FINEFISH Collective Research Project
(*Contract Nº012451*)

(Project coordinator: Mr. C. Hough)

State of the art guidelines for uniform diagnostics

(*WP2: Standardisation of Environmental Fish Monitoring)*

I. <u>Sparus aurata</u> & <u>Dicentrarchus labrax</u>

Contribution of Partner No19
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In the most of the cases, skeletal deformities do not appear solitary on the same individual but in various combinations. In this diagnostic handbook special attention was paid to isolate individuals with solitary deformities, in order to make easier the establishment of a "common" language in deformities diagnosis.

Rare deformities (i.e. haemal kyphosis) were not included in.

Finally, we would like to apologize to authors of many publications which are not cited in the present guideline. As this guideline aims to the practical use at the hatchery level and not to a full scientific review, literature was limited to the earlier and/or more relative studies.

To complete the list of the causative factors of skeletal deformities, readers should also consider the experimental results of the FineFish (final report, in preparation).

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I. Sparus aurata & Dicentrarchus labrax

Vertebral Deformities

HAEMAL LORDOSIS

Anatomy

Haemal part of the vertebral column. In *D. labrax* lordosis centre is located on average on V16-V17. Variable expression in *S. aurata* (anterior, middle or posterior vertebral centra).

Ontogeny

Late larval to juvenile stage.

Known Causative Factors

High velocity of water current, *via* the action of muscles on the vertebrae. Developmental temperature (15^o vs 20^o C) has been proven as an important factor, altering the relative growth of muscles and bones.

Species: *D. labrax, S. aurata.*

Other: Variable expression (frequency and severity). Varying lordosis-intensity can be quantified in respect to its effects on fish morphology.

References: 1-4, UoP unpublished data.

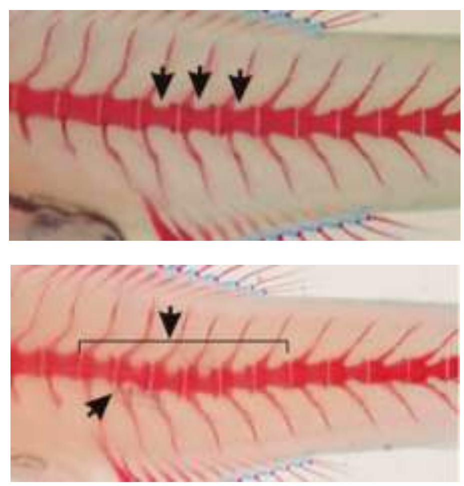
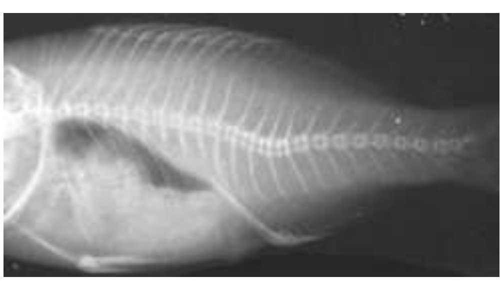
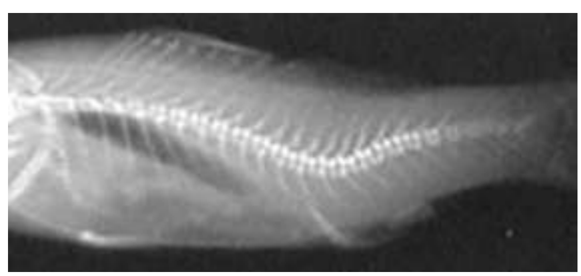
	Sparus aurata	***Dicentrarchus labrax***
ELS		
J-O		

Photo by UoP

Photos by Ref #2
Aquaculture 254: 54-64

ELS, early life stages
J-O, juvenile to on-growing

PRE-HAEMAL KYPHOSIS

Anatomy
Pre-haemal part of the vertebral column (V5-V6, *D. labrax*).

Ontogeny
Late larval stage.

Known Causative Factors:
Unknown factors for the certain species.

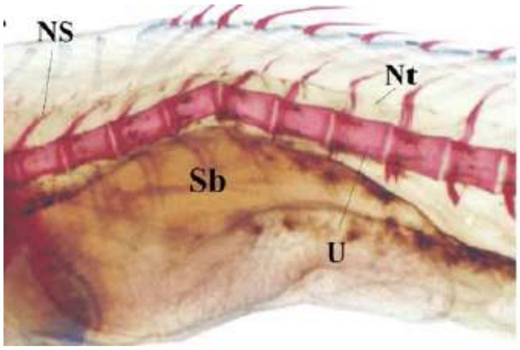
Species: *D. labrax, S. aurata*.

