

NMBQQC

NE Atlantic Marine Biological Analytical Quality Control Scheme

www.nmbaqcs.org

Fish Ring Test Bulletin – FRT13

7th April 2020

Author: Stephen Duncombe-Smith
Photographs: Soren Pears
Reviewer: David Hall
Approved by: Jim Ellis, CEFAS
Contact: nmbaqc@apemltd.co.uk



MODULE / EXERCISE DETAILS

Module:	Fish Ring Test (FRT)
Exercises:	FRT13
Specimen Images Circulated:	4th November 2019
Specimens Circulated:	25th November 2019
Data Submission Deadline:	24th January 2020
Number of Subscribing Laboratories:	11
Number of Submissions Received:	16*

***multiple data entries per laboratory permitted**

Specimen Images and Detailed Breakdown of Identifications	13
F-RT1301 - <i>Eutrigla gurnardus</i> (Linnaeus, 1758)	14
F-RT1302 - <i>Clupea harengus</i> Linnaeus, 1758	15
F-RT1303 - <i>Platichthys flesus</i> (Linnaeus, 1758).....	16
F-RT1304 - <i>Ammodytes tobianus</i> Linnaeus, 1758/ <i>Ammodytes marinus</i> Raitt, 1934	17
F-RT1305 - <i>Liparis liparis</i> (Linnaeus, 1766)	18
F-RT1306 - <i>Pomatoschistus microps</i> (Krøyer, 1838)	19
F-RT1307 - <i>Merlangius merlangus</i> (Linnaeus, 1758)	19
F-RT1308 - <i>Sprattus sprattus</i> (Linnaeus, 1758).....	20
F-RT1309 - <i>Pomatoschistus minutus</i> (Pallas, 1770)	21
F-RT1310 - <i>Limanda limanda</i> (Linnaeus, 1758).....	22
F-RT1311 - <i>Chelon labrosus</i> (Risso, 1827)	22
F-RT1312 - <i>Pomatoschistus lozanoi</i> (de Buen, 1923).....	23
F-RT1313 - <i>Trisopterus minutus</i> (Linnaeus, 1758)	24
F-RT1314 - <i>Pleuronectes platessa</i> Linnaeus, 1758.....	26
F-RT1315 - <i>Crystallogobius linearis</i> (Düben, 1845).....	27
Taxonomic discrepancies and confidence level.....	28
Synonyms	28
Authority errors	28
Confidence level.....	28
FRT13 identifications made from images.	28
Literature Cited for FRT13 Identification	30
Taxonomic and identification policy problems highlighted by this RT.....	31
Juvenile clupeids	31
Sand eels	34

Sand goby complex	36
Juvenile grey mullet	37
Additional specimen comments	38
References	39
Index (FRT Figures).....	42
Specimen labels	42

Figure 1. The number of differences from the AQC identification of specimens distributed in FRT13 for each of the participating laboratories. Arranged in order of increasing number of differences by specific (blue filled circles) followed by generic (open diamond) errors.....	5
Figure 2. Post larval clupeids; number of myotomes in trunk (back of the head to the vent, red), p = pylorus.	32
Figure 3. Comparison of juvenile clupeids.....	33
Figure 4. Comparison of <i>A. tobianus</i> and <i>A. marinus</i> ; fresh specimen top and preserved specimens stained with methyl green below	35
Figure 5. <i>Pomatoschistus</i> species head detail; sensory papillae red and pectoral fin ray range white	36
Figure 6. Juvenile grey mullet ventral head melanophores; m = mandibular, g = gular, v-o = ventro-opercular, s-o = sub-orbital.....	37
Figure 7. Juvenile grey mullet pyloric caeca (pc)	38

Table1. Summary of differences	4
Table 2. The identification of specimens made by participating laboratories for FRT13 (arranged by specimen). Names are given only where different from the AQC identification.	6
Table 3. The identification of specimens made by participating laboratories for FRT13 (arranged by participant). Names are given only where different from the AQC identification.	9
Table 4. Summary of differences from image FRT.....	29

Table1. Summary of differences

Specimen	Genus	Species	Total differences for 16 returns	
			Genus	Species
F-RT1301	<i>Eutrigla</i>	<i>gurnardus</i>	1	1
F-RT1302	<i>Clupea</i>	<i>harengus</i>	5	5
F-RT1303	<i>Platichthys</i>	<i>flesus</i>	3	3
F-RT1304	<i>Ammodytes</i>	<i>tobianus/marinus</i>	2	2
F-RT1305	<i>Liparis</i>	<i>liparis</i>	0	1
F-RT1306	<i>Pomatoschistus</i>	<i>microps</i>	0	1
F-RT1307	<i>Merlangius</i>	<i>merlangus</i>	6	6
F-RT1308	<i>Sprattus</i>	<i>sprattus</i>	4	4
F-RT1309	<i>Pomatoschistus</i>	<i>minutus</i>	1	3
F-RT1310	<i>Limanda</i>	<i>limanda</i>	0	0
F-RT1311	<i>Chelon</i>	<i>labrosus</i>	2	12
F-RT1312	<i>Pomatoschistus</i>	<i>lozanoi</i>	0	11
F-RT1313	<i>Trisopterus</i>	<i>minutus</i>	1	6
F-RT1314	<i>Pleuronectes</i>	<i>platessa</i>	4	4
F-RT1315	<i>Crystallogobius</i>	<i>linearis</i>	7	7
Total differences			36	66
Average differences /lab.			2.3	4.1

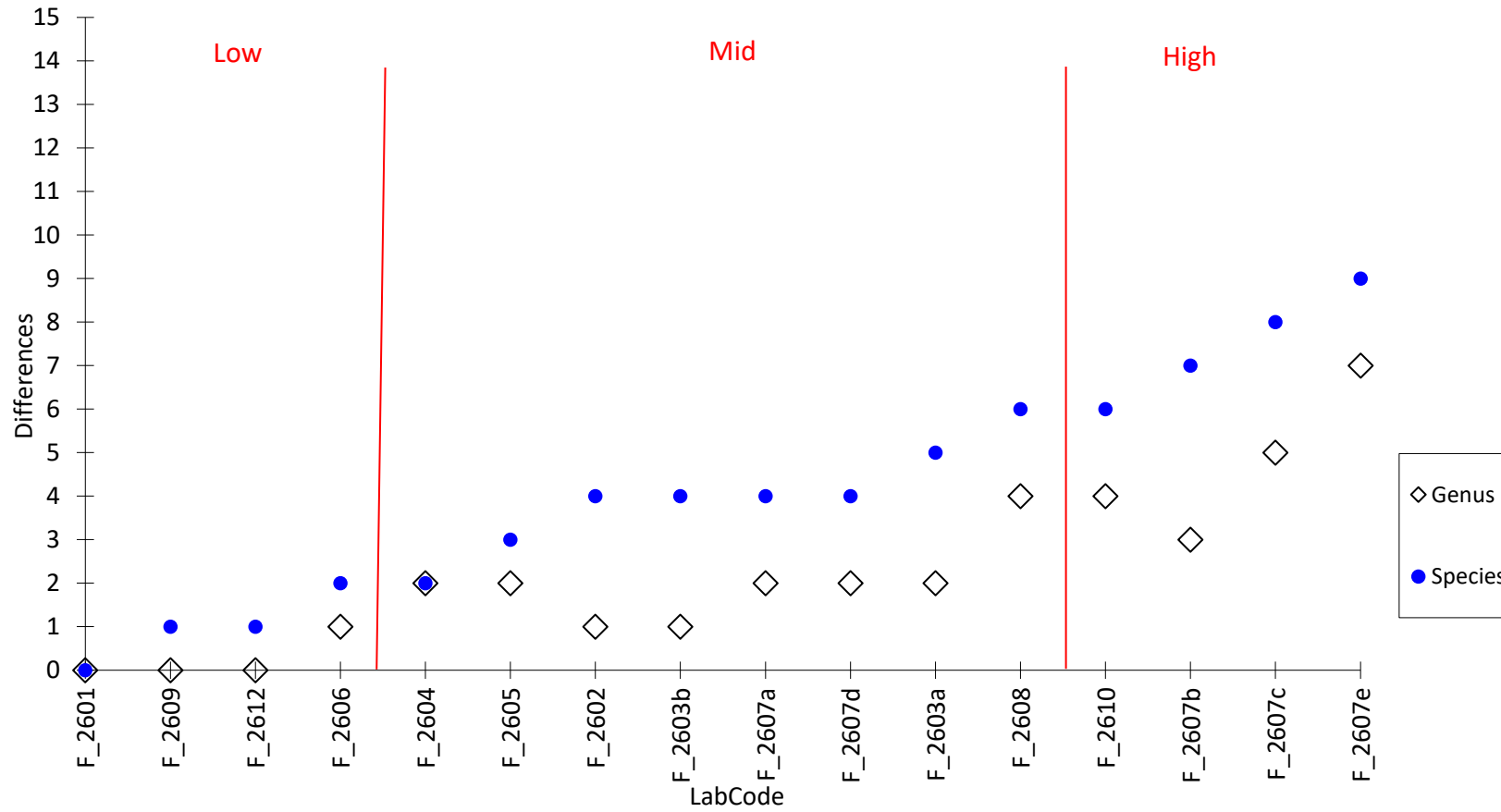


Figure 1. The number of differences from the AQC identification of specimens distributed in FRT13 for each of the participating laboratories. Arranged in order of increasing number of differences by specific (blue filled circles) followed by generic (open diamond) errors.

Table 2. The identification of specimens made by participating laboratories for FRT13 (arranged by specimen). Names are given only where different from the AQC identification.

