Coarse fish

biology

AND

management

ENVIRONMENT AGENCY

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Introduction

Nearly everybody spends some of their leisure time near rivers and lakes, perhaps walking, boating or fishing. We share a common view that these water environments are places of natural beauty and deserve our special attention. It is apparent even without close inspection that rivers and lakes support diverse groups of plants, birds, mammals and fish. Sooner or later the casual observer, fisherman, gamekeeper or scientist will want to know more about the fish that live in them.

Most of the fish that live in rivers, lakes, ponds and canals are collectively known as "coarse fish". This book aims to help give answers to about coarse fish, such as:

- **What are coarse fish?**
- **Where are they found and why do they live there?**
- **Should they be managed and if so how?**

The information here has been gathered from Environment Agency sources and condensed into a step-by-step guide to coarse fish and the factors that most influence them. It is designed to help you find answers to your questions quickly, without having to wade through pages of technical jargon. We hope that you find it both interesting and practical to use.

The first two sections of this book describe how important it is to have different types of habitat to support successful fish populations. They concentrate on the creation of the right habitats to support fish. (Some types of fish stock are intensively managed to be greater than their ecosystem would normally support, often in purpose-built lakes. The management of these types of fish stock is not covered by this book.)

Section 1 coarse fish biology

WHAT ARE COARSE FISH?

The term "coarse fish" means all freshwater fish found in the British Isles other than trout, sea trout and salmon. Most rare fish and exotic or non-native species are also excluded. Coarse fish were once commonly referred to as "rough fish" because on occasions some of them developed rough skin; we now know that a number of coarse fish, for example roach, bream and dace, temporarily develop pimples or "tubercles" over the body before spawning.

Coarse fish are classified into "family" groups based on physical or "taxonomic" differences. A few examples are listed in table 1.

Table 1: Examples of coarse fish within different family groups

Coarse fish	Family	No. species worldwide	No. species in UK
Carp, tench, roach, dace, chub, bream	Cyprinidae	Approx. 2000	13
Perch, ruffe	Percidae	16	2
Pike	Esocidae	5	1

HOW FISH POPULATIONS WORK

A successful fish population is one that prospers within the limits of its environment. If a water body contains all of the elements needed to satisfy the basic requirements of a fish species, then that population is more likely to be successful. In many cases there will be habitat constraints, predation, competition and disease, as well as variable weather conditions at critical times.

- **Large variations in fish populations occur natually.**

The number of fish surviving their first year of life largely determines their overall contribution to the population. If many fish survive the first year, then that "year class" will be more numerous in later years. The classic "population pyramid" can be used to illustrate this:

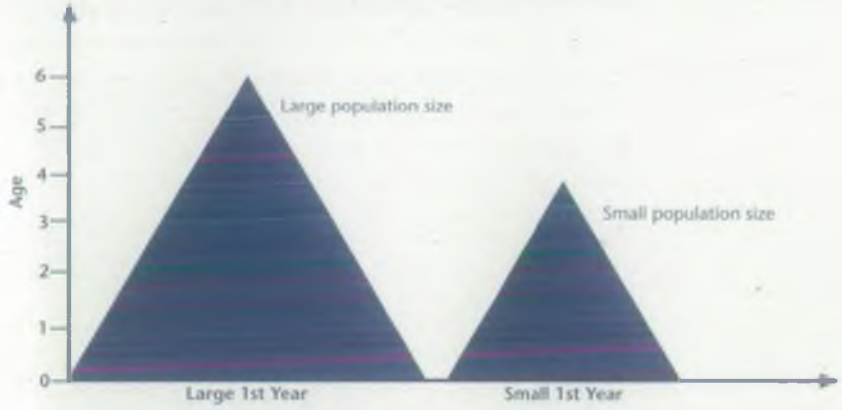


Figure 1: The population pyramid

Poor conditions can affect the survival of young fish, and can result in lower numbers being added, or "recruited", to the adult population.

- **Fish are most affected by the environment in their first year of life.**

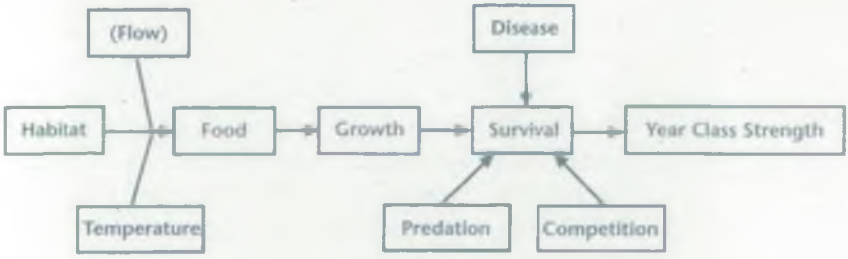


Figure 2: Factors influencing year class strength in coarse fish

Man has manipulated the environment to meet practical, social and economic needs. Many rivers have been modified over time with the construction of weirs, mills and water meadows. Industrial, urban and agricultural development influences rivers and lakes. The impact of human activity on fish populations is varied and widespread.

- **Urban development can alter flow characteristics in rivers.**
- **Sometimes rivers can flow too quickly for small fish.**
- **Water quality can affect fish.**
- **Sewage treatment works discharge into rivers, and chemicals in some sewage effluent may alter breeding success in fish populations.**
- **Agricultural inputs include silt, nutrients and organic pollutants.**

The life history of a coarse fish

The life history of a fish is a description of the physical and habitat changes that occur during the transformation from egg to adult. By knowing more about the different life stages it is possible to understand what makes a healthy fish population and how to manage it. A typical life cycle is shown in Figure 3.

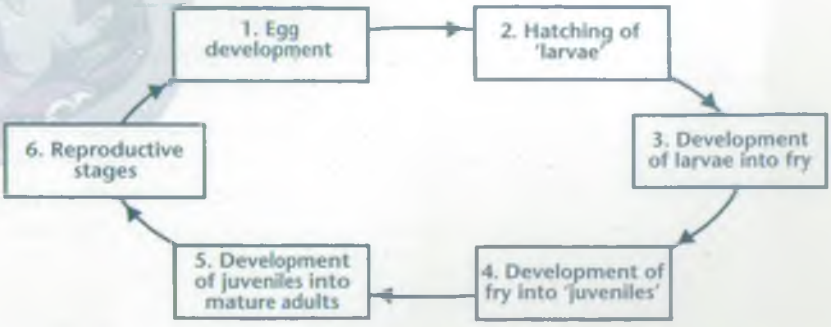


Figure 3: The different life stages experienced by all coarse fish

FISH EGGS

Fish eggs need to be constantly covered by water, so breeding adults must find spawning sites where receding water levels will not leave the eggs exposed. Eggs require good-quality water for development to take place. Temperature is important, since it regulates the rate of development of the egg. Some species deposit their eggs on weed, while others prefer gravel.

Many coarse fish produce adhesive eggs that stick to the preferred spawning surface. This ensures that they are not washed away by excessive flows and that they remain in a suitable oxygen-rich position, away from silted areas.

- **Egg production by each fish varies between species (from 10,000 to 200,000 eggs).**
- **Some species spawn several times a year.**
- **Eggs vary in size (1-2mm) and colour, depending on the species.**
- **Water temperature influences hatching times.**
- **Hatching times vary widely between species, ranging from 4 to 30 days.**

LARVAL DEVELOPMENT

Immediately after hatching, small fish or "larvae" of many species have limited swimming ability and underdeveloped mouth-parts. Larvae carry yolk sacs which provide the small fish with all essential nutrients until they can start to feed. Larvae must locate safe resting sites or "refuge areas", since they are easy prey for larger fish and some insects. Many species will remain close to the spawning substrate, for example in gravel or near submerged weed. Larvae develop swimming and feeding skills over a period of a few days and soon look like very small fish, or "fry".

