

5. Factors limiting fishery production

The habitat, electrofishing and invertebrate surveys carried out by ART since its establishment has enabled it to develop a broad understanding of the factors limiting fish production in the freshwater environment in Ayrshire. Almost all of the limiting factors are related to human activities, both current and historical. There are some issues which are likely to be significant factors limiting fish production in Ayrshire but which are beyond the remit of ART. These would include issues such as climate change, and marine survival of migratory fish. This plan focuses on the potentially major improvements which could be made to reduce the impact of factors limiting fish and fishery production in the freshwater environment.

The following are considered to be the most significant limiting factors.

5.1 Water quality

Many watercourses in Ayrshire suffer from reduced water quality. The principal reasons for reduced water quality are:

5.1.1. Diffuse pollution

Diffuse pollution is a chronic problem in Ayrshire with the main cause being intensive livestock farming in lowland areas. SEPA considers that diffuse agricultural pollution is the most important form of pollution in Scotland's watercourses. Diffuse pollution can be a difficult concept for the layman to understand but it typically consists of nutrient run-off from fertilizers and slurry spreading, siltation from soil erosion and surface run-off and bacterial contamination from animal faeces and manures¹.

Ayrshire's mild, wet climate makes it ideal for producing grass and it is famous for its dairy industry. The county of Ayrshire has the second largest number of dairy cattle in Scotland (c.45,639, <http://www.scotland.gov.uk/Publications/2007/03/14162921/14>), after Dumfries and Galloway. Agricultural diffuse pollution features significantly as a limiting factor in all Ayrshire catchments with the exception of the upper Doon, some of the small coastal burns and to a lesser extent on the Stinchar. ART assessment of the extent of the agricultural diffuse impacts in Ayrshire corresponds closely with SEPA's published data² although the resolution of ART survey data is much finer as we have survey data available from a greater range of watercourses.



Examples of diffuse pollution sources: cattle feeder rings and trampled gateway

5.1.2. Sewage Treatment Effluent

Effluent from sewage treatment works (STWs) can have a major effect on river ecology, especially when river flows are low and ambient temperatures high. Reduced oxygen levels in river water have been recorded downstream of such inputs in Ayrshire by ART and SEPA. This factor is considered to be chronic and possibly increasing on the River Ayr, where planned residential developments are threatening to exceed the existing population equivalents (capacities) of local STWs. Investment programs to address these issues operate on long term planning cycles³ and invariably are reactive, driven by problems, rather than proactive. In the Ayr catchment Scottish Water have recently invested in the provision of tertiary sand filters at the Underwood STW along with aeration equipment.

On the River Irvine and Garnock there are main sewers carrying sewage from all the valley settlements to Meadowhead treatment works on the coast at Irvine. The Irvine Valley sewer was built approximately 70 years ago. Initially the sewage was disposed of at sea via a short sea outfall but is now treated at Stevenston Treatment works, before pumping to sea. The establishment in an Irvine Valley main sewer in the 1930's now looks like an excellent investment and it may be that a similar investment in a main sewer for the Ayr catchment may be the only cost effective way of protecting river quality.

ART has identified many problems associated with STWs including Underwood (which is considered to be the most significant) and Drongan in 2008. Concerns have also been raised regarding the performance of the Mauchline STW, although SEPA monitoring does not indicate any significant issues⁴.



Underwood STW discharge, Lugar Water

5.1.3. Combined sewer overflows (CSOs)

Discharges from Combined sewer overflows (CSOs) are a known problem for water quality in Ayrshire when the capacity of existing sewers and drains is exceeded