	F-RT1301	F-RT1302	F-RT1303	F-RT1304	F-RT1305
Taxon	<i>Eutrigla gurnardus</i>	<i>Clupea harengus</i>	<i>Platichthys flesus</i>	<i>Ammodytes tobianus/marinus</i>	<i>Liparis liparis</i>
F_2601	--	--	--	--	--
F_2602	--	--	--	--	--
F_2603a	--	--	--	<i>Hyperoplus lanceolatus</i>	--
F_2603b	--	<i>Sprattus sprattus</i>	--	--	--
F_2604	--	<i>Sardina pilchardus</i>	--	--	--
F_2605	--	--	<i>Microstomus kitt</i>	--	- <i>montagui</i>
F_2606	--	<i>Sprattus sprattus</i>	--	--	--
F_2607a	--	--	--	--	--
F_2607b	--	--	<i>Pleuronectes platessa</i>	--	--
F_2607c	<i>Trigla lyra</i>	--	<i>Pleuronectes platessa</i>	--	--
F_2607d	--	--	--	--	--
F_2607e	--	<i>Sprattus sprattus</i>	--	<i>Hyperoplus immaculatus</i>	--
F_2608	--	--	--	--	--
F_2609	--	--	--	--	--
F_2610	--	<i>Sprattus sprattus</i>	[<i>Platichthys</i>] -	- [sp.]	--
F_2612	--	--	--	--	--

	F-RT1306	F-RT1307	F-RT1308	F-RT1309	F-RT1310
Taxon	Pomatoschistus microps	Merlangius merlangus	Sprattus sprattus	Pomatoschistus minutus	Limanda limanda
F_2601	--	--	--	--	--
F_2602	--	--	Clupea harengus	--	--
F_2603a	--	--	--	--	--
F_2603b	--	--	--	--	--
F_2604	--	--	Clupea harengus	--	--
F_2605	[pomatoschistos] -	[merlangus] -	--	--	--
F_2606	--	--	--	--	--
F_2607a	--	Trisopterus minutus	--	--	--
F_2607b	- minutus	Trisopterus minutus	--	- microps	--
F_2607c	--	Trisopterus minutus	--	- microps	--
F_2607d	--	Trisopterus minutus	--	--	--
F_2607e	--	Trisopterus minutus	Clupea harengus	Gobius niger	--
F_2608	--	Pollachius pollachius	--	--	--
F_2609	--	--	--	--	--
F_2610	--	--	Clupea harengus	--	--
F_2612	--	--	--	--	[Limada] [limada]

	F-RT1311	F-RT1312	F-RT1313	F-RT1314	F-RT1315
Taxon	Chelon labrosus	Pomatoschistus lozanoi	Trisopterus minutus	Pleuronectes platessa	Crystallogobius linearis
F_2601	--	--	--	--	--
F_2602	[Liza] ramada	- microps	- luscus	--	--
F_2603a	- ramada	- norvegicus	- esmarkii	Microstomus kitt	--
F_2603b	- ramada	- norvegicus	- esmarkii	--	--
F_2604	--	--	--	--	--
F_2605	dicentrurus labrax	[Pomatoschistos] -	[trispoterus] -	--	--
F_2606	--	--	- luscus	--	--
F_2607a	[Liza] ramada	- minutus	--	--	Sprattus sprattus
F_2607b	- ramada	- microps	--	--	Sprattus sprattus
F_2607c	[Liza] ramada	- minutus	- [microps]	Limanda limanda	Sprattus sprattus
F_2607d	[Liza] ramada	- minutus	--	--	[blank]
F_2607e	[Liza] ramada	- minutus	--	Limanda limanda	Ciliata mustela
F_2608	Dicentrarchus labrax	- microps	- esmarkii	Scophthalmus rhombus	Sprattus sprattus
F_2609	--	- minutus	--	--	--
F_2610	[Liza] ramada	- minutus	Gadus morhua	--	Aphia minuta
F_2612	[Liza] ramada	--	--	--	--

Table 3. The identification of specimens made by participating laboratories for FRT13 (arranged by participant). Names are given only where different from the AQC identification.

	Taxon	F_2601	F_2602	F_2603a	F_2603b
F-RT1301	<i>Eutrigla gurnardus</i>	--	--	--	--
F-RT1302	<i>Clupea harengus</i>	--	--	--	Sprattus sprattus
F-RT1303	<i>Platichthys flesus</i>	--	--	--	--
F-RT1304	<i>Ammodytes tobianus/marinus</i>	--	--	Hyperoplus lanceolatus	--
F-RT1305	<i>Liparis liparis</i>	--	--	--	--
F-RT1306	<i>Pomatoschistus microps</i>	--	--	--	--
F-RT1307	<i>Merlangius merlangus</i>	--	--	--	--
F-RT1308	<i>Sprattus sprattus</i>	--	Clupea harengus	--	--
F-RT1309	<i>Pomatoschistus minutus</i>	--	--	--	--
F-RT1310	<i>Limanda limanda</i>	--	--	--	--
F-RT1311	<i>Chelon labrosus</i>	--	[Liza] ramada	- ramada	- ramada
F-RT1312	<i>Pomatoschistus lozanoi</i>	--	- microps	- norvegicus	- norvegicus
F-RT1313	<i>Trisopterus minutus</i>	--	- luscus	- esmarkii	- esmarkii
F-RT1314	<i>Pleuronectes platessa</i>	--	--	Microstomus kitt	--
F-RT1315	<i>Crystallogobius linearis</i>	--	--	--	--

	Taxon	F_2604	F_2605	F_2606	F_2607a
F-RT1301	<i>Eutrigla gurnardus</i>	--	--	--	--
F-RT1302	<i>Clupea harengus</i>	Sardina pilchardus	--	Sprattus sprattus	--
F-RT1303	<i>Platichthys flesus</i>	--	Microstomus kitt	--	--
F-RT1304	<i>Ammodytes tobianus/marinus</i>	--	--	--	--
F-RT1305	<i>Liparis liparis</i>	--	- montagui	--	--
F-RT1306	<i>Pomatoschistus microps</i>	--	[pomatoschistos] -	--	--
F-RT1307	<i>Merlangius merlangus</i>	--	[merlangus] -	--	Trisopterus minutus
F-RT1308	<i>Sprattus sprattus</i>	Clupea harengus	--	--	--
F-RT1309	<i>Pomatoschistus minutus</i>	--	--	--	--
F-RT1310	<i>Limanda limanda</i>	--	--	--	--
F-RT1311	<i>Chelon labrosus</i>	--	dicentrous labrax	--	[Liza] ramada
F-RT1312	<i>Pomatoschistus lozanoi</i>	--	[Pomatoschistos] -	--	- minutus
F-RT1313	<i>Trisopterus minutus</i>	--	[trispoterus] -	- luscus	--
F-RT1314	<i>Pleuronectes platessa</i>	--	--	--	--
F-RT1315	<i>Crystallogobius linearis</i>	--	--	--	Sprattus sprattus

	Taxon	F_2607b	F_2607c	F_2607d	F_2607e
F-RT1301	<i>Eutrigla gurnardus</i>	--	Trigla lyra	--	--
F-RT1302	<i>Clupea harengus</i>	--	--	--	Sprattus sprattus
F-RT1303	<i>Platichthys flesus</i>	Pleuronectes platessa	Pleuronectes platessa	--	--
F-RT1304	<i>Ammodytes tobianus/marinus</i>	--	--	--	Hyperoplus immaculatus
F-RT1305	<i>Liparis liparis</i>	--	--	--	--
F-RT1306	<i>Pomatoschistus microps</i>	- minutus	--	--	--
F-RT1307	<i>Merlangius merlangus</i>	Trisopterus minutus	Trisopterus minutus	Trisopterus minutus	Trisopterus minutus
F-RT1308	<i>Sprattus sprattus</i>	--	--	--	Clupea harengus
F-RT1309	<i>Pomatoschistus minutus</i>	- microps	- microps	--	Gobius niger
F-RT1310	<i>Limanda limanda</i>	--	--	--	--
F-RT1311	<i>Chelon labrosus</i>	- ramada	[Liza] ramada	[Liza] ramada	[Liza] ramada
F-RT1312	<i>Pomatoschistus lozanoi</i>	- microps	- minutus	- minutus	- minutus
F-RT1313	<i>Trisopterus minutus</i>	--	- [microps]	--	--
F-RT1314	<i>Pleuronectes platessa</i>	--	Limanda limanda	--	Limanda limanda
F-RT1315	<i>Crystallogobius linearis</i>	Sprattus sprattus	Sprattus sprattus	[blank]	Ciliata mustela

	Taxon	F_2608	F_2609	F_2610	F_2612
F-RT1301	<i>Eutrigla gurnardus</i>	--	--	--	--
F-RT1302	<i>Clupea harengus</i>	--	--	Sprattus sprattus	--
F-RT1303	<i>Platichthys flesus</i>	--	--	[Platichthys] -	--
F-RT1304	<i>Ammodytes tobianus/marinus</i>	--	--	- [sp.]	--
F-RT1305	<i>Liparis liparis</i>	--	--	--	--
F-RT1306	<i>Pomatoschistus microps</i>	--	--	--	--
F-RT1307	<i>Merlangius merlangus</i>	Pollachius pollachius	--	--	--
F-RT1308	<i>Sprattus sprattus</i>	--	--	Clupea harengus	--
F-RT1309	<i>Pomatoschistus minutus</i>	--	--	--	--
F-RT1310	<i>Limanda limanda</i>	--	--	--	[Limada] [limada]
F-RT1311	<i>Chelon labrosus</i>	Dicentrarchus labrax	--	[Liza] ramada	[Liza] ramada
F-RT1312	<i>Pomatoschistus lozanoi</i>	- microps	- minutus	- minutus	--
F-RT1313	<i>Trisopterus minutus</i>	- esmarkii	--	Gadus morhua	--
F-RT1314	<i>Pleuronectes platessa</i>	Scophthalmus rhombus	--	--	--
F-RT1315	<i>Crystallogobius linearis</i>	Sprattus sprattus	--	Aphia minuta	--

Specimen Images and Detailed Breakdown of Identifications

Participating laboratories were asked to identify to species 15 specimens supplied with images and basic habitat and geographic details recorded when they were collected. Participants could also submit notes on their identifications, confidence level and details of literature used.

FRT13 included species that have been previously highlighted as problematic and juvenile or small specimens that lack diagnostic features present at a larger size. Several participants highlighted problems with identifications and the results emphasise the need for identification policies for some problematic groups, these are discussed at the end of the bulletin.

LabCodes are abbreviated in this report to exclude the Scheme year, i.e. LB2605 = Lab 05. An additional terminal character has been added within each LabCode (small case sequential letters) to permit multiple data entries from each laboratory, *i.e.* two participants from laboratory 01 would be coded as Lab 01a and Lab 01b. For details of your LabCode please contact your Scheme representative or APEM Ltd.

Figured FRT specimens are selected from the circulation series as typical of the size and condition range circulated. Where possible, figured specimens of other species have been selected to be of similar size as the FRT specimen with which they have been confused.

F-RT1301 - *Eutrigla gurnardus* (Linnaeus, 1758)

Substratum: Mixed. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel.
Condition: Good. Size: 45–65 mm.

One generic and specific difference. Lab 07c identified as *Trigla lyra* which has the snout produced to form two flattened plates (one on each side) and a large more developed spine immediately above the pectoral fin.