- **Larvae vary in size between species, and are typically between 4-14mm long.**

FRY

Fry move from the resting sites to areas more suitable for feeding and that provide refuge. They remain vulnerable to high flows, so are often found in backwaters or slow-flowing reaches. Suitable food items include zooplankton (microscopic animals) and algae (microscopic plants) in the water or attached to weed surfaces. Fry grow rapidly under good conditions and after several weeks will start to resemble small fish, or "juveniles".

- **Fry length varies between species and is typically between 10-40mm.**
- **Temperature affects food production and fish growth.**

JUVENILE FISH

Juveniles are the smallest fish people tend to see, and they have survived many dangers to reach this size. As they grow they begin to resemble small versions of the adult. Shoaling species form groups that give individuals relative safety from predators. Migration to deeper water offers different types of food as well as cover from predators, such as herons.

Juveniles grow slowly during the winter because of low temperatures, scarce food and difficult feeding conditions. The swimming ability of small fish is limited, and survival in rivers often depends on the availability of refuge areas. Survival in lakes and canals often depends on availability of the right type of food.

- **Food includes zooplankton, algae and small insect larvae.**
- **Juvenile pike will eat each other.**
- **Normally fewer than 1 in 100 juveniles will survive their first year of life.**

Figure 4: Juvenile pike

ADULT FISH

Adult coarse fish are more robust and adaptable to their environment than younger fish. The larger adults of most species are able to cope with variable river flows, long periods without food, evasion of predators and, to a degree, human influence. Shoaling species, for example bream, dace and rudd, will often stay together throughout adulthood. These fish are usually of the same age and grow at a similar rate; anglers often comment on how all the fish caught on the same day were like "peas in a pod". The oldest fish can appear to be solitary or found only in small groups, and represent the last few survivors of a year class.

Migration is an important part of fishes' lives. Some species have a relatively small "home range" - that is, the furthest distance fish will normally travel - while others are known to migrate large distances. Small feeding movements take place on a daily basis, while longer, more seasonal migrations can

occur before spawning. Physical obstructions like weirs or dams prevent the migration of a number of species, for example dace, chub and barbel.

Successful reproduction is the most critical function of a mature adult fish. Many species can adapt to spawn in different places, while others require very specific conditions to breed successfully. Roach will spawn on a number of different types of weed in flowing and still water and use gravel if other substrates are not available. Barbel, chub and dace tend only to spawn successfully in water flowing over gravel of a particular size.

- **Adults become sexually mature after two to six years.**
- **Breeding is synchronised so that conditions favour young fish when they hatch.**
- **Pike spawn early so their juveniles can feed on other fish fry.**

What is fish habitat?

A habitat in human terms is like a room in a house where specific needs are catered for. For example, the kitchen has a fridge and a cooker, while the living room has a sofa and a television. In the fish world habitats are also quite discrete; physical conditions combine to create areas most suitable for feeding, resting, hiding, spawning and so on. Being more aware of fish habitat needs makes it possible to assess how management practices will affect them.

THE HABITAT COMPONENTS

Water

The medium itself is the most important component of a habitat. It is the environment in which fish live, the source of oxygen, carrier of nutrients, light and temperature, it has a varied chemistry and is either flowing or still.

Depth

Temperature change and light penetration can vary with depth. Shallow water provides favourable conditions for weed growth and food production, and deep water offers refuge from surface predators, such as herons and kingfishers.

Weed (water plants)

The presence and type of weed is an important part of any fish habitat. Weed can provide a source of food for many fish, cover for predators and prey as well as a spawning site for some fish, for example roach.

Substrate

The type of material making up the bed, or "substrate", is important because it influences the presence of weed, insect larvae and consequently fish. The substrate is also important at spawning time; for example, dace will only deposit eggs on gravel in flowing water.

HABITAT TYPES

Still waters (lakes, ponds and reservoirs)

Various habitat types occur at a range of depths. Shallow areas will be relatively warm in summer and, depending on nutrients, will promote weed growth and food production. Deep water will provide cover from predators and can also be slightly warmer during winter months.

Canals

These can be either flowing or still. Canals are generally uniform in shape, and habitat diversity is more limited than in most rivers. Coarse fish more commonly associated with still waters tend to live in canals.

Rivers

Habitat types are associated with the effects of flow, depth,

width and gradient (or slope); these typically form pool, "glide", riffle and slack water areas. Substrate type, nutrients, flow and depth create a spectrum of conditions that suit a variety of water plants. A typical section of natural river is diverse in habitat types and supports a wide range of plants, insects, fish, birds and mammals.

COARSE FISH HABITAT REQUIREMENTS

Coarse fish species share similar life cycles, and yet there are often important differences between them. The following sections examine the different types of habitat they need.

SPAWNING HABITAT

There are two main groups of fish "spawners", those that deposit eggs on gravel and those that prefer to deposit them on aquatic weed. For example, dace, chub and barbel will mainly spawn on gravel, while bream, carp, tench, perch and pike prefer weed. Roach will spawn on many different surfaces, which explains in part why they are relatively successful in many different types of habitat.

Spawning is generally influenced by seasonal change. Different species will spawn at different times in different places. This reduces competition, not only between adult fish for space when spawning habitat is limited, but also between fry for food when first feeding. It also helps reduce interbreeding with other species.

For example, dace mature in their third or fourth year and start to develop eggs and sperm several months before actually spawning. As day length decreases and temperatures fall in the autumn dace migrate upstream to rest near suitable spawning sites. Environmental changes stimulate breeding in spring; the eggs are "sticky" and adhere to gravel. A good flow over the eggs keeps them free

of silt and provides a ready supply of oxygen to the developing embryo. Water temperature regulates the rate of development in the eggs and favourable weather ensures hatching success.

By contrast, the three-spined stickleback prefers shallow, slow-flowing or still water and dense submerged weed where it builds a nest in which the female lays her eggs. The male develops vivid body colours, both to attract females and to ward off other males.

Male cyprinids (see Table 1) develop cyst-like tubercles over the head and body before spawning. These may stimulate females to breed, and offer physical protection while they are excavating nest sites in rough gravel.

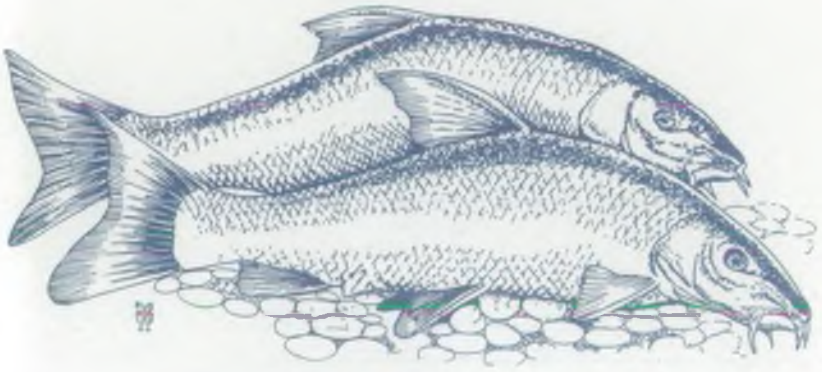


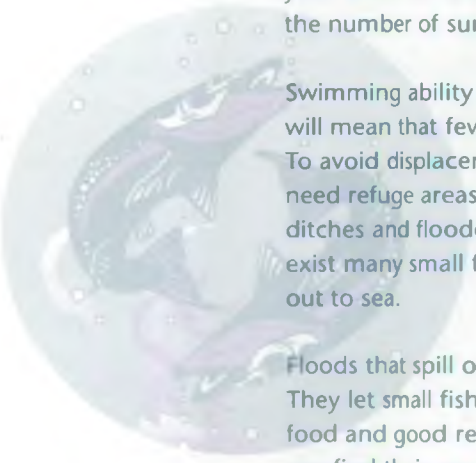
Figure 5: Barbel spawning

- **Access to spawning areas is very important for all fish.**
- **Fish spawning takes place at different times for different species.**
- **Seasonal changes in water temperature and day length stimulate breeding.**
- **Some species deposit eggs on gravel, others prefer to use weed.**
- **Some species spawn in still water, others prefer flowing water.**
- **Coarse fish generally spawn in shallow water less than 1.0m deep.**

FRY AND JUVENILE HABITAT

Fish have evolved to reproduce in spring and early summer when environmental conditions are most likely to ensure the survival of newly hatched fish. Shallow, slow-flowing, slightly weeded marginal shelves are the most important nursery areas for small fish in rivers, canals and still waters.