during heavy rainfall events. Within the Irvine catchment there are 113 CSOs. The performance of all Scottish Water CSO's is reported in the Scottish Water Asset Capacity and Development Plan ⁵. The Scottish Water website includes maps based on local authority areas. The East Ayrshire map shows that 63% of the CSO's were classified as performing unsatisfactorily in 2007. Kilmarnock is the largest settlement in the Irvine catchment, population 44,734 (East Ayrshire Council website), and 93% of the 35 CSO's located within the town were recorded as performing unsatisfactorily. ART are aware that Scottish Water are currently working on improvement plans to collect CSO discharges from Kilmarnock and Irvine for treatment at Stevenston SWT. The human population of the River Irvine catchment is approximately 112,000, giving a population density of 295 persons/km². This is one of the highest population densities of any salmon river in Scotland, probably only exceeded by the River Clyde. According to SEPA's water classification the lower River Irvine is classified as moderate ecological status ⁶. The ecological impact of these spills on fish production is difficult to assess but this form of pollution is likely to add to the burden of water quality problems in the lower reaches of most Ayrshire rivers. Spills may become more frequent, if climate change results in increased rainfall.

5.1.4. Acidification

Acidification of surface waters in Ayrshire is a feature of upland areas with poorly buffered geology and a high proportion of conifer forestry. Acidified areas are typically underlain by an inert type of bedrock such as granite which does not release carbonate or other minerals capable of neutralising acidity. Conifer trees exacerbate the problem by accumulating pollutants and naturally-derived particles from acid rain. Salmonid egg survival is believed to be poor below pH 5 and lower levels have been recorded in tributaries of the upper River Doon since the late 1980s ⁷.

Carrick Lane, Loch Doon, suffers from low pH episodes



5.1.5. Coal mining, past and present

Coal mining is a major industry in Ayrshire where there are significant Coal Measure deposits. There are active and proposed opencast coal mines on the River Ayr and

River Doon. Although there are now no active deep mines in Scotland, minewater from disused deep mines is still a threat to river ecology. The River Girvan suffered one of the worst pollution incidents in Scotland in 1979 following a minewater spill from a disused deep mine at Dailly ⁸. Dissolved minerals and suspended solids in water draining from mines can have a negative impact on river life. Some of the opencast mines in Ayrshire are very large and have a significant effect on local hydrology and water quality. The nature of mining related water quality problems in Ayrshire ranges from historical discharges from the old deep mines, to emerging threats from opencast mines on the Ayr and Doon catchments.



Discoloured water entering the Lugar Water, the result of pollution from an opencast mine



Water from old deep mines can result in severe water quality problems

5.1.6. Point source pollution

Industrial point source pollution incidents are now rare in Ayrshire, primarily due to effective regulation by SEPA but also due to the closure of many industrial plants. There are still pollution incidents every year from farm effluent spills, often resulting in fish kills although again the incidence is reducing due to more effective regulation and awareness. Other pollution problems such as sheep dip pollution, which affected the upper reaches of the River Girvan, have been recorded by ART.

5.2. Habitat degradation

Habitat degradation can occur in many forms but the following are considered that the most significant forms of habitat degradation in Ayrshire.

5.2.1. Farm stock access to water courses

Farm stock overgrazing along riparian zones, often combined with the impact of diffuse pollution, trampling and associated erosion are considered to be a major limiting factor particularly in lowland agricultural tributaries. In ART's experience lowland streams protected from overgrazing are rare in Ayrshire and the situation pictured below is the norm.



Heavily grazed banksides offer little fish cover

The generally high productivity of Ayrshire farmland means that growth of vegetation is very rapid following the erection of fencing and the exclusion of farm stock. ART have initiated several fencing projects and have been able to demonstrate considerable improvements in habitat quality and fish populations.

The impact of intensive agriculture on water quality and biodiversity are now recognised and accepted. Agri-environment grant schemes such as the SRDP ⁹ have measures aimed at reducing impacts of agriculture on the environment at its core. ART believe that there is now huge potential to improve river quality and habitat by developing collaborative catchment based projects in priority areas.

5.2.2. Riparian overshadowing

At the opposite end of the spectrum, and a very common situation in Ayrshire, is overshadowing from established tree growth along riparian zones. Watercourses flowing through steep river valleys are often heavily wooded. Native woodlands have a much lower impact in this respect. There are a few examples of excellent native riparian woodland in Ayrshire, e.g. upper Water of Tig, Gogo Water where the diversity found in natural native woodlands ensures that there is a range of canopy height allowing adequate light to reach stream beds. Plantings of commercial species such as conifers, in steep valleys where there will never be harvested economically, or amenity woodlands, are a particular problem. Modern planting guidelines should ensure that this problem reduces in future years.



