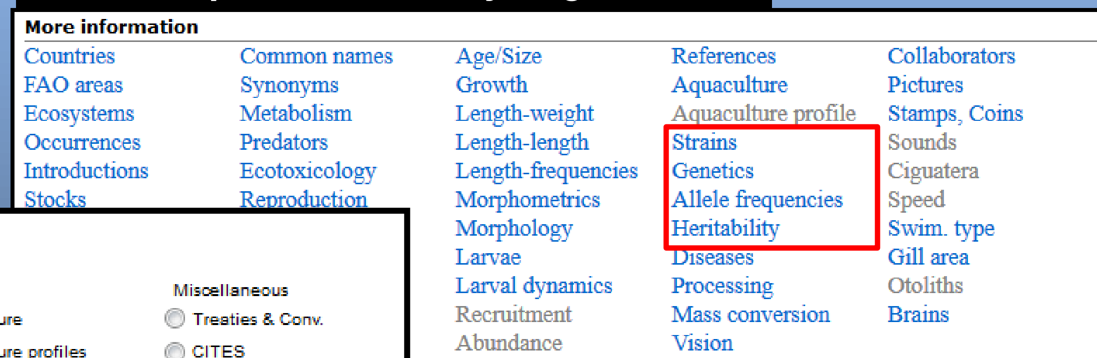
Comment	

2. GENETICS

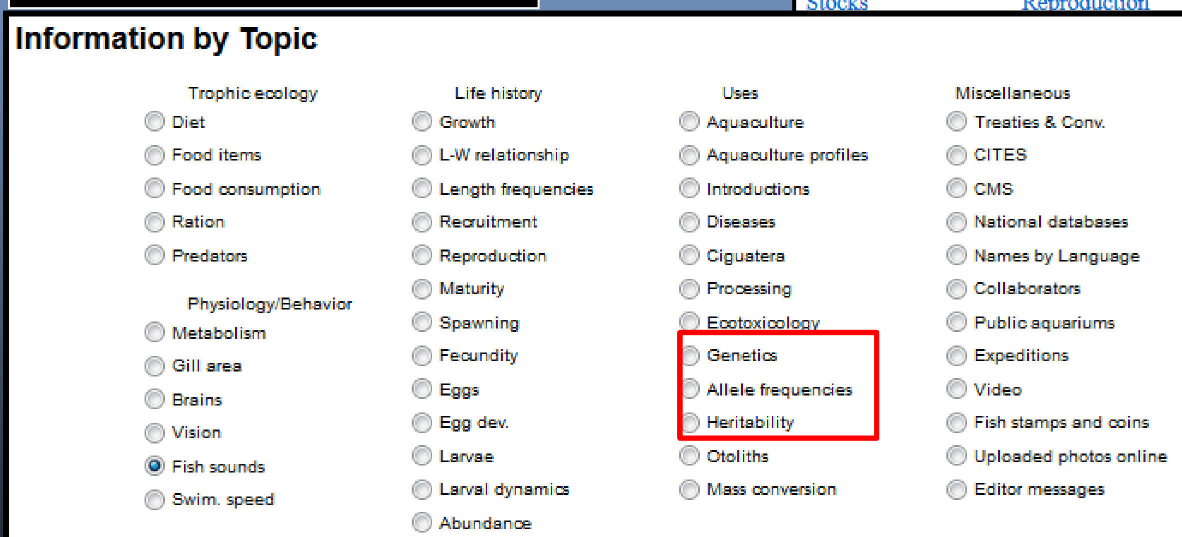
- Fish genetics is covered by 4 main tables in FishBase:

1. **GENETICS**
2. **ALELLE FREQUENCIES**
3. **HERITABILITY**
4. **STRAINS**

Species Summary Page



Search Page



2.1. GENETICS

- this table contains karyological and cellular DNA content data, important for studies of the genetics and systematics of fishes

Search Page

Genetics Records

(1 to 500 of 2,595)