Algae grow well in these areas, providing an important food source for fry of many species. Zooplankton feed on algae and "bloom" in a similar way, becoming food essential for the developing fry. Low temperatures in summer will result in poor production of algae and zooplankton, which will affect juvenile growth and survival at the end of the first year. If too few areas of suitable habitat are available then the number of surviving juveniles will be limited.



Swimming ability is related to fish length, so poor growth will mean that fewer fish will survive during winter floods. To avoid displacement downstream during floods, small fish need refuge areas. These are often backwaters, side bays, ditches and flooded fields. If suitable refuge areas do not exist many small fish can be washed downstream or even out to sea.

Floods that spill over the river banks are important for fish. They let small fish into flooded fields, which have plentiful food and good refuge areas. It is also important that they can find their way back to the river when flood water drops.

- **Marginal shelves (0.25-0.75m deep) in rivers, lakes and canals are important nursery areas.**
- **Algae and zooplankton are essential food items for young fish.**
- **Weed in shallow water provides young fish with food and cover.**
- **Fish size relates to swimming ability, affecting survival of small fish.**
- **Slack water areas are important resting places for small fish.**

ADULT FISH HABITAT

Adult coarse fish are generally more tolerant of different living conditions than juveniles and occupy a multitude of habitats on a daily basis throughout the year. A summary of conditions that suit individual species is listed in Section 2.

Some species are most often found in rivers, for example chub, dace, barbel and gudgeon. Others are associated with still waters, for example carp, tench, bream and rudd. Although these fish are often found in both flowing and still-water habitats, many are better suited to one or other habitat.

Fish use many different resting and feeding habitats. For example, dace are known to make short daily migrations from resting areas to regular feeding sites. Resting places are varied in character, often associated with deeper, slow-flowing, weeded areas. Feeding places include shallow, faster-flowing reaches.

Barbel rest during daylight hours under weed, commonly water crowfoot (*Ranunculus* sp.), before moving out to forage over gravel in low light. Dace and chub take drifting food items at or near the surface as well as foraging in gravel. Gudgeon are found living on a variety of substrate types but prefer to feed in fine gravel or sand. Tench, carp and bream are adept at feeding on insect larvae buried in silt and roots of water plants. Carp will often be seen "basking" in lakes during warm summer days, resting between feeding spells. Roach are highly versatile and will readily colonise most water habitats offering a good supply of food, as will perch and eels.

The very diverse types of habitat in many rivers provide opportunities for most adult coarse fish species to thrive. Likewise, still waters and canals with different types of habitat are more likely to have self-sustaining fish populations.

- **Adult coarse fish are fairly tolerant and adaptive to their environment.**
- **Mature adults require access to suitable spawning areas.**

Age growth and mortality

AGE

The lifespan of coarse fish varies between species. Generally the larger species tend to live longer than the smaller ones. For example carp, pike, chub and barbel can live in excess of 20 years, while dace, gudgeon and minnow rarely exceed 8 years of age.

- **The environment and genetic factors control the maximum age of a fish.**

AGE DETERMINATION

Scientists can tell the age of a fish by counting the number of rings, or "annuli", laid down in a fish scale. During cold winter months fish grow slowly and scale deposits are laid down close together, forming a dark ring just like in a tree trunk. Rapid summer growth results in thinner deposits and the formation of a wider, light ring across the scale. These light and dark rings depict a history of growth over a period of time and therefore represent age.

A graph of age against numbers sampled at each age group forms a picture of the population structure of a species. It is possible to assess whether a population is breeding successfully and is self-sustaining. This helps scientists find out if there are problems with a population.

Growth describes how a fish increases in size over time. All coarse fish species grow at different rates, mature at different sizes and attain different maximum lengths and weights. There are often differences between individuals of the same species; for example, females may grow faster than males and attain a greater size. It is also common to notice faster growth rates in fish from one river or lake compared with another.

Growth depends on temperature and a good food supply. Other factors that can affect it are water quality, disease and parasites. Water temperatures are often low in winter and high in summer. When the temperature is over 14°C food production increases. Fish activity is also greater in warmer water, which enhances swimming, feeding, digestion and growth. Poor water quality may affect food production, and if food is limited then competition between fish may reduce their growth.

- **The environment and genetic factors control maximum size.**
- **Temperature and food availability largely determine growth rates.**
- **Females tend to grow larger than males so that more eggs can be produced.**

Figure 6: Large perch

MORTALITY

Fish die, like other animals, as a result of many events throughout life. The longest-lived individuals of any species are the lucky few that make it to old age. Considering the vast numbers of eggs that certain species produce in comparison to the small numbers of old fish that survive, it is apparent that mortality plays a major role in the workings of any fish population.

Perhaps the largest mortalities occur before eggs even hatch: for example, dace eggs are prone to becoming smothered by silt and can die as a result of poor oxygen transfer to the egg. Eggs are also a ready food source for other fish and insect larvae. Barbel have been observed feeding on chub eggs while the adult fish are actually spawning, only to have their own freshly produced eggs then eaten by chub.

Most fish die in their first year of life, even when conditions are ideal. Environmental and other factors can change conditions, and important habitats can disappear or change. In very bad years, practically no young fish of a species will survive.

Predation can also account for high levels of mortality after hatching. Larger chub, perch and pike eat many juvenile fish. Cannibalism by pike can account for up to half of their mortality within the first two years. This is a very important "self-regulatory" process: small pike become food for larger pike, controlling competition for food as they get older.

Mortality becomes more predictable for most coarse fish after the first two years of life. Natural factors affecting it include disease, parasites, predation and competition for food and space.

Section 2 Fact file

Species - **Barbel**, *Barbus barbus (L.)*

Weight -	rarely 6.4 kg (14lb), very few over 7.3kg (16lb).
Length -	attain 100cm, very few over 130cm.
Age -	maximum 25 years.
Location -	rivers, occasionally stocked in still waters.
Behaviour -	shoaling in small groups, close to the river bed.
Preferred habitat -	fast water, gravel, weed, 15-22°C.
Feeding -	gravel foraging, dawn to dusk, optimum temperature 15°C.
Natural food -	insect larvae, crustaceans, molluscs, small fish.
Maturity -	males 3-4 years, Females 5-8 years.
Fecundity -	8,000-12,000 eggs per kg of body weight.
Spawning times -	May-July, in water 14-20°C.
Spawning -	gravel, typically 10-40mm diameter.
Migratory habits -	home range 2-20km.
Predators -	juveniles taken by pike and chub.

Species - **Bleak**, *Alburnus alburnus (L.)*

Weight -	rarely exceed 0.085kg (3oz).
Length -	rarely exceed 16cm.
Age -	maximum 9 years.
Location -	lowland rivers.
Behaviour -	shoaling in large numbers near the surface.
Preferred habitat -	enriched, slow-flowing water, surface layers.
Feeding -	juveniles feed near the bed, adults at the surface.
Natural food -	planktonic crustacea and insects.
Maturity -	males 2+ years, females 3+ years.
Fecundity -	90-150 eggs per gram of body weight
Spawning times -	April-July, 15°C+, multiple spawning.
Spawning -	Fine gravel and adjacent weed.
Migratory habits -	vertical feeding migration, spawning migration.
Predators -	pike, perch and chub.

