# The River Fergus, Co Clare; An investigation of the distribution, abundance and ecology of species designated under the EU Habitats Directive

## INTRODUCTION

The current study was initiated by Ennis and District Trout Anglers Association (EDTAA) and funded by the Heritage council. The purpose of the current survey was to investigate the distribution, abundance and ecology of fish, mammal and invertebrate species, designated under the EU Habitats Directive, in the Fergus catchment. Through this survey and public dissemination of the results, it is hoped to promote the Fergus as a significant wildlife heritage resource that deserves further protection and enhancement.

*Ennis and District Trout Anglers Association (EDTAA)*

The EDTAA are a voluntary body committed to the conservation and development of the River Fergus. Although originally confined to being an angling club, the EDTAA has grown in its membership and interests in recent years to become an important lobby group on behalf of conservation of the broader ecological heritage resource of the River Fergus System. A primary aim of the group is education, focusing on introducing children to the wonders of aquatic and riparian ecological heritage on the River Fergus through the ancient activity of fly fishing.

*The Heritage Council*

The current project was funded by the Heritage Council. Heritage Council is an independent statutory body, which was established under the Heritage act 1995. Its role is to propose policies and priorities for the identification, protection, preservation and enhancement of the national heritage. National Heritage is defined as including monuments, archaeological objects, heritage objects such as art and industrial works, documents and genealogical records, architectural heritage, flora, fauna, wildlife habitats, landscapes, seascapes, wrecks, geology, heritage gardens, parks and inland waterways. The Council has a particular responsibility to promote interest, education, knowledge and pride in the national heritage.

*The River Fergus*

The River Fergus (EPA hydrometric area 27FO1) rises north-west of Corofin and enters the tide at Ennis, Co Clare (see figure 1). It is one of the principal tributaries of the Shannon estuary. It rises northwest of the village of Corofin, at an altitude of approximately 122 m. It flows initially in an easterly direction, connecting the many springs and streams. At Ballyteighe Lough, the river changes course to flow in a southerly direction through Ennis and Clarecastle, where it enters the Shannon Estuary.

The river has a total length of 59.5 km and a catchment area of 1041km$^2$. This area includes many interconnected lakes and streams, which drain part of the Burren region. The main channel is a designated salmonid water under the European Communities (Quality of Salmonid Waters) Regulations of 1988 (S.I. No. 293, 1988), implementing the Freshwater Fish Directive (78/659/EEC). The lower reaches of the river are also protected as a component of the Lower Shannon candidate Special Area of Conservation (SAC) under the Habitats

Directive (92/43/EEC). Despite its designations, no comprehensive survey of the River Catchment in relation to its conservation value has been undertaken to date.

The Fergus is thought to contain four fish species designated under Appendix II of the EU Habitats Directive. These are river lamprey *Lampetra fluviatilis*, brook lamprey *Lampetra planeri*, sea lamprey *Petromyzon marinus*, and Atlantic salmon *Salmo salar*. The river is also contains the Appendix III listed common goby *Pomatoschistus microps*. The Fergus is noted for its runs of MSW salmon, which are under threat internationally. One of the qualifying interests of the Lower Shannon SAC is its Eurasian otter *Lutra lutra* population. The Otter has been protected since the implementation of the Wildlife Act 1976, and is listed as requiring strict protection in Appendix II of the Berne Convention and in Annexes II and IV of the habitats Directive as a species of European interest.

*Otters*

Otters are members of the Mustelid family. This family includes badgers, polecats, martens, weasels, stoats and mink. Otters are the only truly semi aquatic member of the Mustelid family. No otter surveys have taken place on the Fergus system in over 20 years.

Legal protection is given to most Irish mammal species under national (Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000) and European (Habitats Directive via S.I. 94 of 1997) legislation. The population of otters in Ireland is of International Importance. Of Ireland's mammals, greatest protection is afforded species included in Annex II of the Habitat's Directive. This includes the otter. The otter has been protected since the implementation of the Wildlife Act in 1976. It is listed as requiring strict protection in Appendix II of the Berne Convention and in Annexes II and IV of the Habitats Directive as a species of European Interest and which requires strict protection and the designation of Special Areas of Conservation.

Both on and proximal to the Fergus River system, Special Areas of Conservation have been designated for otter, among other qualifying species, at three locations:

- Dromore Woods and Loughs (Site Code 000032)
- East Burren Complex (Site Code 001926)
- Moyree River (Site Code 000057)

*Fish planting in the River Fergus*

Enhancement type restocking of salmonids has been undertaken in the Fergus in recent years. Salmon are planted as unfed fry and parr and trout are stocked as fry, parr and adult takeable fish. However, no planting was undertaken during 2003 and all fish less than one year old captured during the current survey were considered to be naturally spawned wild salmonids.

## MATERIALS AND METHODS

### Timing of the survey

The current survey was undertaken during August 2003. This was an ideal time to undertake an electrical fishing survey for salmonids (salmon and trout) due to the fact that progeny from the last spawning season (in this case winter 2002/2003) are detectable at this time of year. Moreover, in general the progeny of the previous spawning season (in this case winter 2001/2002) have not yet left the river. However, although water levels were considered normal during the time of survey and rainfall levels were very low, the rivers were running higher than in previous years due to the particularly wet summer which preceded the study period (see table 1). This may have resulted in an overestimation of the habitats available for fish (best estimated at Dry Weather Flow, DWF). It may also have reduced the efficiency of electrical fishing at certain sites (i.e. main Fergus channel). This must be taken into account when comparing the results of the current survey with future investigations.