Show all records

<< < 1 2 3 4 5 6 > >>

Species	English name	Family
Abbottina rivularis	Chinese false gudgeon	Cyprinidae
Abramis brama	Freshwater bream	Cyprinidae
Abramites hypselonotus	Marbled headstander	Anostomidae
Abudefduf notatus	Yellowtail sergeant	Pomacentridae
Abudefduf saxatilis	Sergeant-major	Pomacentridae
Abudefduf sexfasciatus	Scissortail sergeant	Pomacentridae
Abudefduf sordidus	Blackspot sergeant	Pomacentridae
Abudefduf vaigiensis	Indo-Pacific sergeant	Pomacentridae
Abyssocottus korotneffi		Abyssocottidae
Acantharchus pomotis	Mud sunfish	Centrarchidae
Acanthocobitis botia	Mottled loach	Nemacheilidae
Acanthodoras spinosissimus	Talking catfish	Doradidae
Acanthogobius flavimanus	Yellowfin goby	Gobiidae
Acanthogobius lactipes		Gobiidae
Acanthopagrus latus	Yellowfin seabream	Sparidae

Species Summary Page

Genetics Records for Clarias gariepinus

[n = 3]

Sort by : ● Locality ○ Country ○ Genetic markers ○ Ref.

Locality	Country	Chromosome number		Genetic markers	Ref.
		Haploid/ gametic (n)	Diploid/ zygotic (2n)		
Africa		28	56 - 56	No	2209
Ivory Coast	Cote d'Ivoire	28	56 - 56	No	34370
Ivory Coast	Cote d'Ivoire	28	56 - 56	No	34370

2.1. GENETICS

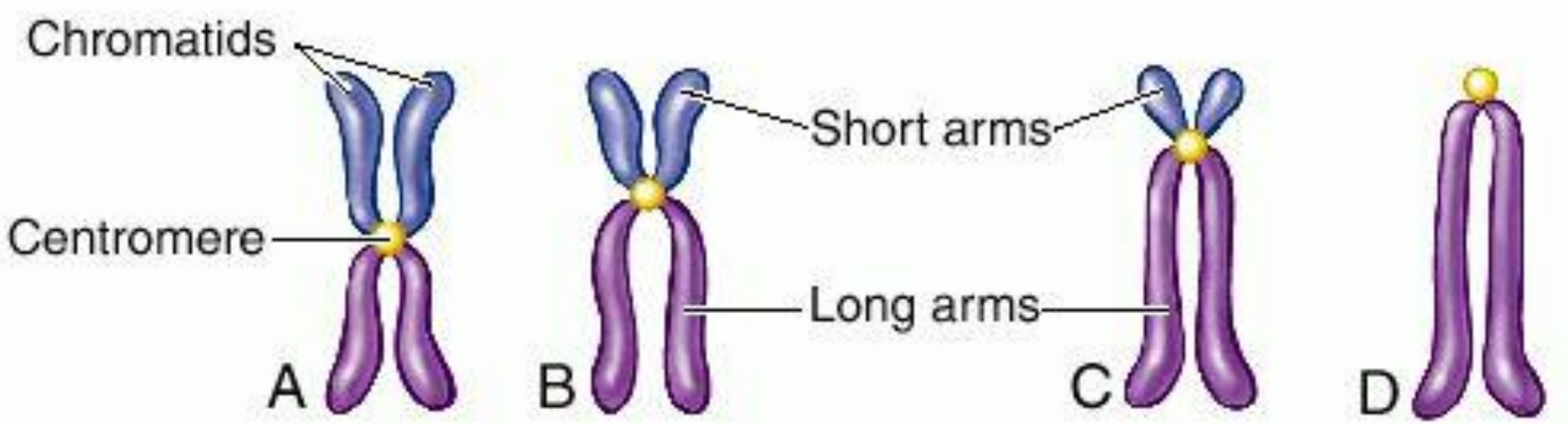
- ***Chromosome number* =** haploid and diploid chromosome number, range given if variable
- ***Chromosome type*** = numbers of chromosomes of different types

Genetics Summary for Clarias gariepinus

Main ref.	Hinegardner, R. and D.E. Rosen, 1972				
Country					
Locality/Yr.	Africa			Sex.	
Chromosome number	Haploid/gametic (n) : 28			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
	Diploid/zygotic (2n) : 56 - 56			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Chromosome Type				Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Metacentric	8	Subtelocentric		MetaSubmetacentric	
Submetacentric	24	Telocentric/Acrocentric	24	Subtelo-Acrocentric	
Chromosome arm no.	88			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Sex determining mechanism				Ref.	
DNA Content (haploid)	1.2			Ref.	Hinegardner, R. and D.E. Rosen, 1972
Genetic markers	No			Ref.	
Remarks	Values given in the form are for the males. Females have 8m + 25 sm + 23a, NF = 89. Location: Africa.			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990