Fig 1a. *Eutrigla gurnardus* (FRT1301)



Fig 1b. *Trigla lyra* (NMBAQC workshop)

F-RT1302 - *Clupea harengus* Linnaeus, 1758

Substratum: Pelagic. Salinity: Reduced. Depth: Circalittoral (Upper Shelf). Geography: Thames Estuary.
Condition: Fair. Size: 35–40 mm.

Five generic and specific differences. Labs 03b, 06, 07e and 10 identified as *Sprattus sprattus* which at this size would have fewer myotomes in the trunk (31–35 instead of 41 from the back of the head to the anus). Lab F04 identified as *Sardina pilchardus* which has the pylorus level with the pelvic fin (7–8 myotomes in front for *C. harengus*).



Fig 2a. *Clupea harengus* (FRT1302)



Fig 2b. *Sprattus sprattus* (Thames Estuary)

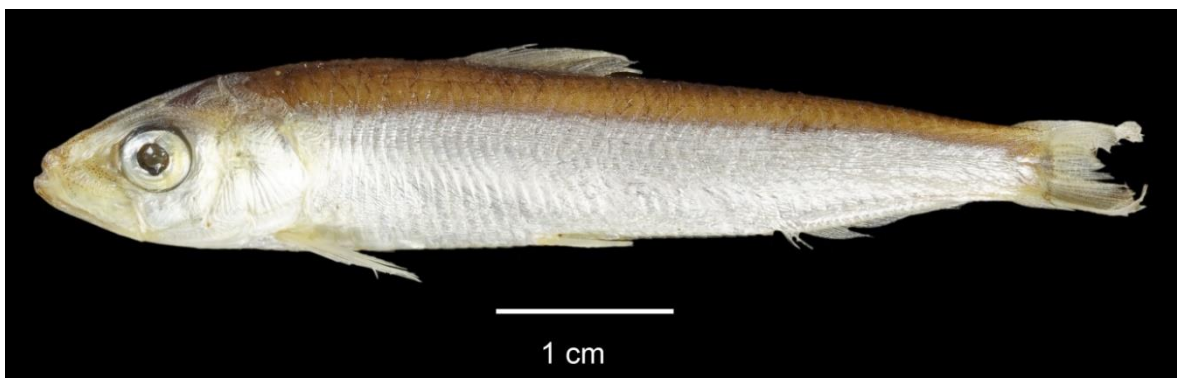


Fig 2c. *Sardina pilchardus* (St Ives Bay)

F-RT1303 - *Platichthys flesus* (Linnaeus, 1758)

Substratum: Mixed. Salinity: Reduced. Depth: Infralittoral. Geography: English Channel. Condition: Fair. Size: 45–65 mm.

Three generic and specific differences. Labs 07b and 07c identified as *Pleuronectes platessa* (Fig 4a) which lacks the sharp prickles along the bases of the dorsal and anal fins and has more caudal fin rays (19–22 instead of 18). Lab 05 identified as *Microstomus kitt* which also lacks the sharp prickles, has a small head (1/5 body length) and very small mouth.

Lab 10 misspelt the generic name as '*Platichyths*'.

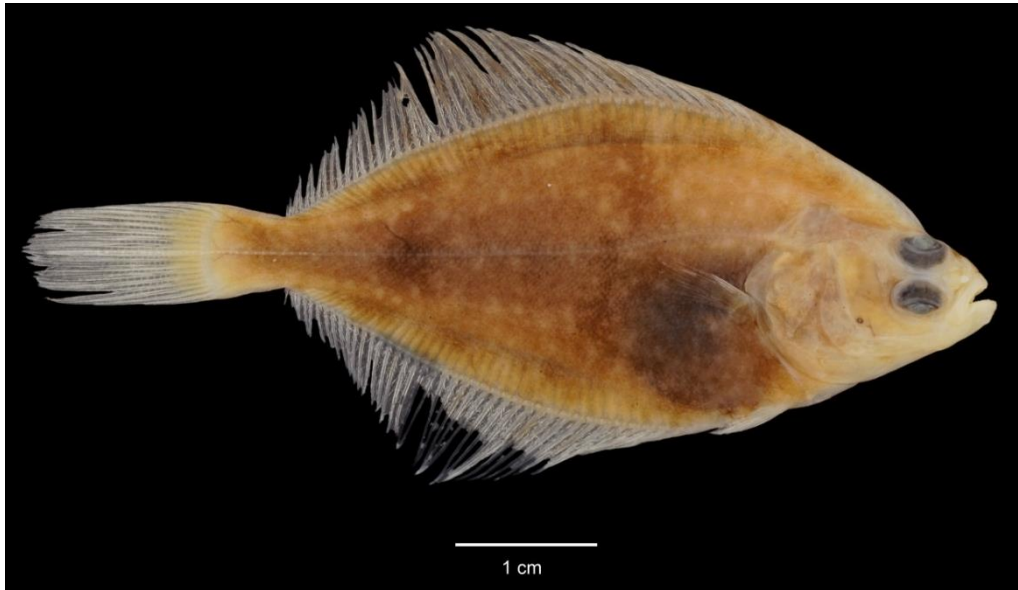


Fig 3a. *Platichthys flesus* (FRT1303)



Fig 3b. *Microstomus kitt* (Blackwater Estuary, approx. 60 mm total length)

F-RT1304 - *Ammodytes tobianus* Linnaeus, 1758/*Ammodytes marinus* Raitt, 1934

Substratum: Sand. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel. Condition: Poor. Size: 55–90 mm.

Identification of specimen 4 was contested and following re-examination of the batch of specimens used its possible some labs received a specimen where the diagnostic features needed to separate the two species (*Ammodytes tobianus* and *A. marinus*) were indeterminant. We have therefore accepted both names as correct.

Two generic differences. Labs 03a and 07e identified *Hyperoplus lanceolatus* which lacks a protrusible jaw and possesses a large bifid tooth on the palate.

Lab 10 did not identify the specimen beyond genus but in this instance we have not included this as a specific error.



Fig 4a. *Ammodytes tobianus* (FRT1304)

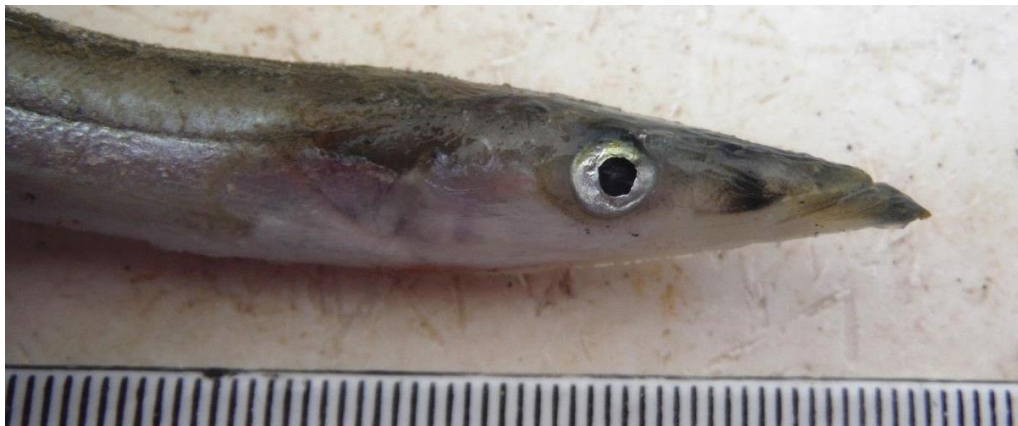


Fig 4b. *Hyperoplus lanceolatus* (Foryd Estuary)

F-RT1305 - *Liparis liparis* (Linnaeus, 1766)

Substratum: Coarse. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel.
Condition: Poor. Size: 35–45 mm.

One specific difference. Lab 05 identified as *Liparis montagui* which does not have the dorsal or anal fin joining the tail fin.



Fig 5a. *Liparis liparis* (FRT1305)



Fig 5b. *Liparis liparis* tail fin detail (Blackwater Estuary)



Fig 5c. *Liparis montagui* (NMBAQC workshop)

F-RT1306 - *Pomatoschistus microps* (Krøyer, 1838)

Substratum: Muddy sand. Salinity: Reduced. Depth: Intertidal. Geography: St Ives Bay. Condition: Fair. Size: 40–45 mm.

One specific difference. Lab 07b identified as *Pomatoschistus minutus* (Fig 9a) which has smaller scales (55–58 in lateral series) and branchiostegal membrane that attaches to the anterior half of the isthmus.

Lab 05 misspelt the generic name as '*Pomatoschistos*'.



Fig 6a. *Pomatoschistus microps* (FRT1306)

F-RT1307 - *Merlangius merlangus* (Linnaeus, 1758)

Substratum: Mixed. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel. Condition: Poor. Size: 60–70 mm.

Six generic and specific differences. Labs 07a, 07b, 07c, 07d and 07e identified as *Trisopterus minutus* which has the origin of the first anal fin beneath the space between the first and second dorsal fins. *T. minutus* also has a relatively long chin barbel (minute barbel present in young *Merlangius merlangus*). Lab 08 identified as *Pollachius pollachius* which has the lower jaw upturned and protruding beyond the upper jaw, and a curve in the lateral line over the pectoral fin.

Lab misspelt the generic name as '*Merlangus*'.



Fig 7a. *Merlangius merlangus* (FRT1307)



Fig 7b. *Trisopterus minutus* (Bristol Channel)



Fig 7c. *Pollachius pollachius* (Blackwater Estuary)

F-RT1308 - *Sprattus sprattus* (Linnaeus, 1758)

Substratum: Pelagic. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel. Condition: Fair. Size: 45–50 mm.

Four generic and specific differences. Labs 02, 04, 07e and 10 identified as *Clupea harengus* which has 27–30 scales along the belly between the throat and pelvic fins and 13–16 between the pelvic fins and vent (21–23 and 11–12 respectively for *Sprattus sprattus*).



Fig 8a. *Sprattus sprattus* (FRT1308)



Fig 8b. *Clupea harengus* (Steart mud flats)

F-RT1309 - *Pomatoschistus minutus* (Pallas, 1770)

Substratum: Pelagic. Salinity: Reduced. Depth: Circalittoral (Upper Shelf). Geography: Thames Estuary. Condition: Good. Size: 45–70 mm.