Species - **Common bream**, *Abramis brama (L.)*

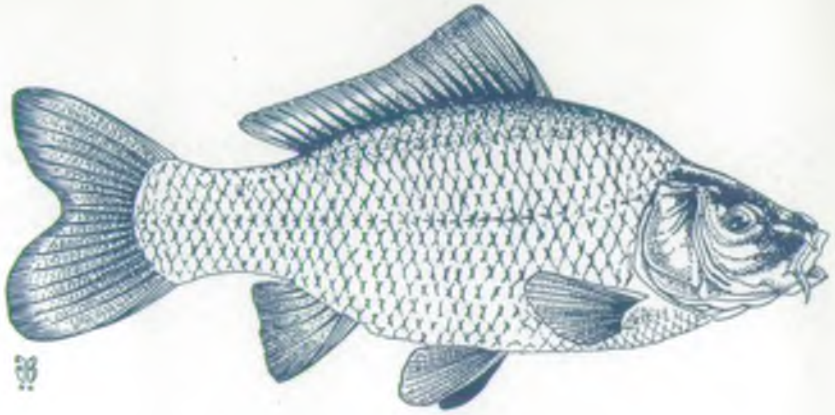
Weight -	rarely 5.5kg (12lb), very few over 6.4kg (14lb).
Length -	rarely exceed 80cm.
Age -	rarely exceed 18 years.
Location -	lowland rivers or still waters.
Behaviour -	shoaling in large groups near the bed.
Preferred habitat -	enriched slack water, mud or silt bottom, adaptive.
Feeding -	warm weather at night, intake up to 7 per cent of body weight per day.
Natural food -	invertebrates such as blood worm, molluscs, crustacea.
Maturity -	4-6 years.
Fecundity -	150,000-300,000 eggs per kg of body weight.
Spawning times -	May-June, 12-20°C
Spawning -	dense weed, rarely on gravel.
Migratory habits -	localised migrations to spawning areas.
Predators -	pike.

Species - **Brook lamprey**, *Lampetra planeri (Bloch)*

Length -	rarely exceed 18cm pre-spawning.
Age -	maximum 7 years.
Location -	rivers, streams.
Behaviour -	juveniles solitary, remain buried in substrate for $6^1/_2$ years.
Metamorphosis -	(juveniles change to adults) March.
Preferred habitat -	small channel, medium flow, gravel, sand, silt substrate.
Feeding -	juveniles filter feed.
Natural food -	algae, rotifers.
Maturity -	7 years.
Spawning times -	single mass spawning, then adults die.
Spawning -	in gravel, form nest or "redd".
Migratory habits -	spawning migrations.

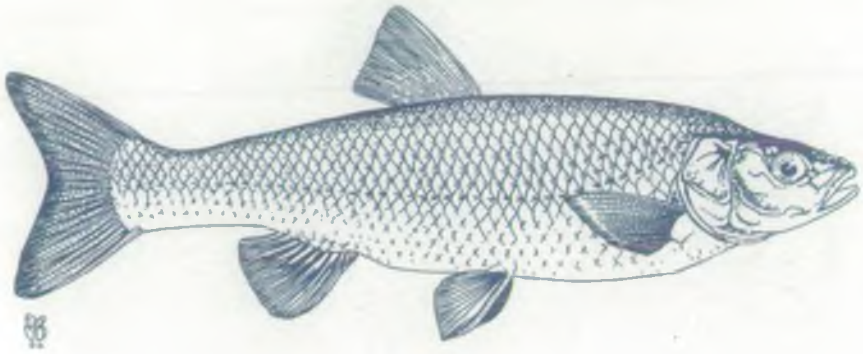
Species - **Bullhead**, *Cottus gobio (L.)*

Length -	rarely exceed 10cm.
Age -	maximum 6 years.
Location -	rivers, streams.
Behaviour -	solitary, cover under stones and wood during daylight.
Preferred habitat -	coarse gravel, wood, oxygen-rich water.
Feeding -	active at dusk, foraging over gravel.
Natural food -	insect larvae, crustacea.
Maturity -	2 years.
Fecundity -	100 eggs per female.
Spawning times -	March-May.
Spawning -	eggs under stones protected by males, multiple broods.
Migratory habits -	localised spawning and "over-wintering".



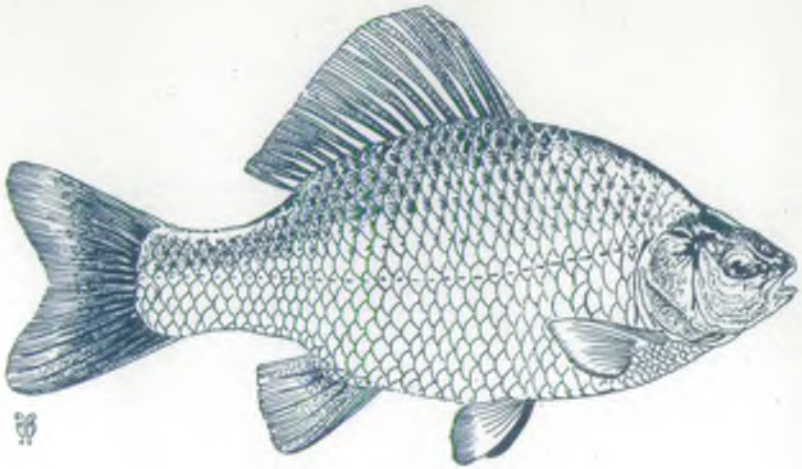
Species - **Carp**, *Cyprinus carpio (L.)* - **Mirror, common carp, etc.**

Weight -	rarely 13.6kg (30lb), few over 18.1kg (40lb).
Length -	rarely exceed 100cm.
Age -	rarely exceeding 30 years.
Location -	lakes and ponds, slow-flowing rivers, very adaptable.
Behaviour -	shoaling in small groups.
Preferred habitat -	dense weed, silt substrate.
Feeding -	warm weather, bottom feeding at night, adaptable.
Natural food -	invertebrates, worms, molluscs and vegetation.
Maturity -	males 3-4 years, females 4-5 years.
Fecundity -	100,000-200,000 eggs per kg of body weight.
Spawning times -	May-July, 16-22°C, multiple spawning.
Spawning -	dense weed, bulrushes.
Migratory habits -	localised spawning migrations.
Predators -	juveniles taken by pike and perch.



Species - **Chub**, *Leuciscus cephalus (L.)*

Weight -	rarely 2.7kg (6lb), very few over 3.2kg (7lb).
Length -	rarely exceed 60cm.
Age -	maximum 22 years.
Location -	medium- to fast-flowing rivers, occasionally still water.
Behaviour -	shoaling, sometimes in large numbers.
Preferred habitat -	fast water, weed cover, coarse gravel.
Feeding -	active throughout the year, adaptable, opportunist.
Natural food -	insect larvae, molluscs, crustacea, small fish, frogs.
Maturity -	males 3-7 years, females 4-8 years.
Fecundity -	20,000-30,000 eggs per kg of body weight.
Spawning times -	May - July, multiple spawning, 18°C-20°C.
Spawning -	gravel, typically 20-40mm diameter.
Migratory habits -	home range 4km, localised spawning.
Predators -	pike, perch and chub.

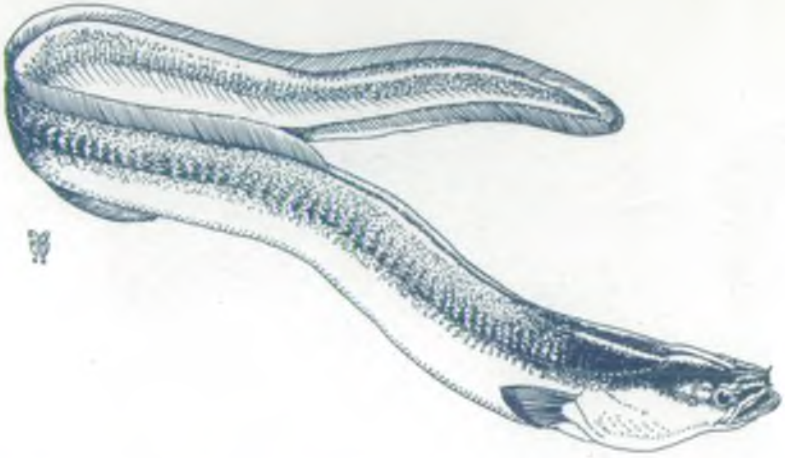


Species - **Crucian carp**, *Carassius carassius (L.)*

Weight -	rarely 1.4kg (3lb), very few over 1.8kg (4lb).
Length -	rarely exceed 40cm.
Age -	maximum 20 years.
Location -	lakes, ponds.
Behaviour -	shoaling in small groups.
Preferred habitat -	shallow still water, dense weed.
Feeding -	most active May-September, dawn and dusk, forage in silt.
Natural food -	molluscs, crustacea, worms.
Maturity -	3-4 years.
Fecundity -	100,000-250,000 eggs per female.
Spawning times -	May-June.
Spawning -	dense marginal weed.
Migratory habits -	localised spawning migrations.
Predators -	pike.