Other: in *D. labrax* it may be associated with deformations of the branchiostegal rays. The deformity is characterized as highly lethal up to 25-30 mm TL (*D. labrax*). Frequently associated with vertebral fusion.

References: 5-6.

Dicentrarchus labrax

ELS



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Aquaculture, 209: 49-58

J-O

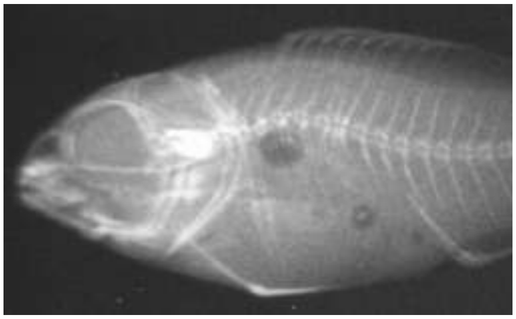


Photo by UoP

Lethal deformity

ELS, early life stages
J-O, juvenile to on-growing

PRE-HAEMAL LORDOSIS

Anatomy

Pre-haemal part of the vertebral column.

Ontogeny

Early larval stage.

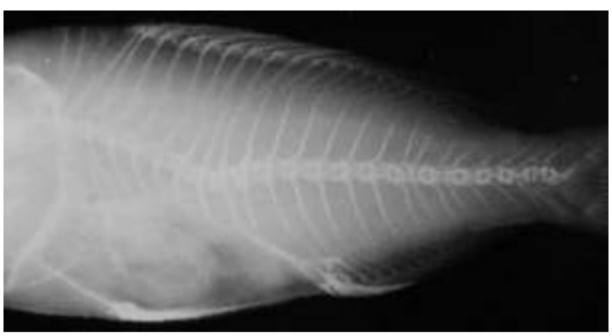
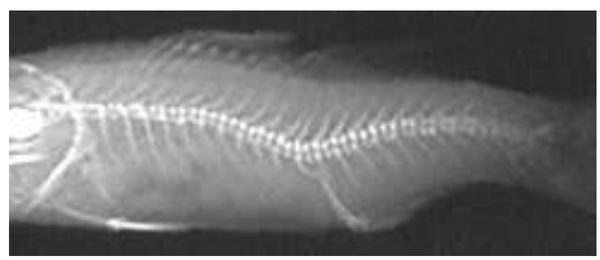
Known Causative Factors

Non-inflation of the swimbladder, via the excessive swimming activity and the altered mechanical loads of the vertebral column. The non-inflation of the swimbladder has been attributed primarily to the presence of surface film on the culture medium, and secondarily to poor larval condition and unfavorable salinity and photoperiod conditions.

Species: *D. labrax, S. aurata* (including rest physoclistous species).

Other: Solved with surface skimmers and the salinity floating test.

References: 7-10.

	Sparus aurata	***Dicentrarchus labrax***
ELS		
J-O	 Photo by UoP	 Photo by UoP

ELS, early life stages
J-O, juvenile to on-growing

SCOLIOSIS

Anatomy

Bilateral bending of the vertebral axis.

Ontogeny

Larval stage, but in some species it has been reported to develop in the juvenile stage.

Known Causative Factors

In *D. labrax* scoliosis has been reported to be induced by high levels (2.3-4.8%) or by very low levels (0.3%) of n-3 PUFA (DHA and EPA) in the phospholipid fraction (11-13%) of the diet. In other fish species, it has been attributed to the dietary deficiencies (vitamin C, phospholipids, tryptophan), to myxosporean parasites, or to the presence of toxicants.

Species: *D. labrax*, *S. aurata*.

Other: rare in both species.

References: 11-14.

	Sparus aurata	***Dicentrarchus labrax***
ELS		
J-O		

ELS, early life stages
J-O, juvenile to on-growing

VERTEBRAL COMPRESSION

Anatomy

Fusion and/or shortening of the vertebral centra.

Ontogeny

Larval stage.