One generic and three specific differences. Labs 07b and 07c identified as *Pomatoschistus microps* (Fig 6a) which has larger scales (39–52 in lateral series) and branchiostegal membrane that attaches to the posterior of the isthmus. Lab 07e identified as *Gobius niger* which has larger scales (32–42 in lateral series) and short caudal peduncle (distance between end of dorsal fin and start of tail fin).



Fig 9a. *Pomatoschistus minutus* (FRT1309)



Fig 9b. *Gobius niger* (Blackwater Estuary)

F-RT1310 - *Limanda limanda* (Linnaeus, 1758)

Substratum: Mixed. Salinity: Reduced. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel.
Condition: Good. Size: 35–50 mm.

No generic or specific differences recorded.

Lab 12 misspelt the generic and specific name as '*Limada limada*'.



Fig 10a. *Limanda limanda* (FRT1310)

F-RT1311 - *Chelon labrosus* (Risso, 1827)

Substratum: Muddy sand. Salinity: Low. Depth: Intertidal. Geography: St Ives Bay. Condition: Fair. Size: 35–45 mm.

Two generic and twelve specific differences. Labs 02, 03a, 03b, 07a, 07b, 07c, 07d, 07e, 10 and 12 identified as [*Liza*]/*Chelon ramada* which has less pigmentation on the ventro-opercular region of the head and usually 7–8 pyloric caeca (*C. labrosus* has stronger ventro-opercular pigmentation and usually 6 pyloric caeca). Labs 05 and 08 identified as *Dicentrarchus labrax* which has a larger mouth.

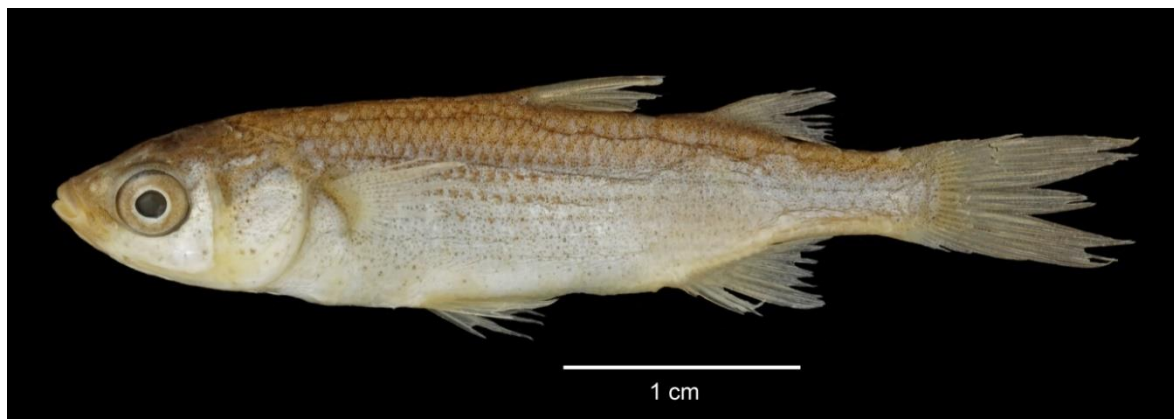


Fig 11a. *Chelon labrosus* (FRT1311)



Fig 11b. *Chelon ramada* (Thames Estuary)



Fig 11c. *Dicentrarchus labrax* (Steart mud flats)

F-RT1312 - *Pomatoschistus lozanoi* (de Buen, 1923)

Substratum: Pelagic. Salinity: Reduced. Depth: Circalittoral (Upper Shelf). Geography: Thames Estuary. Condition: Fair. Size: 35–45 mm.

Eleven specific differences. Labs 02, 07b and 08 identified as *Pomatoschistus microps* (Fig 6a) which has larger scales (39–52 in lateral series) and branchiostegal membrane that attaches to the posterior of the isthmus. Labs 07a, 07c, 07d, 07e, 09 and 10 identified as *P. minutus* (Fig 9a) which has transverse rows of sensory papillae below row *b* with only the *cp* row descending below the level of row *d* (*P. lozanoi* having two rows other than *cp* descending through row *d*). Labs 03a and 03b identified as *P. norvegicus* which has pectoral fins with 17 rays (16–18 range; 18–21 for *P. lozanoi*) and typically occurs offshore.



Fig 12a. *Pomatoschistus lozanoi* (FRT1312)

F-RT1313 - *Trisopterus minutus* (Linnaeus, 1758)

Substratum: Mixed. Salinity: High. Depth: Circalittoral (Upper Shelf). Geography: Bristol Channel. Condition: Fair. Size: 65–75 mm.

One generic and six specific differences. Labs 03a, 03a, and 08 identified as *Trisopterus esmarkii* which has a lower jaw slightly longer than the upper (upper jaw overlaps lower for *T. minutus*), eye diameter slightly longer than the snout (equal for adult *T. minutus*) and small chin barbel (long for *T. minutus*). Labs 02 and 06 identified as *T. luscus* which has the origin of the anal fin well forward under the middle of the first dorsal fin (beneath the space between the first and second dorsal fins or anterior to it for *T. minutus*). *T. minutus* can also be distinguished from *T. luscus* by the number of gill rakers on the first gill arch (25–32 and 14–22 respectively). Lab 10 identified as *Gadus morhua* which has a small eye and the first anal fin originating behind or beneath the space between the first and second dorsal fins. Lab 05 misspelt the generic name '*Trisopterus*' and lab 07c misspelt the specific name '*microps*'.



Fig 13a. *Trisopterus minutus* (FRT1313)

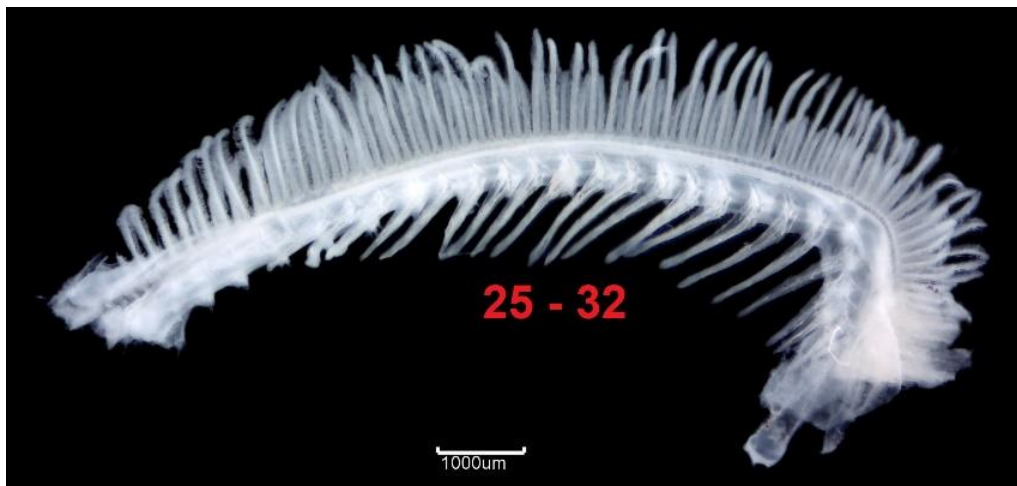


Fig 13b. *Trisopterus minutus* first gill arch (FRT1313)



Fig 13c. *Trisopterus esmarkii* (Stewart mud flats)



Fig 13d. *Trisopterus luscus* (Blackwater Estuary)



Fig 13e. *Gadus morhua* (Bristol Channel)

F-RT1314 - *Pleuronectes platessa* Linnaeus, 1758

Substratum: Mixed. Salinity: Reduced. Depth: Intertidal. Geography: Bristol Channel. Condition: Fair. Size: 15–25 mm.

Four generic and specific differences. Labs 07c and 07e identified as *Limanda limanda* which has 16–18 caudal fin rays (19–22 for *Pleuronectes platessa*). Lab 03a identified as *Microstomus kitt* which has a greater number of anal fin rays (69–79; 43–61 for *P. platessa*). Lab 08 identified as *Scophthalmus rhombus* which has the right eye on the left side of the head (left eye migrating to the right side for *P. platessa*).



Fig 14a. *Pleuronectes platessa* (FRT1314)



Fig 14b. *Scophthalmus rhombus* (FRRT11)

F-RT1315 - *Crystallogobius linearis* (Düben, 1845)

Substratum: Pelagic. Salinity: Reduced. Depth: Circalittoral (Upper Shelf). Geography: Thames Estuary. Condition: Poor. Size: 15–25 mm.

Seven generic and specific differences. Labs 07a, 07b, 07c and 08 identified as *Sprattus sprattus* which has a much greater pre-anal to post-anal length (3:1–2:1 vs 1:1 for *Crystallogobius linearis*). Lab 10 identified as *Aphia minuta* which has fewer vertebrae (26–28 vs 29–31 for *C. linearis*) and fewer second dorsal and anal fin rays (12–14 and 12–16 respectively; 19–21 and 21–22 respectively for *C. linearis*). Lab 07e identified as *Ciliata mustela* which at this size would have long pigmented pelvic fins and many more second dorsal and anal fin rays (45–52 and 39–44 respectively). Lab 07d left the generic and specific name blank.



Fig 15a. *Crystallogobius linearis* (FRT1315), second dorsal and anal fin rays range red



Fig 15b. *Aphia minuta* (Thames Estuary), second dorsal and anal fin rays range red



Fig 15c. *Ciliata mustela* (Blackwater Estuary)

Taxonomic discrepancies and confidence level

Synonyms

The World Register of Marine Species (WoRMS) and FishBase, accessed January 2020, were used for currently valid species names. Seven participants submitted the name *Chelon ramada* (Risso, 1827) for specimen 11. However, there are currently inconsistencies in the preferred names for grey mullet species, as summarised below.

Valid/accepted species names from online sources (January 2020)			
WoRMS	FishBase	Eschmeyer's Catalog of Fishes	UK Species Inventory (Natural History Museum)
<i>Chelon auratus</i>	<i>Chelon auratus</i>	<i>Liza aurata</i>	<i>Liza aurata</i>
<i>Chelon labrosus</i>	<i>Chelon labrosus</i>	<i>Chelon labrosus</i>	<i>Chelon labrosus</i>
<i>Chelon ramada</i>	<i>Chelon ramada</i>	<i>Chelon ramada</i>	<i>Liza ramada</i>

Recent studies of the molecular phylogenies of Mugilidae have demonstrated that UK species of *Liza* should be assigned to *Chelon* (Durand *et al.*, 2012; Durand & Borsa, 2015; Xia *et al.*, 2016). Until recently there was a consensus between WoRMS, FishBase and Eschmeyer's Catalog of Fishes for *C. auratus* and *C. ramada*; however, as of January 2020, Eschmeyer's Catalog of Fishes now lists *L. aurata* as valid instead of *C. auratus*. It is unclear why *L. aurata* is currently valid in Eschmeyer's Catalog of Fishes; we recommend using WoRMS and FishBase for grey mullet species names.