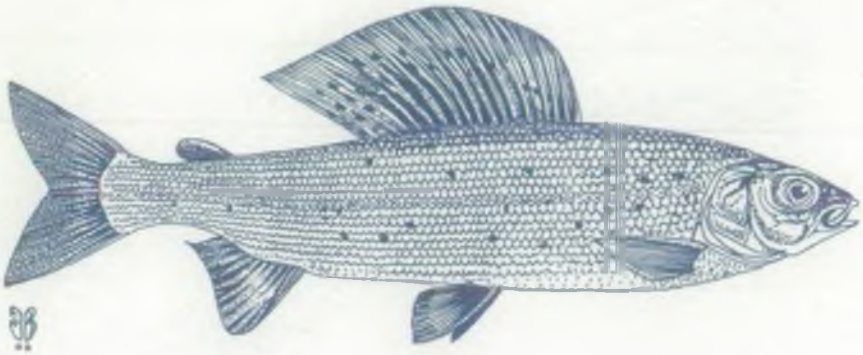
Species - **Dace**, *Leuciscus leuciscus (L.)*

Weight -	rarely 0.40kg (14oz), very few over 0.51kg (1lb 2oz).
Length -	rarely exceed 26cm.
Age -	maximum 10 years.
Location -	rivers.
Behaviour -	shoaling, usually in large numbers.
Preferred habitat -	fast-flowing water, sand or gravel substrate.
Feeding -	all year, intense at dawn and dusk. Take drifting food items.
Natural food -	insect larvae, aerial insects.
Maturity -	3-4 years.
Fecundity -	6,500 - 9,500 eggs for 20cm females.
Spawning times -	March - April, 9-10^{o}C, single spawning.
Spawning -	gravel, typically 10-40mm diameter.
Migratory habits -	large home range, localised feeding migrations.
Predators -	pike, perch, chub and trout.



Species - **Eel**, *Anguilla anguilla (L.)*

Weight -	rarely 2.3kg (5lb), very few over 3.2kg (7lb).
Length -	rarely exceed 100cm.
Age -	maximum recorded 40 years.
Location -	rivers, streams, canals, lakes, ponds, drains and ditches.
Behaviour -	solitary.
Preferred habitat -	slow-flowing, deep water, sand, silt and weed.
Feeding -	May-August, most active at night, forage in debris.
Natural food -	crustacea, worms, small fish.
Maturity -	8-15 years.
Spawning -	Sargasso Sea at depth.
Migratory habits -	August-October, adults to sea; February-May, elvers return.
Predators -	pike.



Species - **Grayling**, *Thymallus thymallus (L.)*

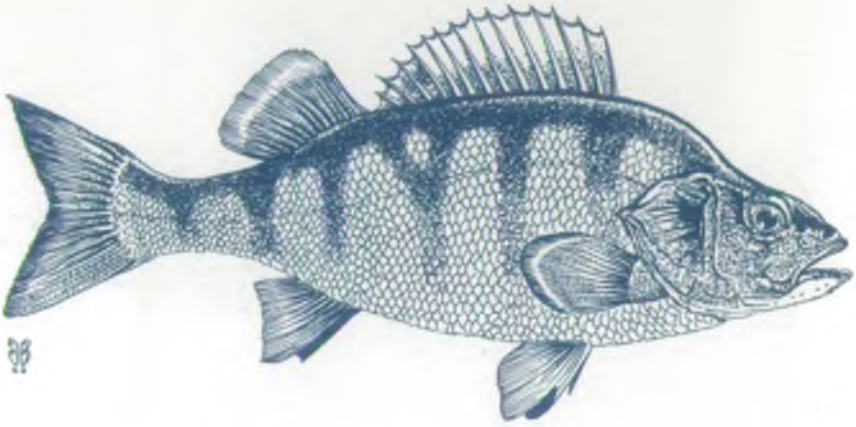
Weight -	rarely 1.4kg (3lb), very few over 1.8kg (4lb).
Length -	rarely exceed 40cm.
Age -	maximum 15 years.
Location -	rivers, streams.
Behaviour -	shoaling, often in large numbers.
Preferred habitat -	fast flow over gravel, oxygen-rich clear water.
Feeding times -	all year, remain active at low temperatures.
Natural food -	insect larvae, aerial insects.
Maturity -	3-4 years
Fecundity -	10,000 eggs in large females.
Spawning times -	March-May.
Spawning -	on gravel.
Migratory habits -	large home range.
Predators -	pike.

Species - **Gudgeon**, *Gobio gobio (L.)*

Weight -	rarely 0.057kg (2oz), very few over 0.085kg (3oz).
Length -	rarely exceed 15cm.
Age -	maximum 8 years.
Location -	rivers, canals, drains and lakes.
Behaviour -	shoaling, often in large numbers, able to produce sound.
Preferred habitat -	clear flowing water, sand or gravel substrate.
Feeding -	active during summer months, bottom feeder, adaptable.
Natural food -	insect larvae, molluscs freshwater shrimp.
Maturity -	2-3 years.
Fecundity -	2,500-6,500 eggs.
Spawning times -	April-August, 17°C+.
Spawning -	gravel, typically 10-20mm.
Migratory habits -	limited home range.
Predators -	pike, perch, chub, barbel, trout and eel.

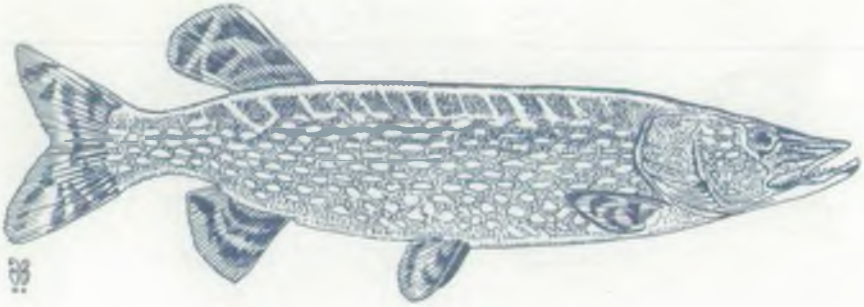
Species - **Minnow**, *Phoxinus phoxinus (L.)*

Weight -	rarely exceed 0.014kg (1/2 oz).
Length -	rarely exceed 10cm.
Age -	maximum 6 years.
Location -	rivers, streams, occasionally lakes and canals.
Behaviour -	shoaling, often in large numbers.
Preferred habitat -	shallow, oxygen-rich, clear water, sand, gravel.
Feeding -	active throughout the year, will forage all day.
Natural food -	zooplankton, insect larvae.
Maturity -	2-3 years.
Fecundity -	200-1,000 eggs per female.
Spawning times -	mainly June to July, multiple spawning.
Spawning -	gravel and weed.
Migratory habits -	localised spawning migrations.
Predators -	pike, perch, chub, barbel, trout, zander and eel.