2.1. GENETICS

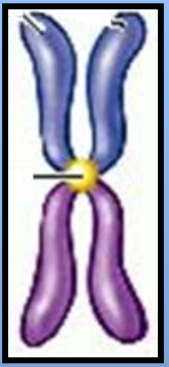
Chromosome type depends on the position of the centromere

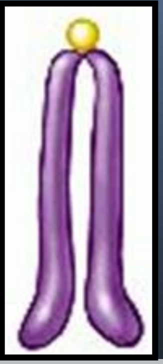


Position of the centromere in *(A)* **metacentric**; *(B)* **submetacentric**; *(C)* **acrocentric**; and *(D)* **telocentric chromosomes**.

2.1. GENETICS

- ***Chromosome arm number*** = largely dependent on chromosome type; metacentric chromosome has 2 arms, telocentric only one





Genetics Summary for Clarias gariepinus

Main ref.	Hinegardner, R. and D.E. Rosen, 1972				
Country					
Locality/Yr.	Africa			Sex.	
Chromosome number	Haploid/gametic (n) : 28			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
	Diploid/zygotic (2n) : 56 - 56			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Chromosome Type				Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Metacentric	8	Subtelocentric		MetaSubmetacentric	
Submetacentric	24	Telocentric/Acrocentric	24	Subtelo-Acrocentric	
Chromosome arm no.	88	=(2*8)+(2*24)+24		Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990
Sex determining mechanism				Ref.	
DNA Content (haploid)	1.2			Ref.	Hinegardner, R. and D.E. Rosen, 1972
Genetic markers	No			Ref.	
Remarks	Values given in the form are for the males. Females have 8m + 25 sm + 23a, NF = 89. Location: Africa.			Ref.	Ozouf-Costaz, C., G.G. Teugels and M. Legendre, 1990

2.1. GENETICS

- ***Sex determination mechanism*** = information on how males and females of the species are designated; **ZW** = females, two different kinds of chromosomes; **ZZ** = males, same chromosomes

Genetics Summary for Clarias gariepinus

Main ref.	Klinkhardt, M, M. Tesche and H. Greven, 1995				
Country	Cote d'Ivoire				
Locality/Yr.	Ivory Coast			Sex.	female
Chromosome number	Haploid/gametic (n) : 28			Ref.	
	Diploid/zygotic (2n) : 56 - 56			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Chromosome Type				Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Metacentric	8	Subtelocentric		MetaSubmetacentric	
Submetacentric	25	Telocentric/Acrocentric	23	Subtelo-Acrocentric	
Chromosome arm no.	89			Ref.	
Sex determining mechanism	ZW-ZZ			Ref.	
DNA Content (haploid)				Ref.	
Genetic markers	No			Ref.	
Remarks				Ref.	

2.1. GENETICS

- ***DNA content ('C-value')*** = gives specific haploid cellular content (in picograms); a measure for cell size (large cells = high amount of DNA per cell)

Genetics Summary for Clarias gariepinus

Main ref.	Klinkhardt, M, M. Tesche and H. Greven, 1995				
Country	Cote d'Ivoire				
Locality/Yr.	Ivory Coast			Sex.	female
Chromosome number	Haploid/gametic (n) : 28			Ref.	
	Diploid/zygotic (2n) : 56 - 56			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Chromosome Type				Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Metacentric	8	Subtelocentric		MetaSubmetacentric	
Submetacentric	25	Telocentric/Acrocentric	23	Subtelo-Acrocentric	
Chromosome arm no.	89			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Sex determining mechanism	ZW-ZZ			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
DNA Content (haploid)				Ref.	
Genetic markers	No			Ref.	
Remarks				Ref.	