Authority errors

From 240 entries only 119 specimen names were submitted with an authority. The authority and year were correct for those submitted; however, there were 32 records either missing parentheses or incorrectly containing them. The Authority for one entry contained a typographic error. Authority errors were not counted as taxonomic discrepancies.

Confidence level

Confidence of identification was given for 209 entries (87% from 240 answers submitted). For those given 80% were confident with species identification, 14% genus and 6% family. Most confidence levels given were accurate or conservative (67% and 11.5% respectively), 21% were overconfident with the identification given.

FRT13 identifications made from images.

Prior to the distribution of FRT13 specimens the images were made available to participants to test identifications made without physical specimens. Participants were asked to complete an optional answer sheet in the same format as the normal FRT and submit results before the specimens were distributed. Images of specimens were kept consistent (dorsal, lateral, ventral etc.) but were not specifically taken to show diagnostic features, the intention was to give images somewhat like those that can be taken in the field. Seven laboratories participated with one laboratory submitting two answer sheets. To avoid duplication and confusion individual results are not included in this bulletin but the overall results are discussed below.

Table 4. Summary of differences from image FRT

Specimen	Genus	Species	Total differences for 8 returns	
			Genus	Species
F-RT1301	<i>Eutrigla</i>	<i>gurnardus</i>	0	0
F-RT1302	<i>Clupea</i>	<i>harengus</i>	3	3
F-RT1303	<i>Platichthys</i>	<i>flesus</i>	1	1
F-RT1304	<i>Ammodytes</i>	<i>tobianus/marinus</i>	1	1
F-RT1305	<i>Liparis</i>	<i>liparis</i>	0	1
F-RT1306	<i>Pomatoschistus</i>	<i>microps</i>	1	1
F-RT1307	<i>Merlangius</i>	<i>merlangus</i>	5	5
F-RT1308	<i>Sprattus</i>	<i>sprattus</i>	2	2
F-RT1309	<i>Pomatoschistus</i>	<i>minutus</i>	2	2
F-RT1310	<i>Limanda</i>	<i>limanda</i>	0	0
F-RT1311	<i>Chelon</i>	<i>labrosus</i>	1	4
F-RT1312	<i>Pomatoschistus</i>	<i>lozanoi</i>	1	5
F-RT1313	<i>Trisopterus</i>	<i>minutus</i>	2	6
F-RT1314	<i>Pleuronectes</i>	<i>platessa</i>	4	4
F-RT1315	<i>Crystallogobius</i>	<i>linearis</i>	3	3
Total differences			26	38
Average differences /lab.			3.3	4.8

The average numbers of generic and specific errors were higher when only images were used. Two specimens were identified from images without any errors (specimen 01 and 10; *E. gurnardus* and *L. limanda*). Generally, specimens with a low number of errors from the image test had a low number of errors for the FRT (specimens 03, 04, 05, 06, 08 and 09). Small specimens and those requiring manipulation to check diagnostic features had the highest errors (Specimens 02, 07, 11, 12, 13, 14 and 15). A direct comparison with results after specimens were distributed is not possible as some participants submitted multiple answer sheets for the different components.

Confidence of identification from images was given for 62 entries (from 120 answers submitted); for those given 63% were confident with species identification, 19% genus, 16% family and 2% order. Only 8% were overconfident, 71% were accurate and 21% were conservative. Notes and comments submitted with answers indicate identifications of some specimens were cautious and that better images of diagnostic features are needed when the specimen is not available to manipulate.

The results from the image only FRT including the notes and comments received indicate that many participants are not confident making species level identifications with images despite mostly answering correctly. Possibilities for the use of image only FRT specimens (e.g. rare or conservation species) will be discussed in the annual report.

Literature Cited for FRT13 Identification

	FRT13 Specimen														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aprahamian <i>et al.</i> , 2003		x													
Costalago & Palomera, 2014		x													
Henderson, 2014/2015	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ICES WKIDFL REPORTS, 2011–2014		x													
Kay & Dipper, 2009									x						
Kovačić, 2008						x						x			x
Lebour, 1921		x													
Maitland & Herdson, 2009	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Miller, 2011a						x						x			x
Miller, 2011b						x						x			x
Minos <i>et al.</i> , 2002											x				
Munk & Neilsen, 2005	x	x													
Nichols, 1971 (ICES/CIEM)			x												
NMBAQC FRT09											x				
Petersen, 1919															x
Ré & Meneses, 2008															x
Reay & Cornell, 1988											x				
Russell, 1976	x	x			x				x		x			x	x
Saville, 1964 (ICES/CIEM)		x						x						x	
Wheeler, 1969	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Wheeler, 1978	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Whitehead <i>et al.</i> , 1984–1986	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
FishBase	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
WoRMS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Additional literature used by APEM Ltd.

Aprahamian *et al.*, 2003
 Arias & Drake, 1990
 Eick, 2012
 Knebelsberger & Thiel, 2014
 Wallis & Beardmore, 1980
 Webb, 1980
 Eschmeyer's Catalog of Fishes

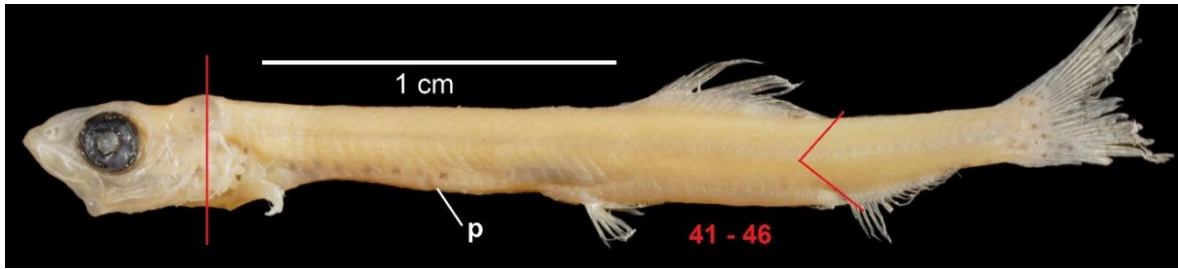
Taxonomic and identification policy problems highlighted by this RT

Four groups of species were highlighted as problematic in the FRT; juvenile clupeids, sand eels, the sand goby complex and juvenile grey mullet. Detailed notes on the diagnostic features used to separate species in these groups are listed below followed by notes and comments raised for other FRT specimens.

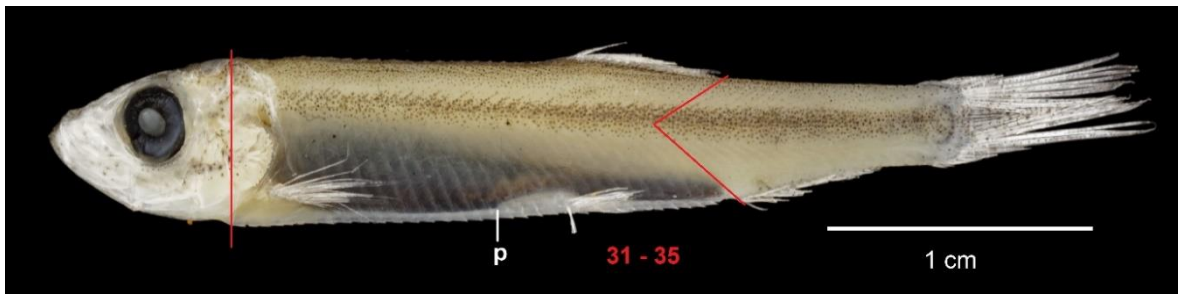
Juvenile clupeids

There were five generic and five specific errors for specimen 02 (*C. harengus*) and four generic and four specific errors for specimen 08 (*S. sprattus*). The relative position of the dorsal and pelvic fin origins is often used to distinguish between *S. sprattus* and *C. harengus*, however in small juvenile and post larval size specimens this feature is unreliable. The body proportions change during development, myotome count decreases with age and the vent moves forward. For 'post larval' size specimens (approx. 30–40 mm) we recommend using the number of myotomes in the trunk (from the back of the head to the vent) and the position of the pelvic fin relative to the pylorus (Figure 2; 41–46 and 7–8 behind for *C. harengus*; 31–35 and 4–5 behind for *S. sprattus*; 36–41 and level with pylorus for *S. pilchardus*). At 'juvenile' size some of the distinguishing adult features become apparent (Figure 3); scales along the belly between the throat and pelvic fins and between the pelvic fins and vent (27–30 and 13–16 for *C. harengus*; 21–23 and 11–12 for *S. sprattus*); striae radiating downward on lower part of operculum (*S. pilchardus*); early development of characteristic body shape (from 20–30mm, *Alosa fallax*).