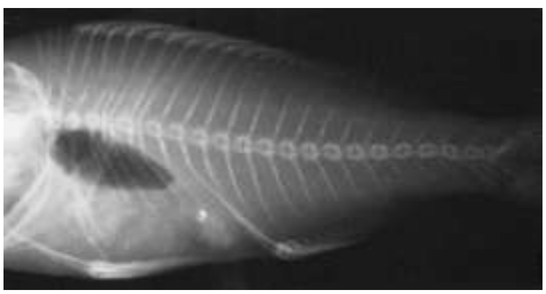
Known Causative Factors

Non.

Species: *D. labrax, S. aurata*.

Other: Compressed vertebrae are frequently present in the rest of the vertebral deformities.

References: 15, UoP unpublished data.

	Sparus aurata	***Dicentrarchus labrax***
ELS		
J-O	 Photo by UoP	

ELS, early life stages
J-O, juvenile to on-growing

I. Sparus aurata & Dicentrarchus labrax

Cranial Deformities

GILL COVER DEFORMITIES

Anatomy

Inside folding of the opercul and sub-opercul.

Ontogeny

Early larval stage.

Known Causative Factors

In *D. labrax*, it was attributed to the lack of n-3 PUFA (EPA, DHA) in the phospholipid dietary fraction. In *Chanos chanos*, the incidence of opercular deformities was significantly reduced when larvae were fed on live food adequately enriched with EFA, DHA and vitamin C.

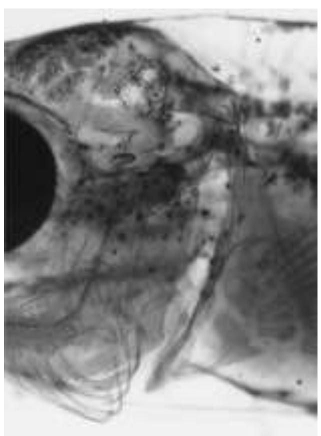
Species: *D. labrax, S. aurata*.

Other: associated with severe deformations of the branchiostegal rays. In some cases it is expressed as external folding of the opercul and sub-opercul.

References: 11, 16-19

Sparus aurata ***Dicentrarchus labrax***

ELS



J-O

Photos by Ref #12
Aquaculture, 156: 165-177

Photo by Ref #16
Br. J. Nutr., 12: 523-538

ELS, early life stages
J-O, juvenile to on-growing

PUGHEADNESS

Anatomy

Antero-posterior compression of the ethmoid region and upper jaws. Maxillaries, pre-maxillaries, parasphenoid, pterygoids and ethmoid plate are involved.

Ontogeny

Early larval stage.

Known Causative Factors

In *D. labrax* it has been attributed to dietary excess of vitamin A, as well as to excess or absence of n-3 PUFA (EPA, DHA) in the phospholipid dietary fraction.

Species: *S. aurata*, *D. labrax*.

Other: frequently, pugheadness is a part of extensive viscerocranial deformities.

References: 11, 19-21.

Sparus aurata ***Dicentrarchus labrax***

ELS

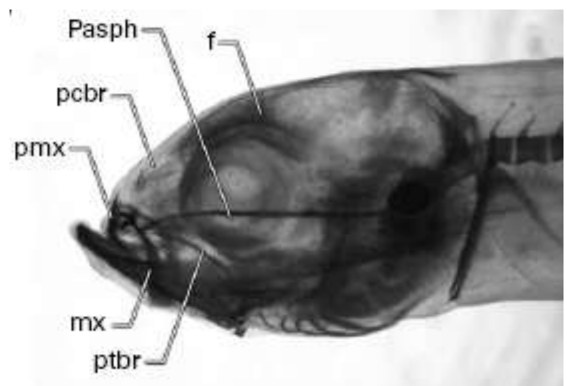


Photo by Ref #21
Brit. J. Nutr. 95: 677-687

J-O

Photo by UoP

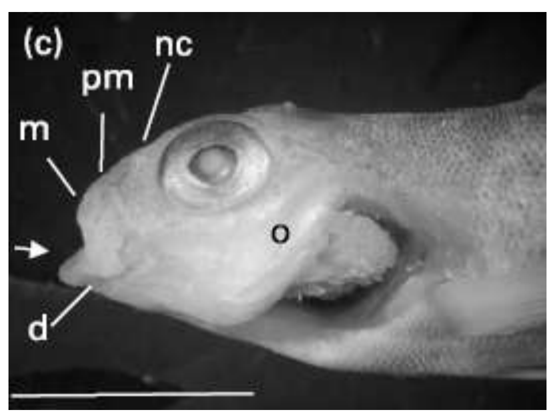


Photo by Ref #20
Br. J. Nutr., 12: 523-538

ELS, early life stages
J-O, juvenile to on-growing

DEFORMITIES OF THE HYOID ARCH

Anatomy
Ventral projection of the hyoid-arch skeleton.

