



Guidelines for the selection of biological SSSIs

Part 2: Detailed guidelines for habitats and species groups

Chapter 19b Estuarine fish

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Cover note

This chapter updates and replaces the previous Estuarine Fish SSSI Selection Guidelines chapter (Nature Conservancy Council 1989). It was initially prepared by Adrian Pinder under contract to JNCC and then adapted by specialists in JNCC, Natural England, Natural Resources Wales, NatureScot and Department of Agriculture, Environment and Rural Affairs.

Other specialists in the Country Nature Conservation Bodies (CNCBs) who commented on the chapter include:

- Silas Walton (Natural England)
- Trevor Harrison (Department of Agriculture, Environment and Rural Affairs, Northern Ireland)
- Sean Evans & Paul Brazier (Natural Resources Wales).

The chapter provides detailed guidance for use in selecting estuarine fish sites throughout Great Britain to recommend for notification as SSSIs. It should be used in conjunction with Part 1 of the SSSI Selection Guidelines (Bainbridge *et al.* 2013), which detail the overarching rationale, operational approach and criteria for selection of SSSIs, and the freshwater fish SSSI guidelines (Bean *et al.* 2018), as well as the Marine Intertidal and Shallow Subtidal Habitats guidelines (Brazier *et al.* 2019).

The main changes from the previous version of the chapter are that it:

- separates fish found solely in, or migrating through, estuaries from freshwater fish normally associated with freshwater habitats;
- provides a better context for the geographical selection of sites for the protection of native estuarine fish of conservation value;
- provides better alignment between the identification of valuable estuarine fish populations and the protection of the habitats which support them. Linkages are made between this chapter and SSSI Selection Guidelines for Marine Intertidal and Shallow Subtidal Habitats where appropriate;
- provides better alignment between the identification of valuable migratory estuarine fish populations and the protection of their associated freshwater migratory fish population. Linkages are made between this chapter and SSSI Selection Guidelines for Freshwater Fish where appropriate;
- It also provides more detailed guidance relating to the identification of site boundaries; and

This chapter has been subjected to appropriate levels of evidence quality assurance. It is compliant with the JNCC Evidence Quality Assurance Policy (2019) and has been subjected to external peer review by Professor Mike Elliott (University of Hull).

1 Introduction

This guidance covers selection for any eligible native fish species in Great Britain that inhabit estuarine systems for all or part of their life cycle. This guidance covers estuarine fish as part of the SSSI Selection Guidelines for Marine Intertidal and Shallow Subtidal Habitats and aligns with the guidance for estuaries in that chapter.

The purpose of this document is to assist the Country Nature Conservation Bodies (CNCBs) in Great Britain in the appropriate site selection of estuarine SSSIs designated for fish species and assemblages. These species may depend on estuaries either as residents, or temporarily, to use various ecosystem functions which facilitate completion of their life cycles, for example, as migratory routes, spawning and nursery grounds, foraging areas, or refugia.

Brazier *et al.* (2019) defines estuaries in Great Britain as: *Estuaries are habitat complexes comprising an interdependent mosaic of subtidal and intertidal habitats, which are closely associated with surrounding coastal and terrestrial habitats. They are defined as the downstream part of a river valley, subject to the tide and extending to the limit of brackish water. There is a gradient of salinity from freshwater in the river to saline marine conditions towards the open sea.*

Estuaries are extremely dynamic environments. Accordingly, different fish species and/or life stages use estuaries in different ways, largely driven by the interacting temporal and spatial dynamics of salinity, tidal rhythms and seasonality. These properties make estuarine ecosystems unique, which is reflected in the diversity of fish fauna found in estuaries. This diversity includes diadromous fish (fish species that divide their life-cycle between freshwater habitats and the sea, either spawning in freshwater and migrating to sea for adult development (anadromous, e.g. Atlantic salmon), or spawning at sea and migrating to fresh water for adult development (catadromous, e.g. European eel)), which migrate between fresh and marine water; species which are specially adapted to estuarine conditions; and species which use estuaries for critical feeding, spawning, refugia or nursery functions.