Clupea harengus (Thames Estuary)



Sprattus sprattus (FRT1308)



Sardina pilchardus (Thames Estuary)

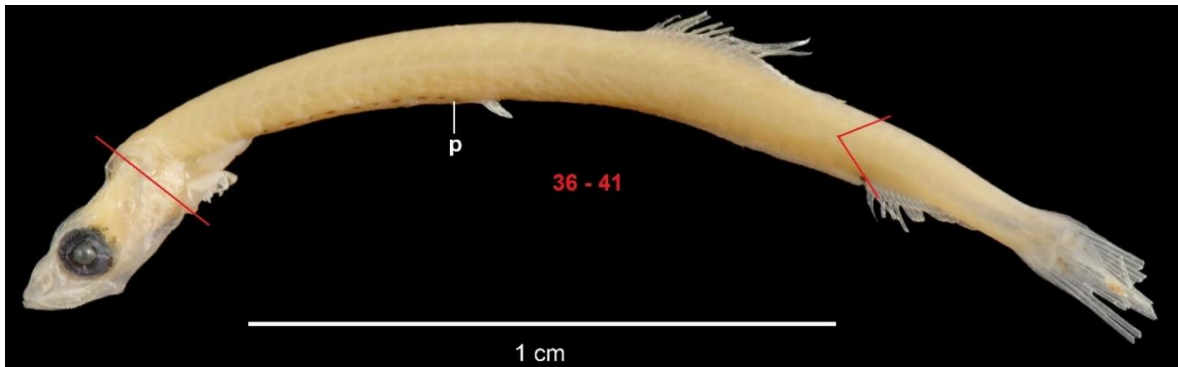
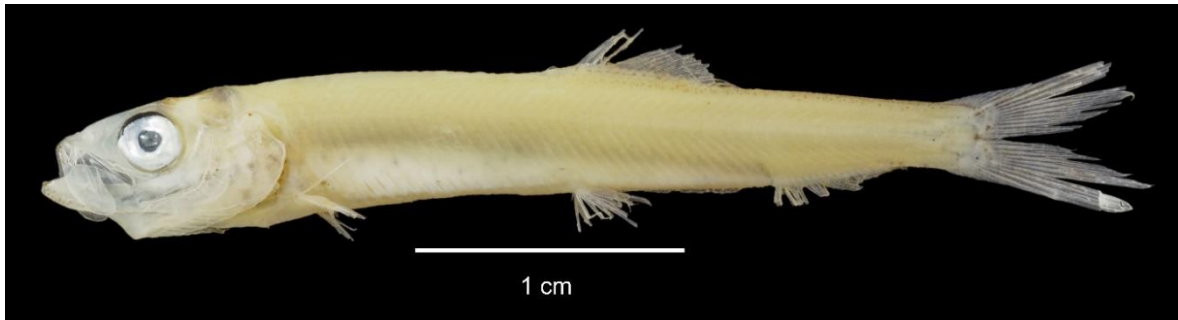
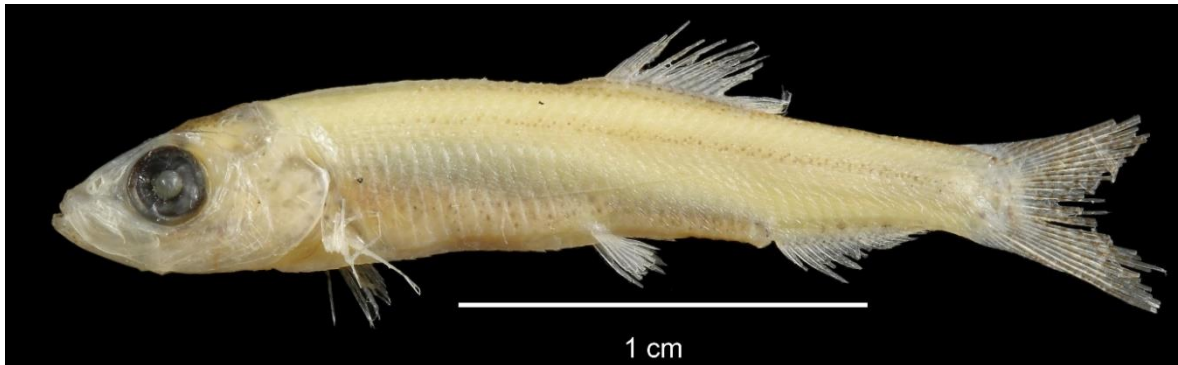


Figure 2. Post larval clupeids; number of myotomes in trunk (back of the head to the vent, red), p = pylorus.

Clupea harengus (FRT1302)



Sprattus sprattus (Thames Estuary)



Sardina pilchardus (Bristol Channel)



Alosa fallax (Bristol Channel)



Figure 3. Comparison of juvenile clupeids

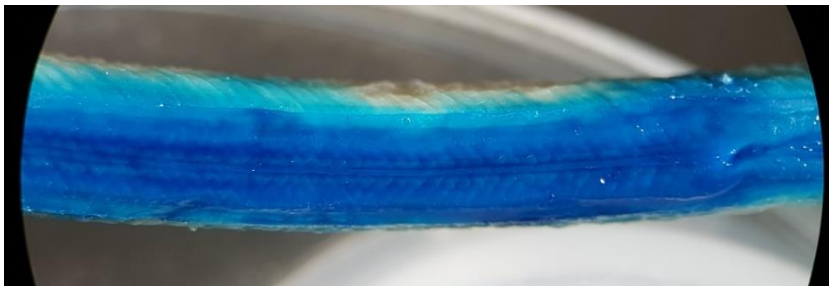
Sand eels

Eight participants identified specimen 08 as *A. tobianus*, four as *A. marinus*, one as *H. immaculatus* and one as *Ammodytes* sp. The lack of a protrusible jaw and a large bifid tooth on the palate distinguished *H. lanceolatus* from *A. marinus* and *A. tobianus*. Fresh *H. lanceolatus* also have a dark spot on the snout (Fig 4b). The key features that distinguish *A. marinus* from *A. tobianus* are the lack of scales on the base of the tail fin lobes, having the belly scales in irregular rows (chevron patterned in *A. tobianus*), 50–56 dorsal fin rays (*A. tobianus* 55–67) and 66–72 vertebrae (*A. tobianus* 60–66). Getting an accurate dorsal fin ray count with small specimens is impractical and vertebrae counts are also impractical for most purposes. Specimens used for the ring test were identified based on belly scales and scales on the base of the tail fin (Figure 4). In fresh specimens the scales are a reliable feature, however after preservation the scales on the base of the tail fin can be lost and the belly scales become less clear. Participants notes suggest that *A. tobianus* and *A. marinus* are not identified to species at the size of the specimens distributed (<9 cm) for some laboratories.

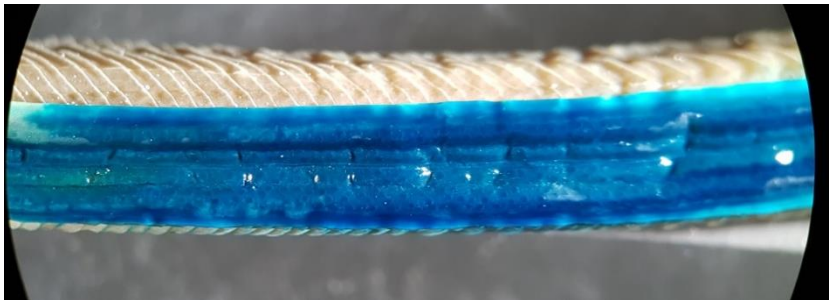
Ammodytes tobianus (Blackwater Estuary) belly scales



Ammodytes tobianus (FRT1304) belly scales



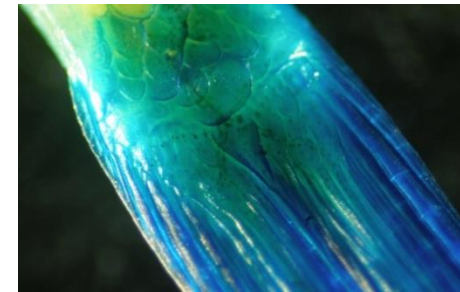
Ammodytes marinus (Moray Firth) belly scales



Ammodytes tobianus (Blackwater Estuary) tail fin lobes



Ammodytes tobianus tail fin lobes (image supplied by participant)



Ammodytes marinus (Moray Firth) tail fin lobes

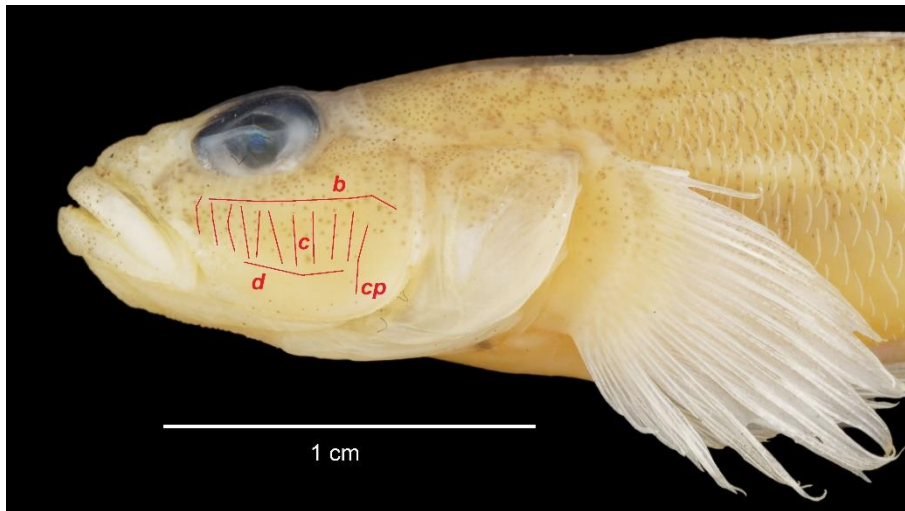


Figure 4. Comparison of *A. tobianus* and *A. marinus*; fresh specimen top and preserved specimens stained with methyl green below

Sand goby complex

Six participants identified specimen 12 (*P. lozanoi*) as *P. minutus* and two participants identified as *P. norvegicus*. These species can be distinguished by sensory papillae on the head (Figure 5; *P. lozanoi* and *P. norvegicus* having two *c* rows other than *cp* descending through row *d*) and pectoral fin rays (*P. norvegicus* with 17 rays, 16–18 range; 18–21 for *P. lozanoi*). The number of transverse *c* rows for each species varies but can also aid identification, 8–12 for *P. minutus*, 7–11 for *P. lozanoi* and 7–9 for *P. norvegicus*. *P. norvegicus* is also reported to occur offshore in deeper water. There is evidence *P. minutus* and *P. lozanoi* interbreed in the wild, to avoid ambiguous specimens being distributed sensory papillae were checked for both sets of specimens. Although these species can be separated using a combination of features they do require preservation and a microscope. Participants commented that they would normally leave *Pomatoschistus* species at genus or aggregate *P. minutus* with *P. lozanoi* and *P. norvegicus*.