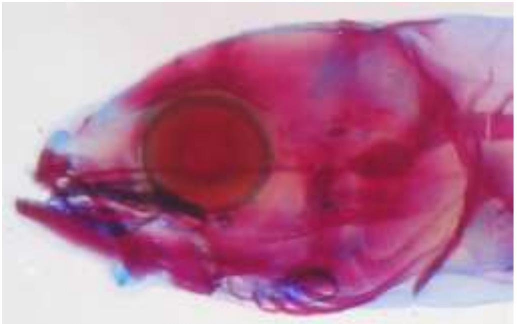
Ontogeny
Larval stage

Known Causative Factors
Unknown.

Species: *S. aurata, D. labrax.*

Other: not associated with other deformities up to now. Occasionally can reach extremely high frequencies (68%).

References: UoP unpublished data.

	Sparus aurata	***Dicentrarchus labrax***
ELS		 Photo by UoP
J-O		

ELS, early life stages
J-O, juvenile to on-growing

DEFORMITIES OF THE BRANCHIOSTEGAL RAYS

Anatomy

Abnormal shape and lack of branchiostegal rays.

Ontogeny

Larval stage.

Known Causative Factors

In *D. labrax*, low developmental temperature (15^o vs 20^o C) has been shown to be correlated with the development of this deformity. However, indirect effects of temperature (i.e. via alteration of nutritional preferences) cannot be excluded (due the overall phenotypic response of *D. labrax* to the water-temperature).

Species: *S. aurata*, *D. labrax*

Other:

References: 22, UoP unpublished results (*S. aurata*)

	Sparus aurata	***Dicentrarchus labrax***
ELS		 Photo by Ref #22 *J. Appl. Ichthyol. 23: 99-103*
J-O		

ELS, early life stages
J-O, juvenile to on-growing

REDUCTION OF THE LOWER-JAW

Anatomy

Angular and/or dentary bones are involved in.

Ontogeny

Larval stage.

Known Causative Factors

Uknown.

Species: *S. aurata*, *D. labrax.*

Other: more frequent in *S. aurata* than in *D. labrax*. Could be associated with the crossbite.

References: UoP unpublished results.

Sparus aurata ***Dicentrarchus labrax***

ELS

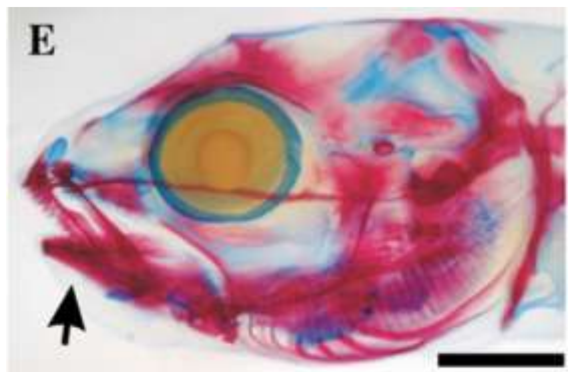


Photo by Ref #28
Mazurais et al. Aquaculture in press

J-O

Photo by UoP

ELS, early life stages
J-O, juvenile to on-growing

CROSSBITE

Anatomy

Lateral displacement of the lower jaw. Angular and/or dentary bones are involved in.

Ontogeny

Larval stage.

Known Causative Factors

Unknown.

Species: *S. aurata*, *D. labrax*

Other: more frequent in *S. aurata* than in *D. labrax*.

References: UoP unpublished results.

	Sparus aurata	***Dicentrarchus labrax***
ELS		 Photo by UoP
J-O		

ELS, early life stages
J-O, juvenile to on-growing

I. Sparus aurata & Dicentrarchus labrax

Fin Deformities

SADDLEBACK SYNDROME

Anatomy

Incomplete or abnormal development of the dorsal fin, due to shape and number abnormalities of the proximal pterygiophores and rays.