Overshading from uniform age trees



Overshading from conifer trees

5.2.3. Siltation

Compaction of spawning gravels is an issue in many watercourses, both small burns and larger tributaries such as the Cessnock Water. Siltation and compaction of gravels can have a serious impact on salmonid spawning success. Compacted gravels can be unattractive, if not impossible for salmonids to spawn in. Heavy silt levels can lead to the smothering of eggs incubating within gravel, reduced flow of water through the gravel, resulting in high incubation mortality. Compacted gravels also lack the void spaces which provide essential habitat for small fish and invertebrates. The problem is at its worst in lowland agricultural burns where the fine clayey ayrshire soils are easily mobilised by heavy rain and overland water flow. If the source of silt can be removed, e.g. by riparian fencing then works to clean the gravels can be very beneficial



Water of Fail, River Ayr, pebbles and cobbles are embedded within silt (*trout died as a result of diffuse pollution related water quality problems*)

5.2.4. Urbanisation

Urbanisation of watercourses can have a very detrimental impact on their ecology as well as more immediate public concerns such as increased risk of flooding. Many Ayrshire towns developed around major rivers (e.g. the Ayr and Irvine). The river banks in town centres are often straightened (canalised) and lined with concrete walls, or gabion baskets in order to prevent flooding, resulting in a degradation of the riparian zone and loss of fish habitat. Channel straightening and flood prevention schemes are ongoing, particularly in densely populated areas of the River Garnock and Irvine. Good bankside cover is essential for healthy fish populations, especially brown trout. The picture below shows a typical urban scene where there is a complete lack of cover along the wall.

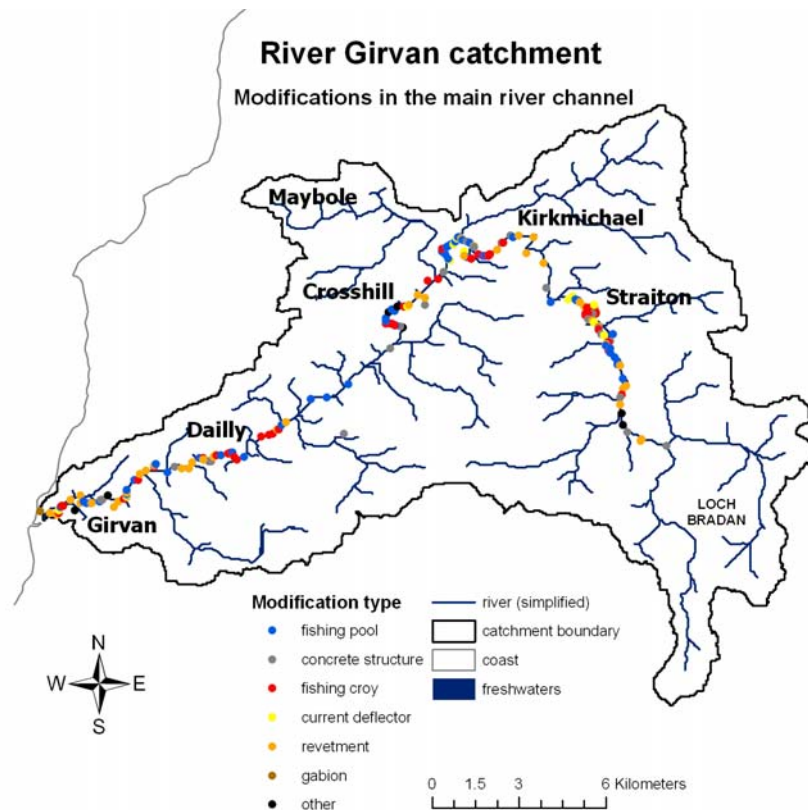


Brick retaining wall River Irvine

The most extreme example of urbanisation in Ayrshire can be seen in the lower Gogo Water in Largs which is confined by high walls throughout the town leaving no room for the river to meander. As a result small substrate sizes such as gravel and pebbles are washed through and substrates are dominated by boulders and cobbles.