***Pomatoschistus minutus* (FRT1309)**



***Pomatoschistus lozanoi* (FRT1312)**

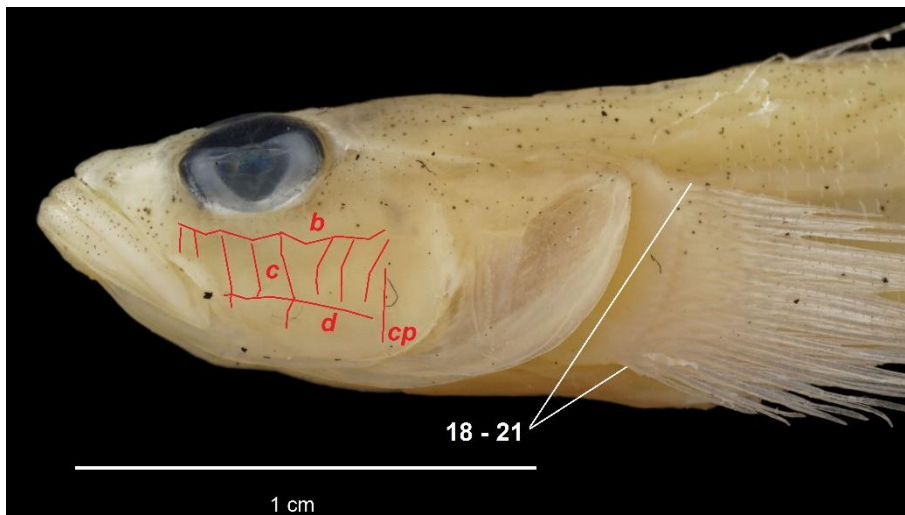
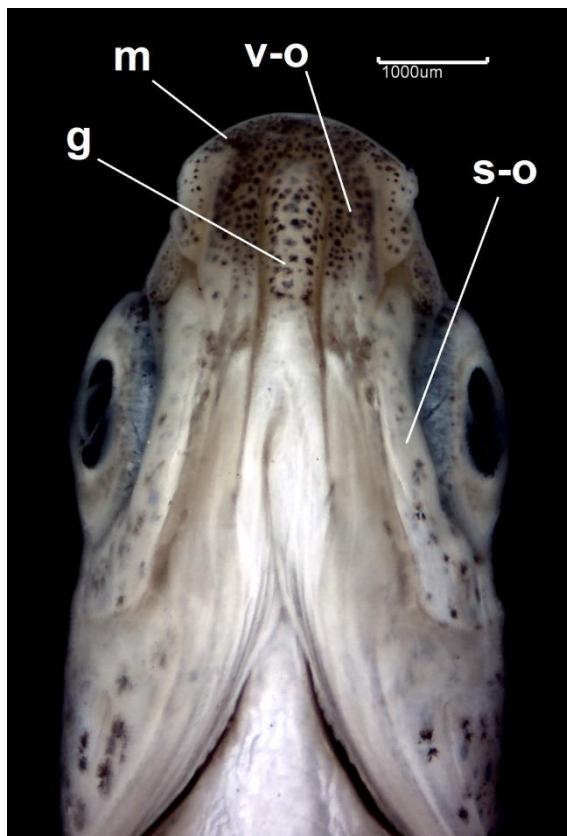


Figure 5. *Pomatoschistus* species head detail; sensory papillae red and pectoral fin ray range white

Juvenile grey mullet

Ten participants identified specimen 11 as *C. ramada* (or the synonym *L. ramada*). The length of the pectoral fin (reaching eye) and presence of lip papillae are unreliable features for juvenile specimens. The diagnostic features we used to separate juvenile *C. ramada*, *C. labrosus* and *C. auratus* are the ventral head pigmentation (Figure 6; Reay & Cornell, 1988) and the dissection of the pyloric caeca (Figure 7) from a sub-sample of specimens. The heaviest ventral head pigmentation for *C. labrosus* occurs on the mandibular (m), ventro-opercular (v-o) and jugular (g). For *C. ramada* the strongest pigment occurs on the mandibular and usually the jugular. For *C. auratus* the heaviest pigment occurs on the ventro-opercular. The number of pyloric caeca for *C. labrosus* is 6 (5–7 range) of equal size. For *C. ramada* 7–8 pyloric caeca (6–9 range) of equal size. *C. auratus* has 8–9 pyloric caeca (6–11 range) in two groups of unequal size. The reported spawning seasons (autumn for *C. ramada* and *C. auratus*; spring for *C. labrosus*) would also suggest that juvenile grey mullet (2–5 cm) captured between August until early spring are likely to be *C. labrosus*.

***Chelon labrosus* (FRT1311)**

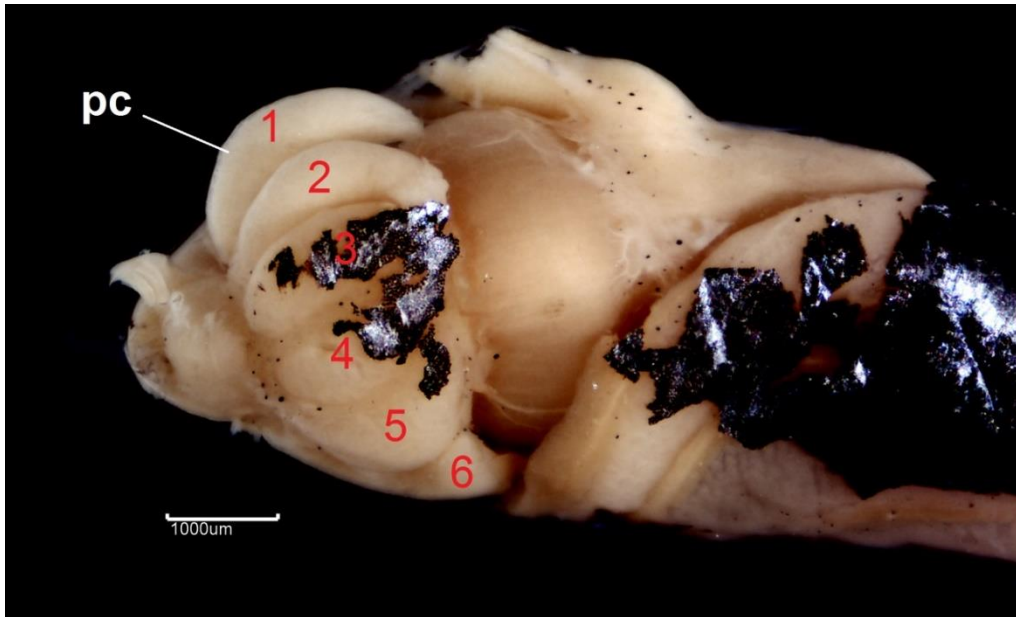


***Chelon ramada* (River Thames)**



Figure 6. Juvenile grey mullet ventral head melanophores; m = mandibular, g = jugular, v-o = ventro-opercular, s-o = sub-orbital

Chelon labrosus (FRT1311)



Chelon ramada (River Thames)

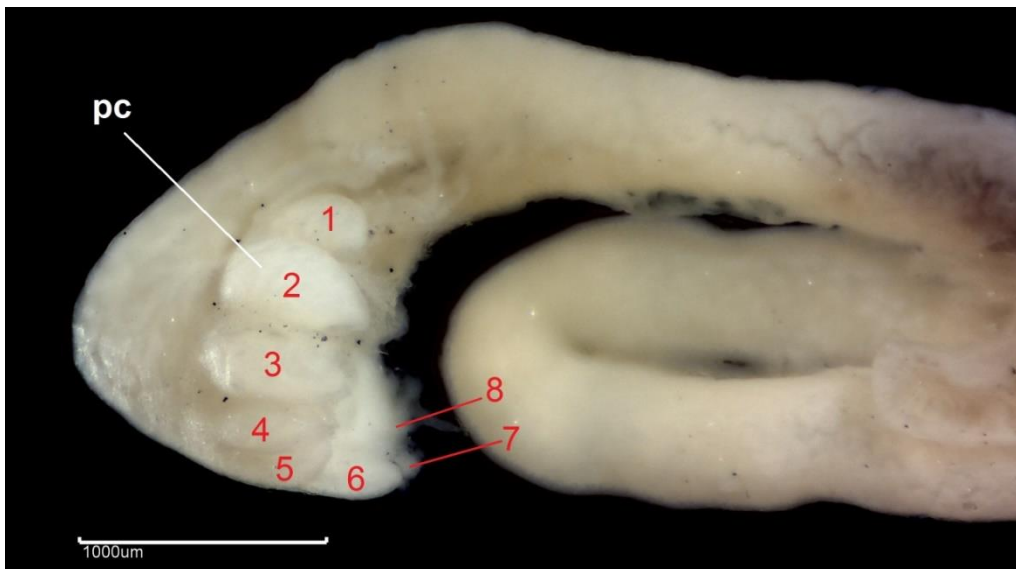


Figure 7. Juvenile grey mullet pyloric caeca (pc)

Additional specimen comments

It was commented that for specimen 01 (*E. gurnardus*) the pectoral fins were long, reaching to the level of the vent (short pectoral fins not reaching the vent being a characteristic for larger specimens). Specimens 14 and 15 (*P. platessa* and *C. linearis*) were noted as being “too small”, either not encountered by participants sample methods or too small to identify in the field. Participants also commented that identification were best made with fresh specimens. We will endeavour to distribute fresh (frozen) specimens in the future but this can be impractical for species requiring detailed examination in the laboratory prior to circulation.

References

- Aprahamian, M.W., Aprahamian, C.D., Baglinière, J.L., Sabatié, R. & Alexandrino, P., 2003. *Alosa alosa* and *Alosa fallax* spp. Literature Review and Bibliography. R&D Technical Report W1-014/TR, Environment Agency, Bristol, UK, 349 pp.
- Arias, A. & Drake, P., 1990. Estados juveniles de la ictiofauna en las caños de las salinas de la bahía de Cadiz. Instituto de Ciencias Marinas de Andalucía. CSIC.
- Checklists of UK species <https://www.nhm.ac.uk/our-science/data/uk-species/checklists/index.html> Accessed January 2020.
- Costalago, D. & Palomera, I., 2014. Feeding of European pilchard (*Sardina pilchardus*) in the northwestern Mediterranean: from late larvae to adults. *Scientia Marina* 78(1), 41–54.
- Durand, J.-D. & Borsa, P., 2015. Mitochondrial phylogeny of grey mullets (Acanthopterygii: Mugilidae) suggests high proportion of cryptic species. *Comptes Rendus Biologies* 338 (4), 266–277.
- Durand, J.-D., Chen, W.-J., Shen, K.-N., Fu, C.-Z. & Borsa, P., 2012. Genus-level taxonomic changes implied by the mitochondrial phylogeny of grey mullets (Teleostei: Mugilidae). *Comptes Rendus Biologies* 335 (10–11), 687–697.
- Durand, J.-D. & Whitfield, A. K., 2016. Biogeography and distribution of Mugilidae in the western, central and southern regions of Africa. In D. Crosetti & S. Blaber (Eds.), *Biology, Ecology and Culture of Grey Mulletts (Mugilidae)*. CRC Press. 102–115.
- Durand, J.-D., 2016. Implications of molecular phylogeny for the taxonomy of Mugilidae. In D. Crosetti & S. Blaber (Eds.), *Biology, Ecology and Culture of Grey Mulletts (Mugilidae)*. CRC Press. 22–41.
- Eick, D., 2012. First confirmed record of Lozano's goby, *Pomatoschistus lozanoi* (de Buen, 1923) (Teleostei: Gobiidae), in the Elbe estuary. *Journal of Applied Ichthyology*, 28(4), 637–640.
- Froese, R. & Pauly, D., (Eds.), 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (08/2019).
- Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2020. Eschmeyer's Catalog of Fishes: Genera, Species, References. Electronic version accessed 03 Jan 2020. (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>).
- Henderson, P., 2015. *Identification Guide to the Inshore Fish of the British Isles*. Pisces Conservation Limited, Pennington, 321 pp.
- ICES/CIEM. Conseil International pour L'exploration de la Mer. Identification Sheets on Fish Eggs and Larvae. Sheets 1 (Clupeoidae), 2 (Ammodytidae), 4–6 (Pleuronectidae), 149 (Labridae), 172 (Blennidae), 173–75 (Macrouridae), 177 (Sparidae).
- ICES/CIEM. Conseil International pour L'exploration de la Mer. Identification Sheets on Zooplankton. Sheets 148 (Callionymidae) and 150–151 (Soleidae).
- Kay, P. & Dipper F., 2009. *A Field Guide to the Marine Fishes of Wales and adjacent waters*. Marine Wildlife, Llanfairfechan, 256 pp.
- Kovačić, M., 2008. The key for identification of Gobiidae (Pisces: Perciformes) in the Adriatic Sea. *Acta Adriatica*, 49(3), 245–254.