Ontogeny

Early larval stage.

Known Causative Factors

Unknown factors for the certain species. In *Dentex dentex* it was related to the larval rearing methodology.

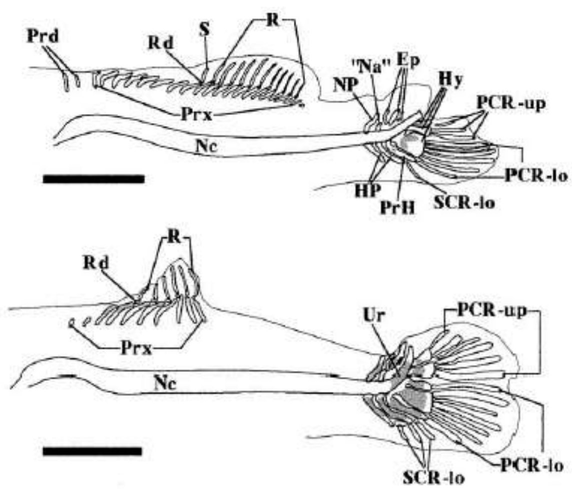
Species: *D. labrax*, *S. aurata.*

Other: associated with severe deformities of the caudal fin or vertebrae.

References: 23-24, UoP unpublised data.

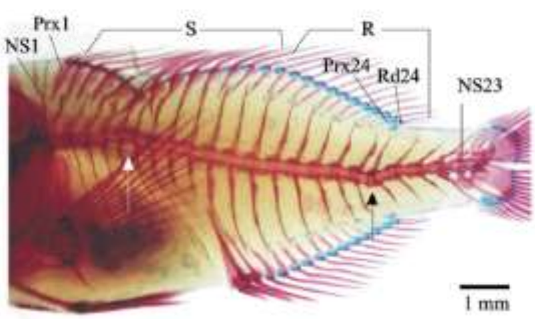
Sparus aurata ***Dicentrarchus labrax***

ELS



D. dentex. Photo by Ref #23
Aquaculture, 200: 285-304

J-O



D. sargus. Photo by Ref #24
Aquaculture, 217: 673-676.

ELS, early life stages
J-O, juvenile to on-growing

<u>INCOMPLETE DEVELOPMENT OF THE ANAL FIN</u>

<u>Anatomy</u>
Shape and number abnormalities of pterygiophores and rays.
<u>Ontogeny</u>
Early larval stage.
<u>Known Causative Factors</u>
Unknown.
<u>Species</u>: *D. labrax, S. aurata*
<u>Other</u>: rare deformity in both species.

<u>References</u>: UoP unpublished data.

	Sparus aurata	***Dicentrarchus labrax***
ELS		
J-O	*As in saddleback syndrome*	

ELS, early life stages
J-O, juvenile to on-growing

DEVELOPMENT OF DOUBLE OR LATERALLY TWISTED CAUDAL FIN

Anatomy

All the caudal elements form abnormally.

Ontogeny

Early larval stage.

Known Causative Factors

General methodology of larval rearing. In *Pagellus erythrinus*, abnormal caudal elements have been attributed to water temperature and methodology of larval rearing.

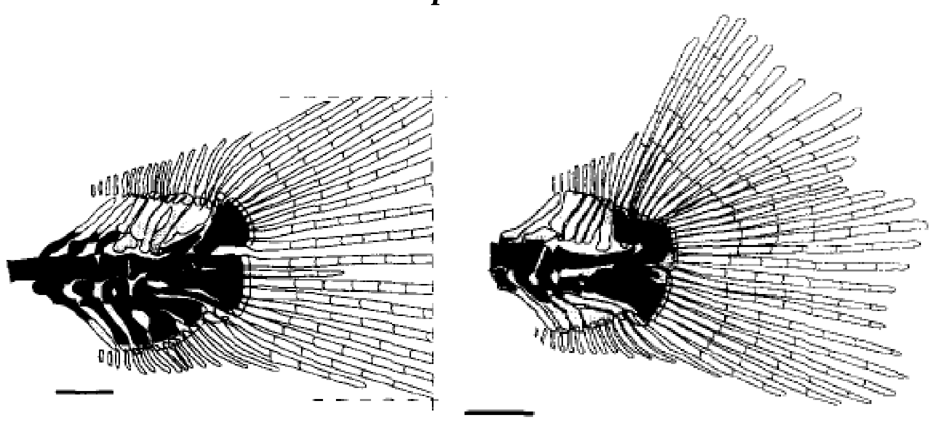
Species: *S. aurata*.