5.2.5. Instream modifications

Instream modifications such as croys, bank revetments, channel straitening can all have a negative impact on stream ecology and fish production. For the purposes of this report instream modifications are regarded as man-made structures or engineering works which do not obviously impede fish migration but have the potential to affect fish production. For instance, fishing croys, revetments, dredging and removal of boulders can all have an effect on the amount of cover for fish and quality of available habitat. The highest densities of salmonid parr in Ayrshire are found in sections with natural instream cover. New instream modifications are now subject to regulation and charges from SEPA and are likely to become less common. However, ART staff have encountered several instances in 2008 where landowners have used excavators to “improve the appearance” of small burns.



River Girvan instream modifications



Ineffectual small weir across prime spawning habitat

5.2.6. Gravel removal

Removal of gravels from watercourses can be a significant issue locally although its prevalence is much reduced since the Controlled Activities Regulations (CAR) were brought into force. Gravel extraction from watercourses now requires a licence CAR.



Gravel extraction Glenmuir Water 2006

5.3. Weirs and other impoundments

Many of the obstructions to fish migration in Ayrshire are historical industrial features such as weirs built when rivers were vital sources of power for mills. Others were created to divert or store water for hydro power generation including modern structures such as Loch Doon Dam. Almost all of the industrial weirs are now disused but the structures remain often having a severe impact on migratory species such as salmonids and eels. Resident fish such as brown trout or grayling also undertake local migrations, for example at spawning time and the presence of impassable weirs can result in fragmented populations.

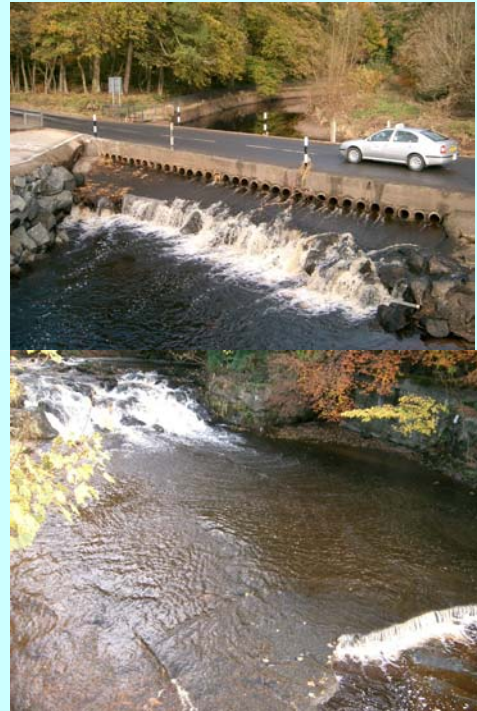
Obstructions range from complete barriers to fish such as in the Kilmarnock Water or the Gogo Water to lesser obstructions which may delay migratory fish or leave them subject to predation, poaching or exhaustion. Removal of man-made obstructions or the provision of effective fish passage is considered one of the most essential and cost-effective measures to improve migratory fish populations.

There are a full range of weirs and other obstructions in Ayrshire, some with effective fish passes, others with ineffective fish passes and some that are totally impassable. There is considerable scope for projects to remove or to provide effective fish passage at obstructions. In most cases removal of weirs would be ART's favoured option although this is rarely likely to be possible. Strong leadership will be required by ART, DSFB's and other organisations if significant progress is to be made to improve fish passage over many of the problematic obstructions. Vested interests may be resistant and tracing ownership of structures is a well known problem, particularly when owners have had the foresight to anticipate the cost implications associated with ownership an aging structure.