2.1. GENETICS

- ***Genetic marker*** = states whether genetic marker(s) exist in the species; a genetic marker is a gene or DNA sequence with a known location on a chromosome; used for paternity testing, tracing inheritance, …

Genetics Summary for Clarias gariepinus

Main ref.	Klinkhardt, M, M. Tesche and H. Greven, 1995				
Country	Cote d'Ivoire				
Locality/Yr.	Ivory Coast			Sex.	female
Chromosome number	Haploid/gametic (n) : 28			Ref.	
	Diploid/zygotic (2n) : 56 - 56			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Chromosome Type				Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Metacentric	8	Subtelocentric		MetaSubmetacentric	
Submetacentric	25	Telocentric/Acrocentric	23	Subtelo-Acrocentric	
Chromosome arm no.	89			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
Sex determining mechanism	ZW-ZZ			Ref.	Teugels, G.G., C. Ozouf-Costaz, M. Legendre and M. Parrent, 1992
DNA Content (haploid)				Ref.	
Genetic markers	No			Ref.	
Remarks				Ref.	

2.2. ALLELE FREQUENCIES

- information on **genetic structure** and **variability** of fish populations
- important for species/strain selection for **aquaculture** and will help the management and **conservation programs for natural stocks**

Search Page

Available Electrophoretic Studies

n = 250

Sort By: ◉ Species ○ English name ○ Family

Species	English name	Family
Acanthurus triostegus	Convict surgeonfish	Acanthuridae
Acentrogobius viridipunctatus	Spotted green goby	Gobiidae
Amphiprion clarkii	Yellowtail clownfish	Pomacentridae
Aphanius fasciatus		Cyprinodontidae
Aphanius iberus	Spanish toothcarp	Cyprinodontidae
Atherina boyeri	Big-scale sand smelt	Atherinidae
Atherina presbyter	Sand smelt	Atherinidae
Barbonymus altus	Red tailed tinfoil	Cyprinidae
Barbus callensis	Algerian barb	Cyprinidae
Barbus meridionalis	Mediterranean barbel	Cyprinidae
Bathycallionymus kaianus		Callionymidae

Species Summary Page

- **Allele frequency** = number of copies of particular allel divided by number of copies of all alleles at genetic place (**locus**) in a population

List of populations of *Clarias gariepinus*

[n = 3]

Sort by : ◉ Locality ○ Country ○ Total loci ○ Polymor-phic loci

No.	Locality	Country	Total loci	Heterozygosity Obs.	Heterozygosity Exp.	Polymor-phic loci
1	Bouake, culture (April, 1988)	Cote d'Ivoire	13	0.17	0.1746	0.539
2	Bouake, culture (October, 1989)	Cote d'Ivoire	13	0.17	0.18	0.46
3	Seberi (September, 1989)	Niger	13	0.06	0.0673	0.154
	Average		13	0.133	0.141	0.384

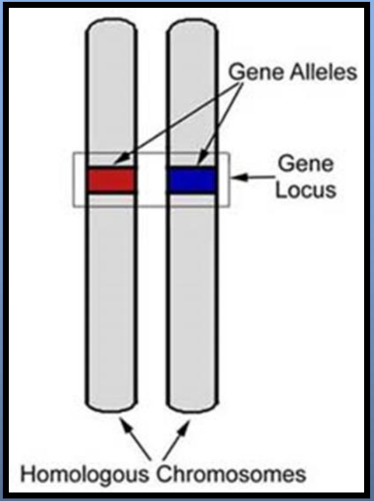
2.2. ALLELE FREQUENCIES

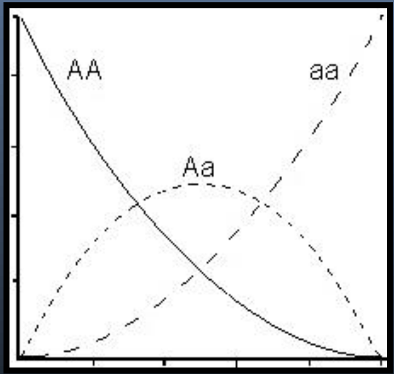
- ***Heterozygosity*** = proportion of individuals in **a population** that are heterozygous at a given number of loci

*An individual with two different alleles (forms of a gene) at a particular locus is called a **heterozygote**; an individual is called a **homozygote** when two alleles at a particular locus are the same*