Estuaries are under significant pressure from development and from flood defence. Key anthropogenic impacts affecting estuarine fish assemblages include (but are not limited to) habitat modification or loss, commercial exploitation, pollution including eutrophication from point and diffuse sources, invasive species, noise (dredging, piling, shipping), water resource management (abstraction/discharge) and power generation. Many of the above anthropogenic impacts are likely to be exacerbated by the effects of climate change, in particular, sea-level rise and temperature increases. Human responses to climate change may also increase development pressure, and climate change may change the structure, function, abundance and distribution of fish species within estuaries.

To ensure consistency of approach with other species chapters in this series, this document follows the overarching 'Guidelines for the Selection of Biological SSSIs Part 1: Rationale, Operational Approach and Criteria for Site Selection' (Bainbridge *et al.* 2013); hereafter referred to as Part 1.

It is important to refer to Chapter 1b (Marine Intertidal and Shallow Subtidal Habitats, Brazier *et al.* 2019) and Chapter 6 (Freshwater Habitats, Mainstone *et al.* 2018) of the SSSI guidelines to allow for alignment and consistency of approach.

2 Species of interest

A total of 182 fish species (including hybrids) had been reported from UK estuaries up to 2011 (UKTAG 2014), comprising six functional guilds:

- **Diadromous** (11 species) – fishes that migrate between fresh and salt water during different life stages. (Fish species that divide their life cycle between freshwater habitats and the sea, either spawning in freshwater and migrating to sea for adult development (anadromous, e.g. Atlantic salmon), or spawning at sea and migrating to fresh water for adult development (catadromous, e.g. European eel)).
- **Estuarine Resident** (28 species) – fishes that spend their entire life in estuaries.
- **Freshwater** (28 species) – fishes that are present mainly or exclusively at low salinity values.
- **Marine Adventitious** (74 species) – fishes that are considered fully marine but inhabit estuaries temporarily.
- **Marine Juvenile** (15 species) – fishes that use estuaries as nursery grounds or during juvenile phases of their life cycle.
- **Marine Seasonal** (26 species) – fishes that use estuaries for part of the year.

It is important to note that the UKTAG list is a list of all species caught within estuaries for Water Framework Directive (WFD) monitoring and was not developed specifically for SSSI selection. For example, the list contains hybrids, freshwater fish that would not survive within a fully estuarine environment and several non-native species.

The fish species from the following guilds are more likely to qualify as features of SSSIs:

- Estuarine Resident
- Marine Juvenile (only where they are reliant on the estuary)
- Diadromous
- Marine Seasonal/Adventitious only where it can be demonstrated that the species presence in the estuary is of particular importance.

3 National and International importance

National and international importance can be classified into four geographical levels:

- Species included in the UK Biodiversity Framework (formally UKBAP species) (National importance);
- Species included in the Habitats Directive and/or Bern Convention (European importance);
- Species included in OSPAR (north-east Atlantic importance) and Bonn Conventions;

- Species included in IUCN Red List (Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR) (Regional or Global importance) and CITES annexes.

The UK Post-2010 Biodiversity Framework, published in July 2012, along with country-level biodiversity and environment strategies, succeeded the UK Biodiversity Action Plan (see the [UK's Clearing House Mechanism \(CHM\) website](#) for details of the latest UK and country-level plans and strategies). Each country within the UK now administers its own Priority Species' list, largely based on the UKBAP Priority Species' list, but with some country-specific modifications.

Species considered a priority for consideration as Estuarine SSSI features are included in Appendix 1, with those species afforded protection by inclusion in national and international lists included in Appendix 2. Species not listed in Appendix 1 should only be considered for SSSI selection as part of an assemblage if they contribute significantly to the diversity and function of the estuary, and the site also meets the other criteria for SSSI selection as described in Section 5.

The presence of the species listed in Appendix 1 should be viewed as a starting point for selection, but the estuarine populations of the species would still need to also meet the criteria for SSSI selection as laid out in Section 5.