Case Study: Impact of obstructions: Fish access

Kilmarnock Water, River Irvine

Two man-made obstructions are currently limiting migratory fish access into the Kilmarnock Water and tributaries upstream of Kilmarnock. The obstructions consist of a pipe bridge and a natural waterfall where the plunge pool has been filled and capped with concrete.



ART has been working with the River Irvine Angling Improvement Association, East Ayrshire Council, SEPA and others to improve fish passage over these obstructions. A technical report has been prepared by consultants for both obstructions and funding to deal with issues at the waterfall has been applied for. There is 27km of good quality habitat which is currently inaccessible. With an average width of 4m there is potential for the production of up to 10,000 salmon and sea trout smolts per annum. This is the single most important

ART are particularly interested in the concept of “rock ramps” or “close to nature” fish passes¹⁰ as these structures can mimic flow conditions found naturally in fast flowing sections of rivers and can provide passage for a full range of fish species and sizes as well as invertebrates. The photo opposite shows Laigh Milton Weir, River Irvine, where a breach in the weir, understood to have been created by angling interests, has resulted inadvertently in an excellent rock ramp style fish pass.



Another major impact of weir building is the impoundment of water upstream. This results in major changes in river ecology with deep pool habitat replacing what would be naturally shallow water with a range of habitats. The lower River Irvine is badly affected particularly in the Drybridge to Gatehead stretch.

Case Study: Impact of weirs: Impoundment

River Irvine, Drybridge to Gatehead

The gradient of the lower River Irvine is relatively low averaging 1.4m fall per km of length between the tidal limit and Kilmarnock. Yet between Drybridge and Laigh Milton Weir, a length of 2.2km, there are three weirs with a total height differential of 4.1m+. The habitat between those three weirs is almost exclusively deep pool with very little habitat suitable for juvenile salmonid production. All the natural fall in the river is taken by the weirs and as a consequence there is a lack of flow diversity and habitat. Two of the weirs are shown below, the third weir is the Laigh Milton Weir pictured above.



Achieving consensus that removal of redundant weirs such as these would be great benefit in the restoration of the lower River Irvine will be difficult and is therefore considered to be a longer term ART aspiration and will not feature as a management action within this plan. Research into the full implications of removal of the weirs will be required, not to mention permission from landowners.

5.4. Upland land use

Upland areas of catchments are of vital importance. The underlying geology in many parts of Ayrshire mean that upland watercourses can be very productive with high pH and conductivity and abundant invertebrates production. Upland areas have traditionally been used for relatively benign forms of landuse such as game sporting estates although few remain. Some of ART's best electrofishing survey results are from moorland upland areas with good rough grasses/heather vegetation where there are often excellent fish populations.

During the 20th century landuse on much of upland Ayrshire has changed with commercial conifer plantations and intensive sheep grazing becoming more prevalent. Large scale opencast coal mines are a distinctive feature of upland Ayrshire and more recently there has been considerable, and expanding interest in windfarms.

5.4.1 Commercial forestry

Commercial forestry plantations have spread rapidly over upland Ayrshire, particularly in the second half of the 20th century. There was a lack of awareness of the potential problems associated with commercial forest plantations when they were first planted. The acidification issue has been mentioned above and ART has found that there is a very close association between the presence of conifer plantations in upland areas and low pH in watercourses. Other problems associated with the early forest plantations are overshadowing caused by planting too close to watercourses, silt laden run-off during initial ploughing and at the felling stage and changes in water chemistry and run-off characteristics. The introduction of the Forest and Water Guidelines (now in its fourth edition) ¹⁰ has resulted in considerable improvements in forest management and forest replanting is now much more environmentally sensitive. There has been little new large scale commercial upland planting in Ayrshire in recent years. If any new plantations are proposed then they should be subject to thorough assessment of their full potential environmental impact.