Electrophoretic studies for *Clarias gariepinus*

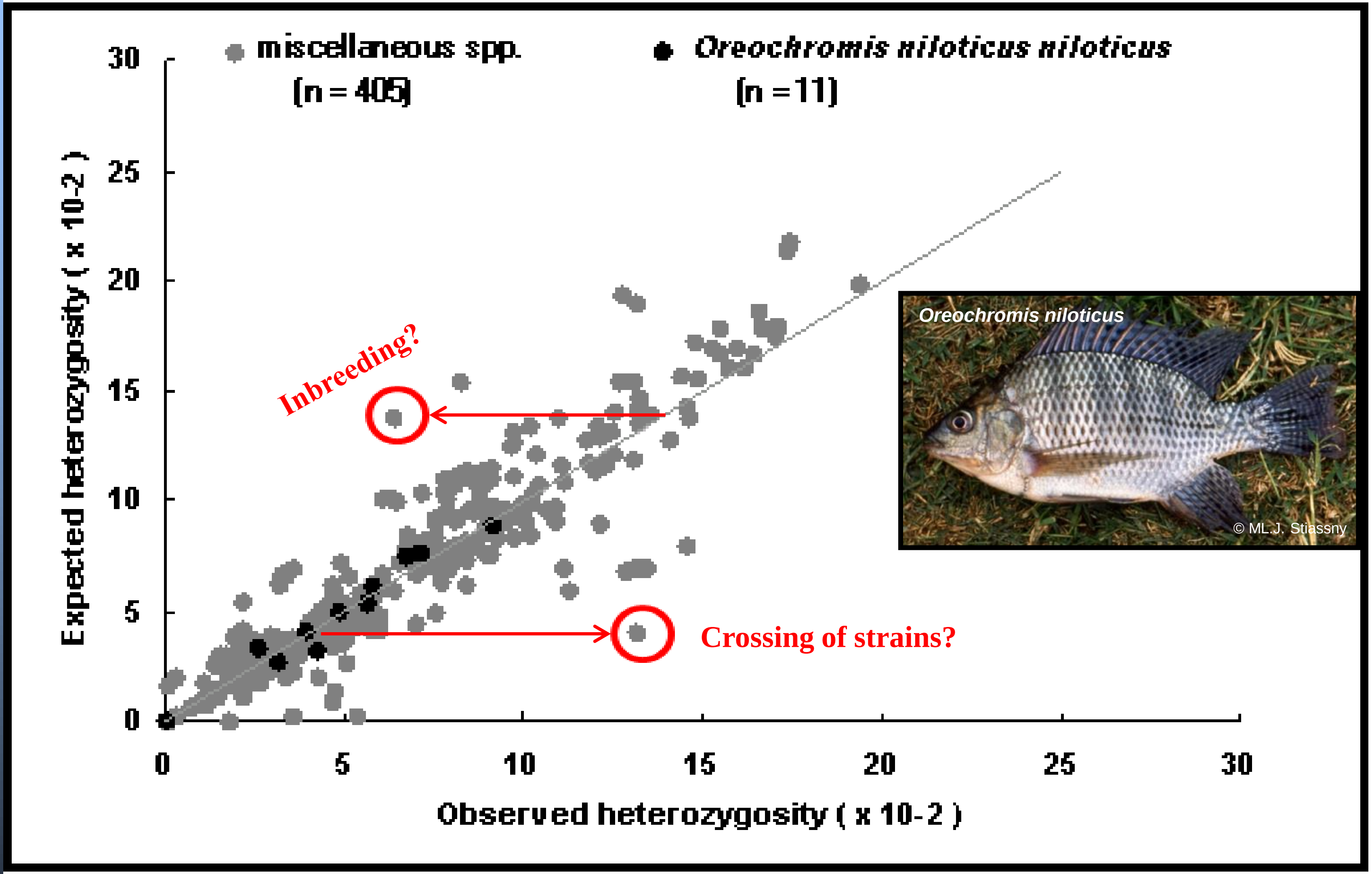
Main ref.	Teugels, G.G., R. Guyomard and M. Legendre, 1992		
Locality	Bouake, culture (April, 1988)		
Country	Cote d'Ivoire	Sample source	captivity
Total loci	13		
Heterozygosity	0.17		
Expected Heterozygosity	0.1746		
Polymorphic loci	0.539		
Comments			





- ***Expected heterozygosity*** = proportion of individuals which are prospective heterozygotes based on the allele frequencies and assuming Hardy-Weinberg equilibrium; these are computed for every locus, population and species and help to indicate, for example, the potential for selective breeding