4 Areas of Search (AoS)

Defining geographical Areas of Search, as per the Part 1 guidelines (Bainbridge *et al.* 2013), is not appropriate for notifications of estuarine fish features. The significant variation in biogeography, with regard to estuarine typology and fish species assemblages, means that grouping estuaries by defined Areas of Search criteria is not advised.

Each country in Great Britain (GB country) should assess the estuarine resource within its territory and propose a series of sites which meet the selection criteria described in Section 5, liaising with other GB countries where possible to maximise the integrity, diversity and representativeness of the network in Great Britain.

5 Selection criteria

Fish inhabiting estuaries (either residents or for part of their life cycle) may qualify as features for notification under one or more of the following categories:

- Rarity
- Size
- Ecological coherence
- Diversity of the overall assemblage of fish species
- Genetic distinctiveness
- Naturalness

As part of the process the appropriate Country Nature Conservation Body (CNCB) specialist should be consulted to determine whether notification is justified under these criteria.

5.1 Rarity

A fish species which is of international importance is of particular interest in its national occurrence even where the feature may be locally numerous (see Section 6 in Bainbridge *et al.* 2013). On this larger geographic scale, rarity is an important criterion, identifying those habitats and species that are rare or highly localised internationally.

Some estuarine fish species (e.g. Atlantic sturgeon *Acipenser sturio* or Houting *Coregonus oxyrinchus*) may be considered for SSSI selection in the future to ensure their protection, if populations of the species re-establish.

There may be instances where an estuary supports an aspect of the recruitment process (i.e. migration, spawning or nursery habitat) of a species in Appendix 1, where these species may be of international importance (e.g. an OSPAR threatened or declining species), however, they would also need to be considered under other criteria.

5.2 Size

It is acknowledged in Part 1 (Section 5.7.2) that population size is difficult to assess for most animal groups. This is particularly true for estuarine fish species, for which the resources required to collect robust population-level data on a large scale are often prohibitively high. Setting target thresholds for population size of estuarine fish populations, or fish species which may use estuaries, are thus difficult to achieve.

Notwithstanding the above, if empirical evidence demonstrates that an estuary supports a recognised nationally important population of any species listed in Appendix 1, the site should be considered for selection.

Determining whether a population of a species is nationally important could for example include:

- a) Identification of all known or potential breeding populations of the species and a general assessment of their respective size, using population estimates if known or else a suitable proxy such as area of spawning or nursery habitat.
- b) Identification of sites where populations are suspected to occur based on records data and a broad assessment of their potential importance.

5.3 Ecological coherence

This criterion relates to the importance of estuaries for fish species to complete their life cycles. Ecological coherence signifies the connectivity between marine, estuarine and freshwater habitats.

Where there is an upstream SSSI for a migratory fish species, the associated estuary should also be considered for designation (See Freshwater Fish guidelines (Chapter 19, Bean *et al.* 2018). Linked and contiguous notifications for river and estuarine habitat are the best means of protecting migratory species (Bean *et al.* 2018).

5.4 Diversity

Diversity of the fish species assemblage within an estuarine ecosystem is an important consideration. Where a particularly diverse assemblage of estuarine fish (as defined under Section 2) is present in the estuary the site should be considered for selection. Diversity should be demonstrated using standard diversity metrics suitable for fish (e.g. Shannon-Wiener or Simpson indices).

5.5 Genetic distinctiveness

Although genetic distinctiveness may be relatively less studied in estuarine fish populations when compared with freshwaters, there may still be scenarios where genetically unique populations have been identified as restricted in their distribution to one or more estuarine locations. This is particularly true in the case of homing diadromous fish species, such as Atlantic salmon *Salmo salar*. Emerging evidence has also shown a high degree of homing in Twaite shad *Alosa fallax* on the Severn (Davies *et al.* 2020), as well as some evidence that the Tywi shad population is genetically distinct from the Usk/Wye/Severn population (Hardouin *et al.* 2013).

Where an estuary supports a genetically/morphological or biologically distinct population of any species listed in Appendix 1, the site may be considered for selection. Genetic distinctiveness here means a genetically discrete population that could not have been predicted by geographic distance alone.