Stinchar plantation: felling, ground preparation and new planting

5.4.2. Upland sheep grazing

The intensification of sheep grazing in upland areas in recent decades has had detrimental impacts in terms of reduced levels of vegetation cover resulting in more rapid rainfall drainage and extreme spate conditions downstream. This is a particular problem in the Stinchar valley where the steep hills surrounding the river are either subject to commercial forest cover or intensive sheep grazing. The trend of sheep numbers in Scotland appears to be downward declining from a peak of almost 10million in 1992 to less than 7.4million in 2007 ¹¹.



Upper Balloch Burn catchment, River Stinchar, with Glengap Hill and Haggis Hill.

5.4.3. Opencast coal mining

Ayrshire is steeped in mining history and culture. Many of its villages were established to house the large mining workforce. There are currently no active deep mines in Ayrshire but there are many active opencast mines, almost exclusively in upland areas. Opencast mining can affect watercourses severely with impacts ranging from disruption of hydrology, watercourse diversion, creation of obstructions and pollution of watercourses and groundwater. Whilst some current mines are very well operated and managed local experience of opencast site restoration has often been that this phase can result in more problems than the active mining phase with delays in reinstatement, abuse of sewage sludge soil “remediation” and secondary uses such as landfill sites resulting in further problems. ART works closely with the mining companies, planning authorities and regulators to ensure that the interests of freshwater are protected as much as possible.



5.4.4. Wind energy

A more recent form of upland landuse, and one that will undoubtedly see further expansion in Ayrshire is the construction and operation of large scale commercial windfarms. Several windfarms have been constructed, or are in the construction phase, with many more in the planning and application phase. Many of the windfarms have been located within commercial forests and ART has considered that in these cases they can be beneficial in terms of accelerating forest restructuring and the opening up of forest canopies. The risk of ecological damage from windfarms proposed on more pristine moorland sites is considered by ART to be significantly greater. As well as local damage to burns in the immediate vicinity there have been several examples of massive peat slides which have destroyed rivers and their fish populations¹². Industrial scale operations in upland moorland sites carry considerable risk and it is essential that a rigorous environmental assessment, with robust monitoring of key habitats and species is completed.



Hadyard Hill windfarm at Penwhapple Reservoir

5.5. Water management

The water resource in many sub-catchments of upland Ayrshire is managed, mainly for public water supply or for hydro power generation. This normally consists of abstraction resulting in a net loss of water from catchments but other potentially important issues are water transfer between catchments and regulation of flow regimes.

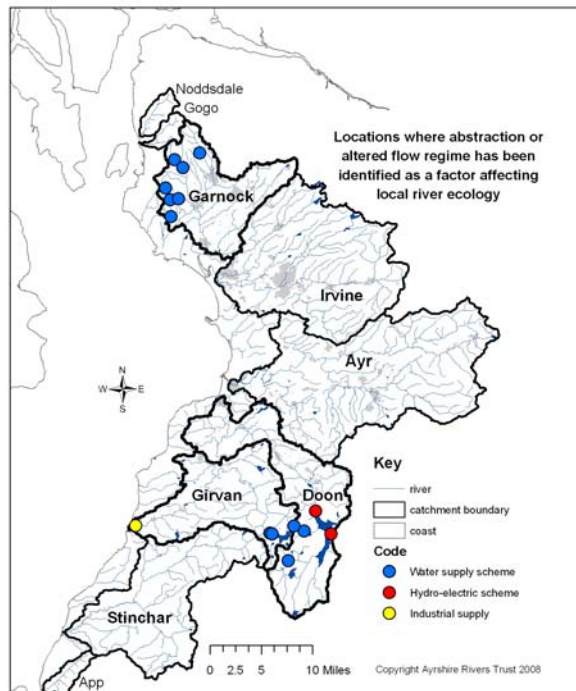
5.5.1. Abstraction

Abstraction in Ayrshire is largely for drinking water supplies, with several water-bodies modified by dams and linked to water supply schemes. Hydro power is responsible for the abstraction of a significant proportion of the upper River Doon water to an adjacent catchment, as part of the Galloway hydro-electric scheme. There are a few abstractions for industrial manufacturing (none are thought to have a serious impact on river flow, except in drought conditions). There is some abstraction for irrigation by farmers but this is thought to have a low impact on river flow and fish production. ART have concerns regarding abstraction levels from a number of watercourses. When the Controlled Activities Regulations came into force many existing abstraction were transferred directly into the new licensing regime. SEPA are currently undertaking a review of CAR licences to assess compliance with the WFD and shortcomings may be addressed through that process.