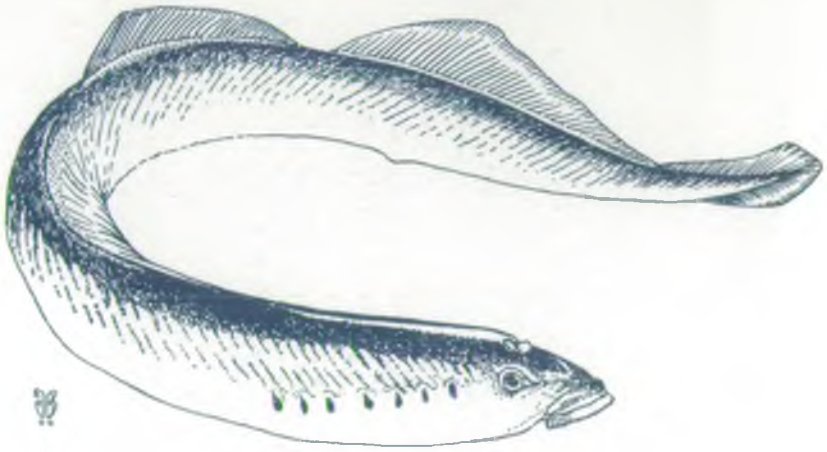
Species - **Perch**, *Perca fluviatilis (L.)*

Weight -	rarely 1.8kg (4lb), very few over 2.3kg (5lb).
Length -	rarely exceed 40cm.
Age -	maximum 10 years.
Location -	rivers, canals, drains and lakes.
Behaviour -	shoaling in young fish, adults form small groups.
Preferred habitat -	dense weed.
Feeding -	active in the summer. Dependent on light and cover.
Natural food -	insects, small fish (roach, bleak, perch, minnow).
Maturity -	males 2-4 years, females 4-6 years.
Fecundity -	10,000-200,000 eggs per female.
Spawning times -	April-May, 8.5-13.5°C, eggs in 1m "ribbons".
Spawning -	dense submerged weed.
Migratory habits -	can migrate large distances.
Predators -	pike and perch.



Species - **Pike**, *Esox lucius (L.)*

Weight -	rarely 13.6kg (30lb), few males over 4.5kg (10lb).
Length -	rarely exceed 130cm.
Age -	rarely exceed 18 years.
Location -	rivers, lakes, canals and ponds. Adaptable.
Behaviour -	solitary, occasional groups near feeding or spawning areas.
Preferred habitat -	juveniles: shallow, weed. Adults: open water.
Feeding -	dawn and dusk.
Natural food -	fish, including small pike.
Maturity -	males and females 2-3 years.
Fecundity -	15,000- 30,000 eggs per kg of body weight.
Spawning times -	March-May, rise in temperature 6-10°C.
Spawning -	dense weed, for example *Phragmites* or *Elodea*.
Migratory habits -	seasonal spawning migrations up to 10km.
Predators -	pike.



Species - **River lamprey**, *Lampetra fluviatilis (L.)*

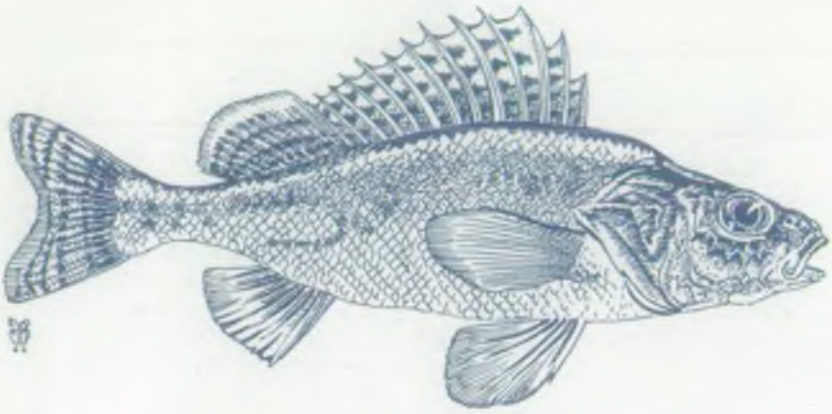
Length -	rarely exceed 60cm pre-spawning.
Age -	maximum 7 years.
Location -	rivers, streams.
Behaviour -	juveniles solitary, in substrate for 4 years pre-migration.
Metamorphosis -	(juveniles change to adults) February.
Preferred habitat -	oxygen-rich, marginal silts or organic debris.
Feeding -	juveniles filter feed, adult parasites on marine fish.
Natural food -	algae, rotifers in fresh water, parasites on herring, sprat at sea.
Maturity -	5-7 years.
Spawning times -	mass single spawning then adults die.
Spawning -	gravel, form nest or "redd".
Migratory habits -	adults go to sea for 1 year, return to spawn.

Species - **Roach**, *Rutilus rutilus (L.)*

Weight -	rarely 1.4kg (3lb), very few over 1.6kg (3.5lb).
Length -	rarely exceed 40cm.
Age -	maximum 18 years.
Location -	lowland rivers, lakes, ponds, canals and drains.
Behaviour -	shoaling as young fish and adults.
Preferred habitat -	slow water, variable depth and dense weed, very adaptable.
Feeding -	most active from June to October, dawn and dusk.
Natural food -	zooplankton, bloodworm, snails, filamentous algae.
Maturity -	males 2-4 years, females 3-5 years.
Fecundity -	1,000-15,000 eggs per female.
Spawning times -	April to early June, 8-14°C.
Spawning -	dense weed, occasionally gravel.
Migratory habits -	limited home range, spawning migrations.
Predators -	pike, perch and zander.

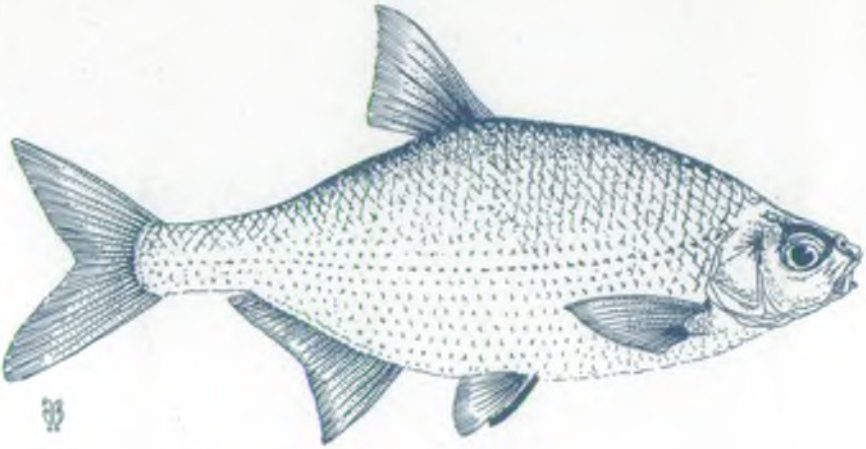
Species - **Rudd**, *Scardinius erythrophthalmus (L.)*

Weight -	rarely 1.4kg (3lb), very few over 1.8kg (4lb).
Length -	rarely exceed 34cm.
Age -	maximum 17 years.
Location -	lakes, reservoirs, ponds, canals and lowland rivers.
Behaviour -	shoaling, often in large numbers.
Preferred habitat -	shallow still water, reeds, sand or silt substrate.
Feeding -	active April-August, often feed near or at the water surface.
Natural food -	zooplankton, insect larvae and filamentous algae.
Maturity -	3-4 years.
Fecundity -	100,000 - 200,000 eggs per kg of body weight.
Spawning times -	May-July, 14-20°C.
Spawning -	weed: *Phragmites* sp., 0.1-0.9m deep.
Migratory habits -	limited home range; move to deeper water in autumn.
Predators -	pike, perch and zander.