2.2. ALLELE FREQUENCIES

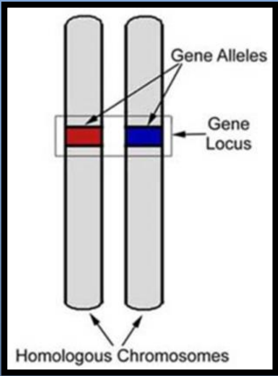


2.2. ALLELE FREQUENCIES

- ***Polymorphic loci*** = number of polymorphic loci/total number of loci examined; a locus is considered polymorphic if the frequency of the most common allele does not exceed 95%.

Electrophoretic studies for *Clarias gariepinus*

Main ref.	Teugels, G.G., R. Guyomard and M. Legendre, 1992		
Locality	Bouake, culture (April, 1988)		
Country	Cote d'Ivoire	Sample source	captivity
Total loci	13		
Heterozygosity	0.17		
Expected Heterozygosity	0.1746		
Polymorphic loci	0.539		
Comments			



2.3. HERITABILITY

- aims to assist the application of genetics to modern aquaculture
- contains records of heritabilities and responses to selection

Search Page

Heritability Records

n = 8

Sort By: Species English name Family

Species	English name	Family
Gambusia affinis	Mosquitofish	Poeciliidae
Ictalurus punctatus	Channel catfish	Ictaluridae
Oncorhynchus mykiss	Rainbow trout	Salmonidae
Oreochromis aureus	Blue tilapia	Cichlidae
Oreochromis mossambicus	Mozambique tilapia	Cichlidae
Oreochromis niloticus	Nile tilapia	Cichlidae
Salmo salar	Atlantic salmon	Salmonidae
Salmo trutta	Sea trout	

Species Summary Page

Population Characteristics for *Oreochromis mossambicus*

[n = 8]

Sort by : Locality Trait Heritability Ref

Locality	Trait	Heritability	Ref
Canada	growth rate	0.04000	2050
Canada	growth rate	0.04000	2050
Canada	growth rate	0.29000	2050
Canada	growth rate	1.09000	2050
Canada	growth rate	0.30000	2050
Canada	growth rate	0.07000	2050
Canada	growth rate	0.74000	2050
Canada	growth rate	0.80000	2050

2.3. HERITABILITY

- ***Trait* =** the desirable phenotypic character for improvement by selective breeding (e.g. growth rate, age and size at first maturity, egg number, size, weight and survival, larval survival, disease resistance, behavior, resistance to environmental factors, dressing weight, carcass quality, fat content, protein content, …)

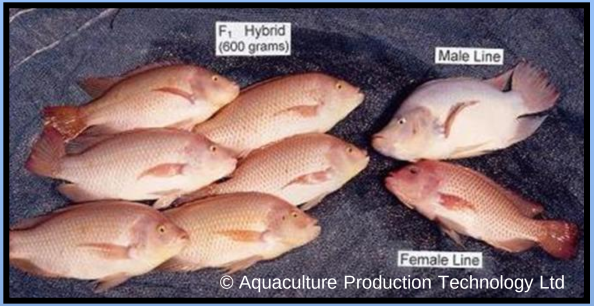
Heritability Summary for Oreochromis mossambicus

Main ref.	Kamonrat, W. and R.W. Doyle, 1988				
Country	Canada				
Locality	Dalhousie University				
Trait	growth rate				
Comment	Scale circulus spacing (CIRC) - MECIRC.				
Mean	51.60000	Unit	µg		
S.D	0.04000	C.V	0	S.E	1.47000
Heritability	0.80000	Method	sib analysis		
Comment	Estimated heritability based on sire components of variance.				
Selection studies	☐				
Response (%)		Method			
Comment					

- ***Heritability (h²)* =** the proportion of additive genetic variance in the total phenotypic variation, i.e. will the trait be expressed or passed on to the offspring? If a trait is sufficiently heritable ('fixed in the genes'), selective breeding is likely to be very effective; if h² is low, environmental factors have caused most variation and little genetic gain can be obtained by selection.