Abstraction weir in upper River Garnock

The map below shows the locations of water abstractions in Ayrshire where river ecology has been affected.



Location of known abstractions thought to be impacting fish production

5.5.2. Flow regulation

The lower River Doon is classified as a regulated river as a high proportion of the flow in low to medium flow conditions consists of compensation flow from Loch Doon Dam. Here the net loss of water from the loch is offset by a compensation flow agreement which has been in operation since 1936. The compensation flow would appear to be beneficial in terms of the salmon fishery as the Doon is consistently the most productive river in Ayrshire. However there are legitimate concerns regarding the absence of key ecological features such as high flows to maintain channel dimensions and substrate conditions as well as low flows to keep gravels weed free.

5.5.3. Small scale hydro schemes

Hydro power is considered to be a potential limiting factor due to the increased interest in the development of small scale or community scale hydro schemes. This is considered to be an emerging risk as ART are aware of a number of proposals currently at the investigative or planning stage. ART consider that there is potential for a number of small scale hydro works in Ayrshire as there are several steep burns which are naturally inaccessible to migratory fish. The impacts of any proposal would need to be assessed carefully as there are other impacts of hydro scheme in addition to potential impacts on migratory fish.

5.6. Stock exploitation

Stock exploitation refers to adult fish mortality caused by anglers or poachers. In the freshwater environment there is no doubt that this is the most significant form of mortality amongst adult fish. Collection of broodstock for hatcheries may also have a local impact on fish production. Exploitation of spring-running salmon is known from studies elsewhere to be particularly high, as these fish have a much higher probability of being captured in the river than late-running salmon and are exposed to capture or predation risk for a longer period. There is no information available on exploitation rates by anglers in Ayrshire rivers. As with the rest of Scotland catch and release rates have increased although the published catch-and-release rates for the Ayr and Irvine Districts are amongst the lowest in Scotland. The low release rates published for these rivers may be partly the result of under-reporting of released fish. However it is generally acknowledged that there is still considerable work required locally in highlighting the importance of catch and release as a conservation measure. The DSFB's have all produced Angling Guidelines which include recommendations on bag limits and catch and release. These guidelines rely on voluntary participation within the angling community but they have been very helpful in changing attitudes.

Catch and release (C&R) has been widely adopted and respected for sea trout in all the rivers with DSFB's although published exploitation rates are still high in the Irvine district. C&R can also help to protect stocks of indigenous wild fish such as native brown trout or grayling.



Small Ayr springer about to go back

Poaching is a localised problem everywhere, although its impact is much reduced compared to previous years. Poaching of adult fish is thought to be a significant issue still in the Irvine Estuary. Bailiffing within Ayrshire relies on voluntary effort and it currently managed effectively by the DSFB's. There is a particular problem in the Irvine District as the Scottish Government is now unable to issue bailiff warrant cards unless the person has passed the Institute of Fishery bailiffs examination. This issue is an action point that needs to be addressed.

On the River Doon at Dalmellington there is a local tradition of making ‘putty’ from salmon eggs, an illegal form of bait, although again this appears to be in decline. Removal of spawning fish from the redds on the point of reproducing is a particularly invidious form of poaching and one which should be eradicated.

5.7. Predators

Fish are subject to a range of predation pressures, primarily from native species such as predatory fish, otters, goosanders, herons, cormorants etc in the freshwater with anadromous species such as salmon and sea trout preyed upon by even greater range of predators in the marine environment. Non-native predators such as mink can also be significant predators in the freshwater environment. All of these predators are protected by law with the exception of mink. The impact of any of these predators on overall fish production is not known, however, significant numbers of piscivorous bird, such as goosanders and cormorants have been observed during bird counts on the Doon and Stinchar. Significant numbers of piscivorous birds such as goosanders and cormorants were recorded during these counts. Predation on the younger juvenile salmonid stages may not impact fish production as there is normally a surplus at this point. However, predation on larger parr or smolts or grayling will not be compensated and there will be a net overall loss to the fishery.