In all cases, proposals should be supported by clear scientific evidence. Where there is good reason to suspect the presence of important evolutionary selection pressure, scientific evidence should be gathered to allow a judgement of importance.

5.7 Naturalness

Fish are a key component of estuarine ecosystems, and the natural characteristic fish assemblage should form an integral component of the estuary.

Although estuaries are inherently dynamic environments, natural communities can consistently be identified. For example, the Water Framework Directive (WFD) Transitional Fish Classification Index (TFCI) (UKTAG 2014) could be used for assessing this criterion as they are a measure of naturalness against reference conditions. Estuarine fish communities classified as High Status may be considered for selection. In doing so there should be confidence that the High-Status classification is correct and stable. This should normally be reflected in a high confidence in class (> 90%) or where monitoring results from multiple years are available and provide a stable classification of High-Status.

6 Defining site boundaries

Site boundaries should be defined based on the best available scientific data and evidence available, including the incorporation of expert knowledge. Boundaries may range from the whole estuary (e.g. as a migratory corridor for diadromous species) or to specific, limited and clearly defined areas such as identified location(s) of critical spawning habitat (e.g. smelt *Osmerus eperlanus*).

Consideration should be given to whether the estuary in question has been chosen for other features under Chapter 1b Marine Intertidal and Shallow Subtidal Habitats guidance (Brazier *et al.* 2019), so that site boundaries align where possible.

Consideration should also be given to any contiguous upstream freshwater SSSIs (see Chapter 6, Section 6.3 Mainstone *et al.* 2018) to allow for boundary alignment.

7 References

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- Mainstone, C.P., Hall, R.A., Hatton-Ellis, T.W., Boon, P.J., Bean, C.W. & Lee, A.S.L. 2018. *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 6 Freshwater habitats*. Joint Nature Conservation Committee, Peterborough. <https://hub.jncc.gov.uk/assets/3e03b1ee-a9ba-4437-90f7-782a49af9cfd>
- UKTAG. 2014. *UKTAG Transitional Water Assessment Method: Fish Fauna – Transitional Fish Classification Index*. Water Framework Directive United Kingdom Technical Advisory Group (WFD-UKTAG).

Appendix 1. Fish considered a priority for SSSI selection (species would still need to meet at least one of the site selection criteria)

Scientific name	Common name	Does the species use estuaries?	Does the species form geographically discrete populations?	Nationally important	Internationally important
<i>Acipenser sturio</i> *	Atlantic sturgeon	Y	Y	Y	Y
<i>Alosa alosa</i>	Allis shad	Y	Y	Y	Y
<i>Alosa fallax</i>	Twaite shad	Y	Y	Y	Y
<i>Osmerus eperlanus</i>	European smelt	Y	Y	Y	N
<i>Anguilla anguilla</i>	European eel	Y	Y	Y	Y
<i>Lampetra fluviatilis</i>	River lamprey	Y	Y	Y	Y
<i>Petromyzon marinus</i>	Sea lamprey	Y	Y	Y	Y
<i>Salmo salar</i>	Atlantic salmon	Y	Y	Y	Y
<i>Salmo trutta</i>	Brown trout / Sea trout	Y	Y	Y	N
<i>Atherina boyeri</i>	Big-scaled sand smelt	Y	Y	N	N
<i>Coregonus oxyrinchus</i> **	Houting	Y	Y	N	Y
<i>Hyperoplus immaculatus</i>	Corbin's sandeel	Y	Y	N	N
<i>Hyperoplus lanceolatus</i>	Greater sandeel	Y	Y	N	N
<i>Nerophis ophidion</i>	Straightnose pipefish	Y	Y	N	N
<i>Syngnathus typhle</i>	Broadnosed or Deep-snouted pipefish	Y	Y	N	N

* No known spawning locations within UK. New recent evidence suggests that two species historically are found in GB rivers, *Acipenser sturio* and *Acipenser oxyrinchus* (Steve Colough *pers comm*). If an *Acipenser oxyrinchus* population were discovered, it would also qualify.