2.4. STRAINS

- allows the documentation of **ancestry of cultivated strains**
- strains may emerge through the simple act of domestication and restricted gene flow among farms or through breeding practices (selective breeding, chromosome-set manipulation, hybridization and/or gene transfer)



***Tilapia* ND 56 strain**

Common carp varieties resulting from selective breeding and genetic improvement

© Fish Culture Research Institute Szarvas Hungary

2.4. STRAINS

- the registry can be used to locate fish with specific characters and to track genetic improvement technologies. However, by recording the number of breeding individuals in the strain, the registry can also serve as a watch list for potentially threatened strains.

- the genetic data, including histories of founding population, broodstock management, status of the strain and descriptions of the distinguishing characters of the strains will assist in the utilization and conservation of intraspecific genetic variation in aquaculture.

Tilapia ND-41 strain: all-male population without hormonal treatment for sex reversal

Rare guppy strain "Japan full golden albino" (*Poecilia reticulata*)

***Oryzias latipes* "glowfish"**

2.4. STRAINS

List of Strains for *Oreochromis niloticus*

[n = 30]

Sort by : Strain code   Stock definition   Ref.

Strain code	Stock definition	Main ref.
ORNILED020	*Oreochromis niloticus filoa*: Uganda strain. Introduced to the Kajansi Fish Culture Station, Uganda from Lake George. Year of introduction and size of founding stock are unknown.	2679
ORNILED021	*Oreochromis niloticus filoa*: Israel strain. Introduced to the Gan Shmuel hatchery, Israel from Kajansi Fish Culture Station, Uganda by Pruginin in 1969. Founding stock consisted of 120 fry and a further sample (?) in 1970.	2679
ORNILNI001	DOR-Ghana 1974 strain. Introduced to the Fish and Aquaculture Research Station, DOR, Israel from the drainage system of Lake Volta, in the vicinity of Accra, Ghana in 1974. Founder stock included nine females and two males.	2680
ORNILNI002	Auburn-Egypt 1982 strain. Introduced to Auburn University, Alabama from Egypt in May 1982. Founder stock of 66 females and 20 males were collected from Ismailia Canal one of the distributaries of the Nile River, about 0.75 km northeast of Cairo, Egypt.	166
ORNILNI003	CLSU-Egypt 1988 strain. Introduced to the National Freshwater Fisheries Technology Research Center of the Bureau of Fisheries and Aquatic Resources in CLSU, Nueva Ecija, Philippines from Egypt in May, 1988 (1st collection) and in August 1989 (2nd collection). Collected from rivers, canals and lakes in Egypt.	1
ORNILNI004	CLSU-Ghana 1988 strain. Introduced to the National Freshwater Fisheries Technology Research Center of BFAR in Central Luzon State University, Nueva Ecija, Philippines from Ghana in October 1988. Founder stock of 220 fingerlings were collected from the Akosombo and Kpong dams (Kpong headpond) in the Volta River.	1725
ORNILNI006	CLSU-Senegal 1988 strain. Introduced to the Bure Resources in Central Luzon State University, Nuev 1988. Founder stocks were collected from floodpla Dakar-Bangos (40 breeders) and Mbane (40 finger	

ORNILNI002	Auburn-Egypt 1982 strain. Introduced to Auburn University, Alabama from Egypt in May 1982. Founder stock of 66 females and 20 males were collected from Ismailia Canal one of the distributaries of the Nile River, about 0.75 km northeast of Cairo, Egypt.	166

Strains Summary for *Oreochromis niloticus*

Main ref.	166		
Country	USA	Pic.	
Strain code	ORNILNI002	Trait	
Breeding strategy		Viability	☐
Size of founding stock	86	Source of founding stock	wild
Female	66		Ismailia Canal of Cairo, Egypt
Male	20	Strain code of source	
No. of broodstock		Year of arrival	1982
Years of first breeding			
Availability of strain			
Remarks	Commonly called `Egypt strain' in the USA.	Ref.	

2.4. STRAINS

- ***Strain code*** = unique combination of letters and a 3-digit number, the first two letters refer to the first two letters of the **genus**, letters 3-5 refer to the first three letters of the **species**, letters 6-7 refer to the first two letters of the **subspecies**; the number is sequential; if no subspecies exists, the letters 6-7 are **XX**; for hybrids, the letters 6-7 are **HX**

e.g. OR – NIL – NI – 002

Strains Summary for *Oreochromis niloticus*

Main ref.	166		
Country	USA	Pic.	
Strain code	ORNILNI002	Trait	
Breeding strategy		Viability	☐
Size of founding stock	86	Source of founding stock	wild
Female	66		Ismailia Canal of Cairo, Egypt
Male	20	Strain code of source	
No. of broodstock		Year of arrival	1982
Years of first breeding			
Availability of strain			
Remarks	Commonly called `Egypt strain' in the USA.	Ref.	