Seals are present along the Ayrshire coast but research in the Moray Firth Seal management plan ¹³ concluded that only seals regularly present in or close to river mouths are likely to be significant predators of salmon.

5.8. Introduced species

Introduced fish species can predate upon and compete with native fish species for food, territory and introduce diseases. The number of introduced fish species varies between Ayrshire’s river catchments, with the River Stinchar having the least number of introduced fish species.

Other introduced plants and animals can have an effect on fish production and other aspects of river ecology. The North American mink is a generalist predator which feeds on a variety of animals including fish, birds, amphibians and small mammals such as water voles. Introduced plants such as giant hogweed and Japanese knotweed are also problematic but their direct effect on fish production is relatively low.

One of the greatest threats to salmon is the potential for the introduction of *Gyrodactylus salaris*, a parasitic flatworm, naturally present on salmonids in the Baltic, where the fish have developed effective immunity. When *G. salaris* was introduced into Norway via infected farm fish the parasite rapidly spread through the native juvenile fish population eventually affecting many rivers resulting in the collapse of juvenile salmon populations. The authorities have often been left with no option but to use fish poison across entire catchments to eradicate hosts and therefore the parasite.

If *G. salaris* arrived in UK salmon rivers the impact would be devastating with the potential loss of salmon populations and the fisheries they support for many years.

There are a number of potential routes for transfer of the parasite into the UK. The highest risk routes are via direct transfer of fish, e.g. aquaculture or ornamental fish industries but anglers and canoeists also have a responsibility as the parasite could be transported on wet equipment and clothing by anglers returning from fishing trips in infected waters, or via canoes used on trips. The authorities in Scotland have led a high profile campaign to alert anglers and canoeists to the risk of infection transfer. In Ayrshire ART and the local District Salmon Fishery Boards are active in local awareness campaigns directed at angling and canoeing groups. Details of disinfection and prevention measures can be found on the Governments website <http://www.infoscotland.com/gsbug>.

5.9. Marine issues

Sea trout catches collapsed in Ayrshire in the 1980/90's. The relative roles of freshwater issues and marine survival in the sea trout collapse are not known but it is likely that marine survival is a significant factor. Sea lice emanating from marine salmon farms is recognised as being a major contributory factor in the decline of sea trout populations in the north west highlands of Scotland. Ayrshire is on the periphery of the salmon aquaculture area although there is one farm in Ayrshire, off the Arran coast, and many in the inner Firth of Clyde. It is likely that Ayrshire sea trout feed in the inner Firth of Clyde where they could be exposed to unnaturally high sea lice levels from aquaculture. ART have no information on this issue and past attempts to net sea trout in local river mouths were unsuccessful except on the west coast of Arran where the levels of lice were sufficient to cause concern. This is an area where further collaborative research with neighbouring Fishery Trusts may be beneficial.

Limiting factors summary

The relative importance of each of these issues varies considerably in each management unit. The table below shows the significance of each limiting factor in each of the management areas.

Management Unit	Water quality	Water management	Habitat degradation	Obstructions	Upland landuse	Stock exploitation	Introduced species	Predators
Largs Burns	Low	High	Medium	High	Low	Medium	Low	Medium
Garnock	Medium	High	Medium	High	Low	Medium	Medium	Medium
Ayr	High	Low	High	Medium	Medium	Medium	Medium	Medium
Doon	Medium	Medium	Medium	Low	Medium	Medium	Medium	Medium
Upper Doon	High	Medium	Low	High	High	Low	Medium	Medium
Girvan	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Stinchar	Low	Low	Medium	Low	High	Medium	Medium	Medium

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<http://www.swap.org.uk/index.asp?pageid=86474>
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