Other: Linked with severe notochord abnormalities at the yolk-sac larval stage.

References: 25-26.

Sparus aurata

ELS



Photos by Ref #25
Aquaculture, 149: 215-226.

J-O

Photo by UoP

ELS, early life stages
J-O, juvenile to on-growing

INCOMPLETE DEVELOPMENT OF CAUDAL FIN

Anatomy

All the caudal elements form abnormally, leading to extensive lack of lepidotrichia.

Ontogeny

Early larval stage.

Known Causative Factors

In *Pagellus erythrinus*, abnormal caudal elements have been attributed to water temperature and methodology of larval rearing.

Species: *S. aurata.*

Other: Linked with severe notochord abnormalities at the yolk-sac larval stage. Occasionally, it can reach to very high frequencies (90-100%).

References: UoP unpublished data.

Sparus aurata

ELS

J-O

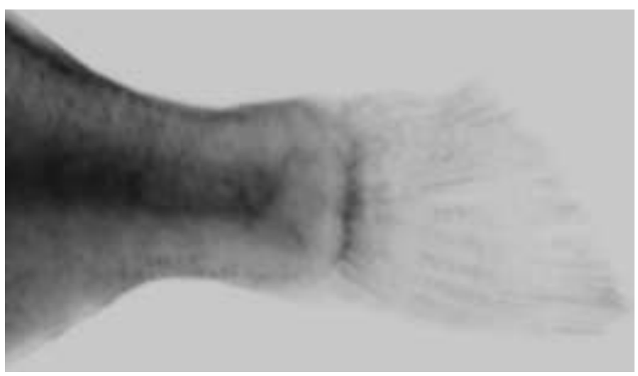


Photo by UoP

ELS, early life stages
J-O, juvenile to on-growing

I. Sparus aurata & Dicentrarchus labrax

Miscellaneous Abnormalities

ABNORMALITIES OF THE LATERAL LINE

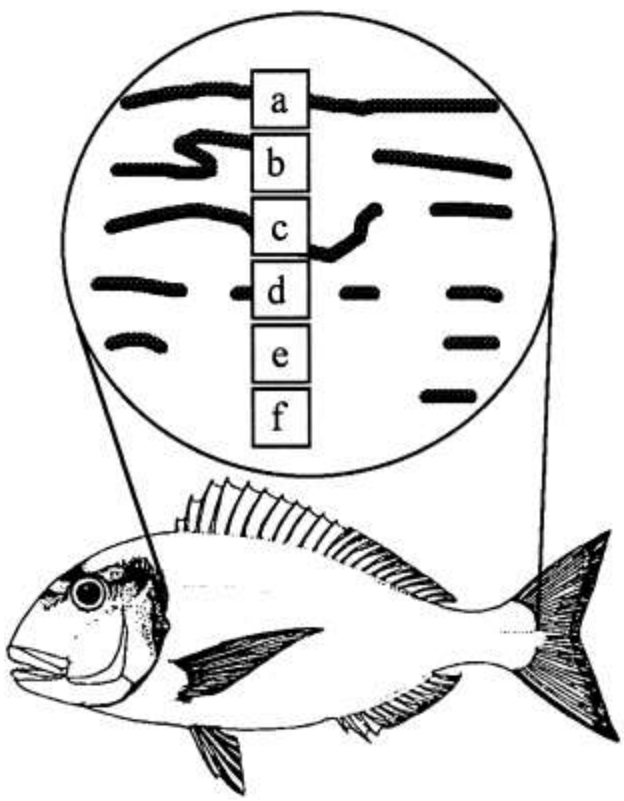
Anatomy
Abnormal arrangement and/or lack of the modified scales of the lateral line.
Ontogeny
Unknown.
Known Causative Factors
Unknown.
Species: *S. aurata.*
Other: widely used as criterion of distinction between wild and farmed fish. Linked with severe behavioural alterations.

References: 27.

Sparus aurata

ELS

J-O



Photos by Ref #27
Aquaculture, 192: 281-290.

ELS, early life stages
J-O, juvenile to on-growing

I. Sparus aurata & Dicentrarchus labrax

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