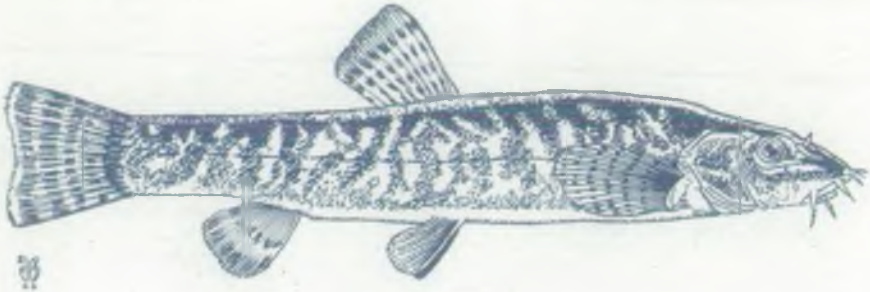
Species - **Ruffe**, *Gymnocephalus cernuus (L.)*

Weight -	rarely 0.085kg (3oz), very few over 0.11kg (4oz).
Length -	rarely exceed 12cm.
Age -	maximum 6 years.
Location -	lowland rivers, lakes and canals.
Behaviour -	shoaling, often in large numbers.
Preferred habitat -	weed, sand or gravel substrate with low flow.
Feeding -	forage in the substrate, most active dawn and dusk.
Natural food -	insect larvae.
Maturity -	2 years.
Fecundity -	4,000-100,000 eggs per female.
Spawning times -	March-May.
Spawning -	stones and weed in shallow water.
Migratory habits -	limited home range.
Predators -	pike, perch, chub, barbel, ruffe, and eel.



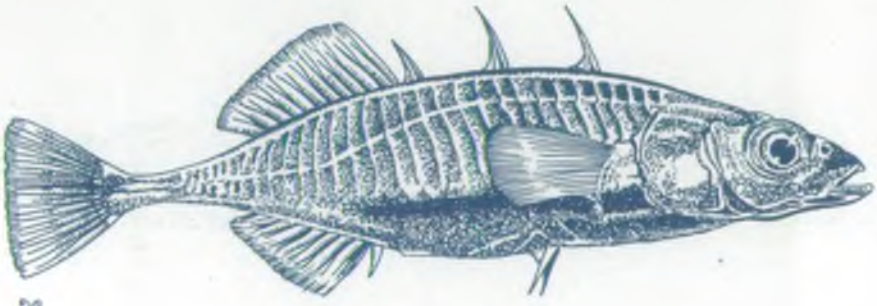
Species - **Silver bream**, *Blicca bjoerkna (L.)*

Weight -	rarely 0.67kg (1.5lb), very few over 0.91kg (2lb).
Length -	rarely exceed 30cm.
Age -	maximum 19 years.
Location -	slow-flowing lowland rivers, lakes and ponds.
Behaviour -	shoaling, often in large numbers.
Preferred habitat -	slack deep water, weed and silt substrate.
Feeding -	most active March-September.
Natural food -	zooplankton, invertebrates and filamentous algae.
Maturity -	males 3-4 years, females 4-5 years.
Spawning times -	May - June, 16-25°C, multiple spawning.
Spawning -	weed, 0.5-1.0m depth range.
Migratory habits -	limited home range, localised spawning.
Predators -	pike and perch.



Species - **Stone loach**, *Barbatula barbatulus (L.)*

Length -	rarely exceed 12cm.
Age -	maximum 8 years.
Location -	rivers, streams.
Behaviour -	solitary, live under stones.
Preferred habitat -	stones, gravel, medium flow, oxygen-rich water.
Feeding times -	summer, active dawn and dusk, graze over stones.
Natural food -	filamentous algae, insect larvae.
Maturity -	2-3 years.
Fecundity -	500,000 - 800,000 eggs per female.
Spawning times -	April-May.
Spawning -	coarse gravel, stones.
Migratory habits -	limited home range.

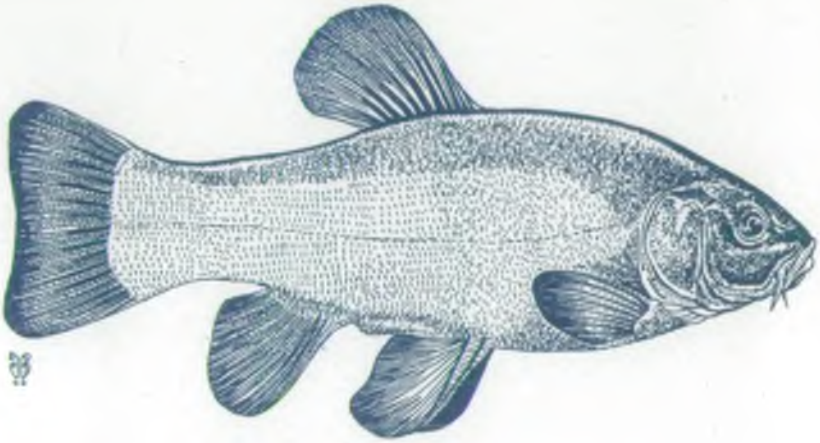


Species - **3-spined stickleback**, *Gasterosteus aculeatus (L.)*

Length -	rarely exceed 8cm.
Age -	maximum 4 years.
Location -	canals, ponds and rivers.
Behaviour -	shoaling in small groups, territorial and aggressive.
Preferred habitat -	shallow, dense weed, sand, silt substrate.
Feeding -	summer, most active dawn and dusk.
Natural food -	zooplankton and insect larvae.
Maturity -	1-2 years.
Fecundity -	90-450 eggs per female.
Spawning times -	March-June.
Spawning -	form nest in weed, males protect brood.
Migratory habits -	limited home range.

Species - **10-spined stickleback**, *Pungitius pungitius (L.)*

Length -	rarely exceed 7cm.
Age -	maximum 8 years.
Location -	lowland rivers and estuaries.
Behaviour -	shoal in small groups.
Preferred habitat -	slow-flowing, nutrient-rich water, weed, sand.
Natural food -	insect larvae and crustaceans.
Maturity -	1 year.
Spawning times -	April-July.
Spawning substrate -	male builds nest in weed.
Migratory habits -	sea water tolerant, can migrate to other rivers.



Species - **Tench**, *Tinca tinca (L.)*

Weight -	rarely 4.5kg (10lb), very few over 5.5kg (12lb).
Length -	rarely exceeding 60cm.
Age -	maximum 14 years.
Location -	lakes, canals and lowland rivers
Behaviour -	mostly solitary, occasionally in small groups.
Preferred habitat -	shallow still water, dense weed, silt substrate.
Feeding -	May-September, active benthic foraging at dawn and dusk. Natural
Natural food -	zooplankton, benthic invertebrates such as molluscs.
Maturity -	3-5 years, 20-24°C.
Fecundity -	300,000-400,000 eggs per kg of body weight.
Spawning times -	May-August.
Spawning -	dense weed, shallow water, low or no flow.
Migratory habits -	limited home range, localised spawning.
Predators -	pike.

Species - **Zander**, *Stizostedion lucioperca (L.)*

Weight -	rarely 5.5kg (12lb), very few over 6.8kg (15lb).
Length -	rarely exceeding 110cm.
Age -	maximum 15 years.
Location -	lowland rivers, drains and large still waters.
Behaviour -	shoaling as young fish, solitary as adults.
Preferred habitat -	shallow, enriched, slow-flowing, turbid water.
Feeding -	most active in the summer, dawn and dusk.
Natural food -	small fish, roach, rudd, perch, ruffe.
Maturity -	3-4 years.
Fecundity -	135,000-200,000 eggs per kg of body weight.
Spawning times -	April-June, 8-12°C.
Spawning -	nest at base of weed beds, males guard eggs.
Migratory habits -	limited home range around 1km, localised spawning.
Predators -	pike and zander.

Section 3 Managing coarse fish

Almost all the rivers and lakes in England an Wales have been affected to some extent by the demands of society and economic development. In addition the entire canal network exists only because it was the motorway system of earlier times, and many lakes were created as by-products of commercial digging (for example gravel pits) or for the storage of flood water.