- Knebelberger, T. & Thiel, R., 2014. Identification of gobies (Teleostei: Perciformes: Gobiidae) from the North and Baltic Seas combining morphological analysis and DNA barcoding. *Zoological Journal of the Linnean Society*, 172, 831–845, 6 figures.
- Lebour, M., 1921. The larval and post-larval stages of the pilchard, sprat and herring from Plymouth District. *Journal of the Marine Biological Association of the United Kingdom*, 12(3), 427–457.
- Maitland, P.S. & Herderson D., 2009. *Key to the Marine and Freshwater Fishes of Britain and Ireland*. Environment Agency, 480 pp.
- Miller, P.J., 2011a. Gobies of the British Isles (Teleostei: Gobiidae). NMBAQC Fish Workshop, Cullercoats, April. 2011, 1–23 pp., (unpublished).
- Miller, P.J., 2011b. Key to the Gobies of the British Isles. NMBAQC Fish Workshop, Cullercoats, April. 2011, 1–5pp., (unpublished).
- Minos, G., Katselis, G., Ondrias, I. & Harrison, I., 2002. Use of melanophore patterns on the ventral side of the head to identify fry of grey mullets (Teleostei : Mugilidae). *The Israeli Journal of Aquaculture, Bamidgeh*. 54, 12–26.
- Munk, P. & Nielsen, J.P., 2005. *Eggs and larvae of North Sea fishes*. Biofolia, Frederiksberg, Denmark, 2005, 215 pp. ISBN 87-9131-924-2.
- Petersen, C.G.J., 1919. Our gobies (Gobiidae). From the egg to the adult stages. *Reports of the Danish Biological Station*, 26, 45–66.
- Ré, P. & Meneses, I., 2008. Early stages of marine fishes occurring in the Iberian Peninsula. IPIMAR/IMAR, 282 pp.
- Reay, P. J. & Cornell, V., 1988. Identification of grey mullet (Teleostei: Mugilidae) juveniles from British waters. *Journal of Fish Biology*, 32, 95–99.
- Raper, C., 2014. Dataset: UK Species Inventory - Simplified copy. Resource: UK Species Inventory Simplified copy. Natural History Museum Data Portal (data.nhm.ac.uk) [Last updated Oct 2019].
- Russell, F.S., 1976. *Eggs and Planktonic Stages of British Marine Fishes*. Academic Press, London, 524 pp.
- Wallis, G.P. & Beardmore, J.A., 1980. Genetic evidence for naturally occurring fertile hybrids between two goby species, *Pomatoschistus minutus* and *P. lozanoi* (Pisces, Gobiidae). *Marine Ecology Progress Series*, 3, 309–315.
- Webb, C.J., 1980. Systematics of the *Pomatoschistus minutus* complex (Teleostei: Gobioidae). *Philosophical Transactions of the Ray Society London B*, 292, 201–241.
- Wheeler, A., 1969. *The fishes of the British Isles and North West Europe*. Macmillan, London, 380 pp.
- Wheeler, A., 1978. *Key to the fishes of Northern Europe*. Warne, London, 380 pp.
- Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.-C, Nielsen, J. & Tortonese, E., 1986. *Fishes of the North-eastern Atlantic and the Mediterranean*, Volume I., 1–510pp., Volume II, 511–1007, Volume III, 1008–1473., UNESCO, Paris.
- WoRMS Editorial Board 2020. World Register of Marine Species. Available from <http://www.marinespecies.org> at VLIZ. Accessed 2020-01-03. doi:10.14284/170.

Xia, R., Durand, J.-D. & Fu, C.-Z. 2016. Multilocus resolution of Mugilidae phylogeny (Teleostei: Mugiliformes): implications for the family's taxonomy. *Molecular Phylogenetics and Evolution*, 96, 161–177.

Index (FRT Figures)

Fig 1a. <i>Eutrigla gurnardus</i> (FRT1301).....	14
Fig 1b. <i>Trigla lyra</i> (NMBAQC workshop)	14
Fig 2a. <i>Clupea harengus</i> (FRT1302).....	15
Fig 2b. <i>Sprattus sprattus</i> (Thames Estuary)	15
Fig 2c. <i>Sardina pilchardus</i> (St Ives Bay)	15
Fig 3a. <i>Platichthys flesus</i> (FRT1303)	16
Fig 3b. <i>Microstomus kitt</i> (Blackwater Estuary, approx. 60 mm total length)	16
Fig 4a. <i>Ammodytes tobianus</i> (FRT1304).....	17
Fig 4b. <i>Hyperoplus lanceolatus</i> (Foryd Estuary).....	17
Fig 5a. <i>Liparis liparis</i> (FRT1305).....	18
Fig 5b. <i>Liparis liparis</i> tail fin detail (Blackwater Estuary)	18
Fig 5c. <i>Liparis montagui</i> (NMBAQC workshop).....	18
Fig 6a. <i>Pomatoschistus microps</i> (FRT1306).....	19
Fig 7a. <i>Merlangius merlangus</i> (FRT1307)	19
Fig 7b. <i>Trisopterus minutus</i> (Bristol Channel).....	20
Fig 7c. <i>Pollachius pollachius</i> (Blackwater Estuary).....	20
Fig 8a. <i>Sprattus sprattus</i> (FRT1308)	20
Fig 8b. <i>Clupea harengus</i> (Stear mud flats).....	21
Fig 9a. <i>Pomatoschistus minutus</i> (FRT1309)	21
Fig 9b. <i>Gobius niger</i> (Blackwater Estuary)	21
Fig 10a. <i>Limanda limanda</i> (FRT1310).....	22
Fig 11a. <i>Chelon labrosus</i> (FRT1311).....	22
Fig 11b. <i>Chelon ramada</i> (Thames Estuary)	23
Fig 11c. <i>Dicentrarchus labrax</i> (Stear mud flats).....	23
Fig 12a. <i>Pomatoschistus lozanoi</i> (FRT1312).....	23
Fig 13a. <i>Trisopterus minutus</i> (FRT1313).....	24
Fig 13b. <i>Trisopterus minutus</i> first gill arch (FRT1313).....	24
Fig 13c. <i>Trisopterus esmarkii</i> (Stear mud flats)	25
Fig 13d. <i>Trisopterus luscus</i> (Blackwater Estuary)	25
Fig 13e. <i>Gadus morhua</i> (Bristol Channel)	25
Fig 14a. <i>Pleuronectes platessa</i> (FRT1314).....	26
Fig 14b. <i>Scophthalmus rhombus</i> (FRRT11).....	26
Fig 15a. <i>Crystallogobius linearis</i> (FRT1315), second dorsal and anal fin rays range red	27
Fig 15b. <i>Aphia minuta</i> (Thames Estuary), second dorsal and anal fin rays range red	27
Fig 15c. <i>Ciliata mustela</i> (Blackwater Estuary)	27

Specimen labels

You are not required to return the specimens to APEM Ltd. A sheet of labels is provided for incorporating these specimens into in-house reference collections.

NMBAQC Scheme
<i>Eutrigla gurnardus</i> Location: Bristol Channel Gear: Otter trawl F-RT1301

NMBAQC Scheme
<i>Pomatoschistus microps</i> Location: St Ives Bay Gear: Seine net F-RT1306

NMBAQC Scheme
<i>Chelon labrosus</i> Location: St Ives Bay Gear: Seine net F-RT1311

NMBAQC Scheme
<i>Clupea harengus</i> Location: Thames Estuary Gear: Nackthai sampler F-RT1302

NMBAQC Scheme
<i>Merlangius merlangus</i> Location: Bristol Channel Gear: Otter trawl F-RT1307

NMBAQC Scheme
<i>Pomatoschistus lozanoi</i> Location: Thames Estuary Gear: Nackthai sampler F-RT1312

NMBAQC Scheme
<i>Platichthys flesus</i> Location: English Channel Gear: Water entrainment F-RT1303

NMBAQC Scheme
<i>Sprattus sprattus</i> Location: Bristol Channel Gear: Otter trawl F-RT1308

NMBAQC Scheme
<i>Trisopterus minutus</i> Location: Bristol Channel Gear: Otter trawl F-RT1313

NMBAQC Scheme
<i>Ammodytes tobianus</i> Location: Bristol Channel Gear: Otter trawl F-RT1304

NMBAQC Scheme
<i>Pomatoschistus minutus</i> Location: Thames Estuary Gear: Nackthai sampler F-RT1309

NMBAQC Scheme
<i>Pleuronectes platessa</i> Location: Bridgewater Bay Gear: Seine net F-RT1314

NMBAQC Scheme
<i>Liparis liparis</i> Location: Bristol Channel Gear: Otter trawl F-RT1305

NMBAQC Scheme
<i>Limanda limanda</i> Location: Bristol Channel Gear: Otter trawl F-RT1310

NMBAQC Scheme
<i>Crystallogobius linearis</i> Location: Thames Estuary Gear: Nackthai sampler F-RT1315