2.4. STRAINS

- ***Breeding strategy*** = refers to the method of propagation of the stock (e.g. chromosome manipulation (polyploidization and sex reversal), selective breeding, hybridization, gene transfer and normal mating).

Strains Summary for *Oreochromis niloticus*

Main ref.	166		
Country	USA	Pic.	
Strain code	ORNILNI002	Trait	
Breeding strategy		Viability	
Size of founding stock	86	Source of founding stock	wild
Female	66		Ismailia Canal of Cairo, Egypt
Male	20	Strain code of source	
No. of broodstock		Year of arrival	1982
Years of first breeding			
Availability of strain			
Remarks	Commonly called `Egypt strain' in the USA.	Ref.	

- ***Viability*** = refers to whether the strain is reproductively viable; for example, a strain of all female triploid trout would not be able to reproduce

- ***No. of broodstock*** **=** refers to the current number of fish used as breeders and helps determine the conservation status of and threat of extinction to the strain

GENBANK

- = a collection of all publicly available **DNA sequences**
- a new release is made available every 2 months
- each GenBank entry includes a description of the sequence, the scientific name and taxonomy, and a table of features that identifies coding regions and other sites of biological significance (transcription units, sites of mutations or modifications, and repeats).
- protein translations for coding regions and bibliographic references are included
- FishBase provides a link in the « Internet Resources » section of the Species Summary Page

Species Summery Page

Internet sources

Alien/Invasive Species database | BHL | Cloffa | BOLDSystems | Websites from users | Check FishWatcher | CISTI | Catalog of Fishes (gen., sp.) | DiscoverLife | Faunafri | Fishtrace | GenBank(genome, nucleotide) | GOBASE | Google Books | Google Scholar | Google | IGFA World Record | iSpecies | National databases | OsteoBase(skull, spine) | Public aquariums | PubMed | RFE Identification | Scirus | SeaLifeBase | Tree of Life | uBio | Wikipedia(Go, Search) | World Records Freshwater Fishing | Zoological Record

GENBANK

Oreochromis niloticus mitochondrion, complete genome

GenBank: GU238433.1

FASTA Graphics

Go to:

```
LOCUS       GU238433               16627 bp    DNA     circular VRT 21-DEC-2009
DEFINITION  Oreochromis niloticus mitochondrion, complete genome.
ACCESSION   GU238433
VERSION     GU238433.1  GI:281309673
KEYWORDS    .
SOURCE      mitochondrion Oreochromis niloticus (Nile tilapia)
  ORGANISM  Oreochromis niloticus
            Eukaryota; Metazoa; Chordata; Craniata; Vertebrata; Euteleostomi;
            Actinopterygii; Neopterygii; Teleostei; Euteleostei; Neoteleostei;
            Acanthomorpha; Acanthopterygii; Percomorpha; Perciformes;
            Labroidei; Cichlidae; African cichlids; Pseudocrenilabrinae;
            Tilapiini; Oreochromis.
REFERENCE   1  (bases 1 to 16627)
  AUTHORS   Yang,L., Lu,M., Ye,X., Zhu,H., Gao,F., Mo,Y. and Huang,Z.
  TITLE     Complete mitochondrial genome DNA of the Nile tilapia Oreochromis
            niloticus and phylogenetic analysis
  JOURNAL   Unpublished
REFERENCE   2  (bases 1 to 16627)
  AUTHORS   Yang,L., Lu,M., Ye,X., Zhu,H., Gao,F., Mo,Y. and Huang,Z.
  TITLE     Direct Submission
  JOURNAL   Submitted (26-NOV-2009) Pearl River Fisheries Research Institute of
            CAFS, 1,Xingyu Road, Liwan District, Guangzhou, Guangdong 510380,
            China
```

Oreochromis niloticus mitochondrion, complete genome

GenBank: GU238433.1

GenBank FASTA