Despite this history of human influence, most lakes, rivers, canals and drains form an extremely valuable wildlife conservation resource. They contain a wide range of habitat types that support many different species of fish, insects, birds and mammals. However, this resource is under pressure from such things as the demand for water for homes and industry, the discharge of treated effluent and the installation of flood defences. There are also the natural pressures of a variable environment, some of which have been described earlier in this book.

For wild fish in wild places, the Agency promotes the principle of self-sustaining fish stocks. These are natural fish populations that develop to suit the aquatic ecosystem they inhabit. Management of such fisheries should be based on knowledge of coarse fish biology. In this way we can ensure that actions are both cost effective and of benefit to all parts of the aquatic ecosystem.

WORKING TOGETHER

Many different groups have an interest in river and lake management. Any fishery management should consider the needs of these groups, and work to the benefit of all.

THE PUBLIC

The public, or society, is not actively involved with rivers and

still waters but expects them to be managed and used responsibly. The Government maintains various responsible bodies, like **The Environment Agency, English Nature** and the **Countryside Council for Wales** to achieve this.

ANGLING GROUPS

Anglers generally share a desire to fish for a range of different fish species in different locations, from wild natural river systems to specially built lakes and ponds. Their management objectives therefore include protecting the natural environment and maintaining good fish stocks.

- **Anglers are aware of and concerned about the environment.**
- **Anglers and fishery owners can help manage coarse fish populations.**
- **Good fishery management can benefit wildlife conservation.**

CONSERVATION GROUPS

Some habitats or species are so important or rare that they need to be protected. English Nature uses "Special Areas of Conservation" (SAC) and "Sites of Special Scientific Interest" (SSSI) to achieve this. Coarse fish are a vital component of the conservation capital in England and Wales.

- **Conservation groups can help manage coarse fish populations.**

RIVER ENGINEERING

The need for post-war agricultural development in the 1940s lead to extensive "land drainage" schemes. These were designed to drain water away from land so that farmers could produce more crops to feed a nation recovering from

World War II. Many different types of river habitat were changed or lost, and the success of some coarse fish species was affected. The prime objective of a modern river engineer is to protect lives and property from flood water. By understanding the types of habitat that different coarse fish species need, they can be designed into flood prevention schemes.

- **River engineers can develop "environment friendly" schemes.**
- **River engineers can help to manage coarse fish populations.**

OTHER FORMS OF RECREATION

Boaters, walkers, cyclists and others value the water environment, and take pleasure from it. Many of these groups will therefore have a legitimate interest in management of the aquatic environment, and they must be considered in any management plan.

- **Many people and groups can be affected by fishery management actions.**

PLANNING MANAGEMENT

Successful coarse fishery management is most often based on a clear plan with specific targets. Plans give direction and purpose to management objectives, but need the problem to be clearly defined. Answering the questions below is an important first step.

- **What exactly is the problem?** *(for example, no one is catching any fish)*
- **How long has it existed?** *(for example, for the last year)*
- **What evidence is there?** *(for example, declining match returns)*
- **If there is no problem now, must we act to *maintain* the coarse fishery?**

Once these questions and answers have been considered, professional help can be extremely valuable. Successful fishery and habitat management needs skill, understanding, experience and time. It is very easy to make mistakes and cause more problems. The local Environment Agency Fisheries Office can be contacted for advice and guidance on any aspect of coarse fishery management. The telephone number of the general enquiry line is on the back page of this book.

CARRYING OUT THE PLAN

It is then a case of applying the knowledge about the biology of coarse fish to solve the problem, as the following two examples demonstrate.

Example one:
Problem: few adult coarse fish present at the site.
Cause: unsuitable habitat due to past river channel works.
Solution: increase diversity of habitats at the site, especially pool, riffle and slack water.

Meanders, pinch points and small islands were created using natural river processes.

Brushwood bundles (faggots) were fixed to the riverbed in the margins, using wooden stakes. The brushwood slows river flow and traps silt. These areas became colonised by plants and after three years formed natural-looking banks.

Slack water areas were established between meanders and behind small islands which were created using brushwood. Flow became concentrated in other parts of the channel, forming scour holes and shallows, or "pool-riffle" sequences.

Pools and riffles provided good resting, feeding and spawning sites for many coarse fish including dace, chub, barbel and bullheads.

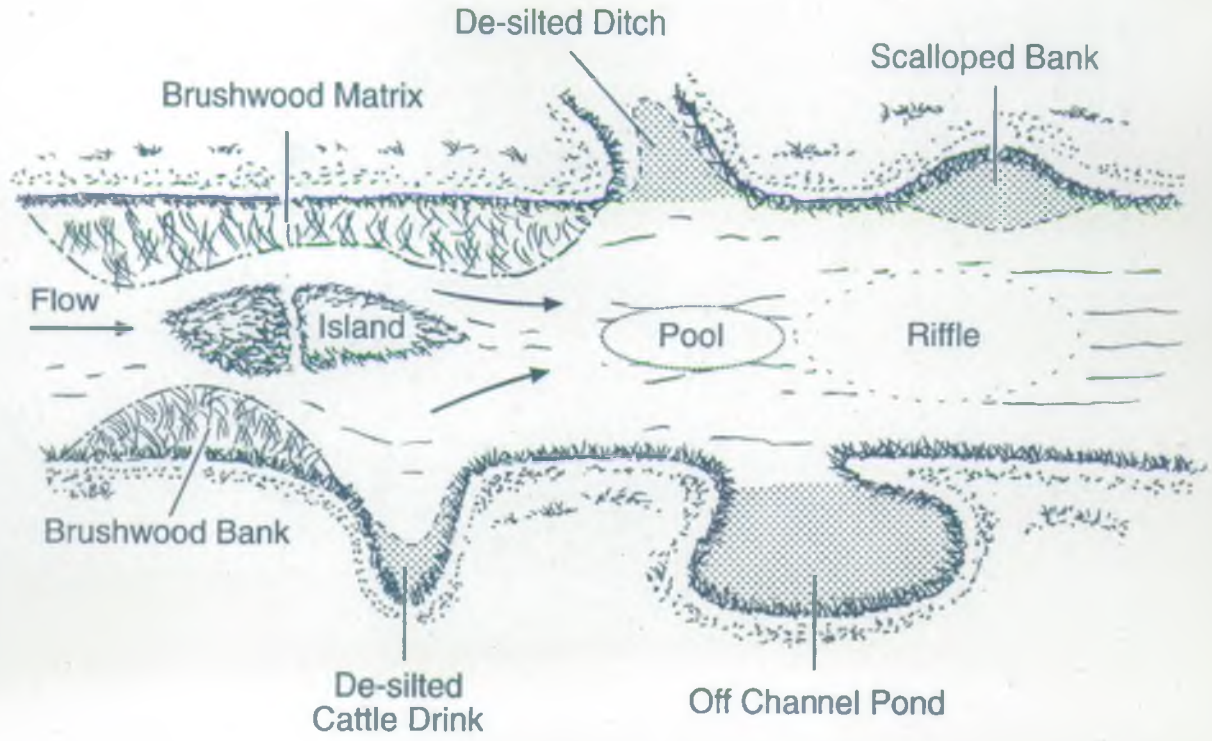


Figure 7: Examples of river habitat restoration

Example two:

Problem: poor recruitment in large parts of the river.
Cause: not enough refuge areas for juvenile fish.
Solution: establish habitats where juvenile fish can shelter and feed.

Silted side channels and ditches were carefully excavated to improve winter refuges for young fish.

Steep banks were changed to form new wide, shallow side bays and "off channel ponds" that provided ideal summer nursery areas as well as winter refuges for young fish. They were also designed to be used by wading birds.

Figure 8: Heron hunting in shallow margins

Further reading

"Freshwater Fisheries and Wildlife Conservation - a good practice guide" describes how fisheries management can work to the benefit of all parts of the ecosystem. It gives descriptions of simple management that can help promote self-sustaining stocks of native fish. This booklet can be obtained free of charge from your local Environment Agency office.

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

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ENVIRONMENT AGENCY GENERAL ENQUIRY LINE

0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

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