** Considered to be locally extinct with no known spawning locations within the UK.

Scientific name	Common name	Does the species use estuaries?	Does the species form geographically discrete populations?	Nationally important	Internationally important
<i>Ammodytes tobianus</i>	Lesser sandeel	Y	Y	Y	N
<i>Nerophis lumbriciformis</i>	Worm pipefish	Y	Y	N	N
<i>Hippocampus guttulatus</i>	Spiny or Long-snouted seahorse	Y	Y	Y	Y
<i>Hippocampus hippocampus</i>	Short-snouted seahorse	Y	Y	Y	Y
<i>Clupea harengus</i>	Herring	Y	Y	Y	N
<i>Dicentrarchus labrax</i>	Sea bass	Y	Y	N	N
<i>Pagellus bogaraveo</i>	Red sea bream (Blackspot)	Y	Y	N	Y
<i>Spondylisoma cantharus</i>	Black sea bream	Y	Y	N	N
<i>Liza aurata</i>	Golden grey mullet	Y	Y	N	N

Appendix 2: Protection afforded to fish species listed in Appendix 1

Scientific name	Common name	W&C Act ¹	UK BF ²	HD Annex ³	Cons Regs Sched. ⁴	Bern Conv App. ⁵	Bon Conv App. ⁶	OSPAR ⁷	CITES ⁸	IUCN 2018 ⁹
<i>Acipenser sturio</i> *	Atlantic sturgeon	Sch. 5	Y	II, IV	II	III	I, II	Y	I	CR
<i>Alosa alosa</i>	Allis shad	Sch. 5	Y	II, V	IV	III		Y		
<i>Alosa fallax</i>	Twaite shad	Sch. 5	Y	II, V	IV	III				
<i>Osmerus eperlanus</i>	European smelt		Y							
<i>Anguilla anguilla</i>	European eel		Y				II	Y	II	CR
<i>Lampetra fluviatilis</i>	River lamprey		Y	II, V	IV	III				
<i>Petromyzon marinus</i>	Sea lamprey		Y	II		III				
<i>Salmo salar</i>	Atlantic salmon		Y	II, V	IV	III				
<i>Salmo trutta</i>	Brown trout / Sea trout		Y							
<i>Coregonus oxyrinchus</i> **	Houting									EX
<i>Ammodytes tobianus</i>	Lesser sandeel		Y (Scotland only)							
<i>Hippocampus guttulatus</i>	Long-snouted seahorse	Sch.5	Y			II		Y	II	
<i>Hippocampus hippocampus</i>	Short-snouted seahorse	Sch.5	Y			II		Y	II	
<i>Clupea harengus</i>	Herring		Y							

* No known spawning locations within UK. New recent evidence suggests that two species historically are found in GB rivers, *Acipenser sturio* and *Acipenser oxyrinchus* (Steve Colclough, *pers comm*). If an *Acipenser oxyrinchus* population was discovered it would also qualify.

** Considered to be locally extinct with no known spawning locations within the UK.

Notes on protection measures:

¹ Wildlife and Countryside Act 1981 (as amended). Schedule 5 – animals (other than birds) that are protected.

² UK Post-2010 Biodiversity Framework (formerly UKBAP). Listed in Priority Species List of individual countries.

³ EC Habitats Directive: Annex II – designation as qualifying feature within SACs for the feature listed; Annex IV – special protection for the species listed; Annex V – exploitation may be subject to management.

⁴ The Conservation of Habitats and Species Regulations 2010. Schedule II – European protected species in Great Britain; Schedule IV – animals that may not be taken in certain ways.

⁵ Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats). Appendix II – Strictly Protected Fauna; Appendix III – regulation of the exploitation of species listed.

⁶ Bonn Convention (The Convention on Migratory Species). Appendix I – migratory species that are endangered; Appendix II – migratory species that require international agreements for their conservation and management.

⁷ Convention for the protection of the marine environment of the north-east Atlantic. Threatened and/or declining species within the OSPAR region.

⁸ CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). Appendix I (species threatened with extinction) & II (Controlled trade).

⁹ International Union for Conservation of Nature Red List of Threatened Species: Global Assessment 2020. EX – Extinct; CR – Critically Endangered.