**Table 1** Rainfall (mm) at Shannon Airport meteorological station during the period January-September 2003 compared with 30-year mean rainfall (mm) (1961-1990) recorded from that station. (Source: Met Eireann). The current survey was undertaken during August. Shannon Airport is the nearest station to the Fergus catchment.

| *Year* | *Jan* | *Feb* | *Mar* | *Apr* | *May* | *Jun* | *Jul* | **Aug** | *Sep* |
|---|---|---|---|---|---|---|---|---|---|
| *2003* | 44.7 | 50.6 | 50.9 | 50.0 | 91.8 | 105.0 | 77.0 | **11.3** | 37.3 |
| *30-year mean* | 97.8 | 71.5 | 71.4 | 55.7 | 59.5 | 62.8 | 56.8 | **82.4** | 81.6 |

### Location of the aquatic survey sites

Following an initial walkover study, representative sites throughout the Fergus catchment were selected as study sites. The locations of these sites are shown in figure 1 and photographs of the survey sites are presented in plates 1-30. The aquatic ecology survey had a site density of 0.02 sites/km$^2$catchment area.

### Fisheries Habitat Assessment

*Water quality*

The Environmental Protection Agency (EPA), and its predecessors (An Foras Forbartha, Environmental Research Unit), have assessed water quality (Chemical and Biological) in the Fergus catchment since 1971 as part of the National Water Quality Monitoring Programme (McGarrigle 2002). This information was reviewed as part of the fisheries habitat assessment.

*River Flows*

The OPW operate three hydrometric gauges in the Fergus catchment (McCarthaigh 1997). These are located on the Claureen River at Inch Bridge and on the main Fergus channel at Ballycorey and Corofin. Because of the importance of flow to salmonid habitats, this information was also reviewed as part of the fisheries habitat assessment.

*Physical habitat assessments*

This assessment was undertaken at the 30 aquatic survey sites. The diversity (species richness) of aquatic/riparian fauna is primarily a function of the integrity and physical diversity of the aquatic habitats. The more diverse the aquatic habitat is in terms of substrate, depth, riparian vegetation, etc. the richer the biological community is likely to be. Salmonid fish (trout and salmon) in particular have specific habitat requirements and the presence and abundance of these fish has been shown to be strongly correlated with key physical habitat variables (Haury 1999). Habitat considerations for juvenile salmonids in streams and rivers include stream size and flow (Hatfield & Bruce 2000), depth and gradient (Kennedy & Strange 1986), substrate (Greenberg & Dahl 1998), canopy (O'Grady 1993) and engineering history of the river (O'Grady and Curtin 1993). In the current survey, salmonid habitat suitability at each site was assessed with reference to information provided from the above scientific sources and Kennedy (1984), Fluskey (1989), and Heggenes & Saltveit (1996). The rating of the site as habitat for salmonid spawning, nursery and adult holding was on a scale of 1-5 where 1=Unsuitable, 2=Poor, 3=Satisfactory, 4=Good and 5=Excellent. A rating of "1" indicates that the ecologist carrying out the assessment regarded it as impossible that the stream could support salmonid fish in the relevant life stage. A rating of "1- 2" indicates that it was regarded as possible but unlikely that the stream could support salmonid fish in the relevant life stage.

Quantitative physical habitat assessments were undertaken at the 30 biological sampling sites. These sites were assessed in terms of:

| | | |
|---|---|---|
| Wetted width (m) | Left Bank height (m) | Rock substrate (%) |
| Right Bank height (m) | Riffle (%) | Cobble substrate (%) |
| Mean depth (cm) | Glide (%) | Gravel substrate (%) |
| Maximum depth (cm) | Pool (%) | Clay/silt substrate (%) |
| Thalweg width (m) | Vegetation cover (%) | Bank cover (%) |
| Canopy cover (%) | Shade (%) | Bank slope (degrees) |

These predictors were used to assess the physical suitability of each channel for supporting populations of salmonids and other fish.

**Fish Stock Assessment**

*Electrical fishing survey*

An electrical fishing survey (Bohlin *et al*, 1982) was also undertaken at the 30 survey sites. Permission for this survey was provided by the Shannon Regional Fisheries Board under Section 18 of the Fisheries Act 1980.The work was carried out using a GFT Safari Researcher 660D portable electrical fishing unit and micromesh stop nets. The stop nets were placed at the upstream and downstream ends of each site to prevent fish escaping from the survey area. The set delivered a 100Hz pulsed DC current at 200V with a condensator discharge waveform. The cathode, three wires, was trailed and the operator held the anode, a metal net with an insulated handle. An assistant using a dip net collected fish that failed to be captured by the operator. Fishing was carried out in the upstream direction against the flow of water and all species of fish captured were retained in a holding bin. The operation was carried out continuously at each site. At three sites (Q1-Q3), quantitative estimates were made using a three-catch method using constant effort with a 15 minute interval between fishing. At all sites captured fish were

anaesthetised using a solution of 2-phenoxyethanol and measured to the nearest millimetre. Following recovery from anesthesia, all fish were released unharmed into the water. Fish densities for three sites were calculated using the Leslie-Davies Method (Leslie & Davies, 1939). Results of the electrical fishing investigations from all other sites are presented using catch per unit effort (CPUE) indices. CPUE is a term used in fisheries science to standardize catch information. In the current survey the CPUE for fish captured by electrical fishing is described as the number of fish caught per minute electrical fishing (i.e. fish/min) and the number of fish caught per area (in $m^2$) fished by electrical fishing (i.e. fish/$m^2$).

*Lamprey survey*

Investigations of juvenile lamprey (ammocoete) habitats were also undertaken using electrical fishing. Juvenile lampreys burrow into silt and the most physically suitable areas in the immediate vicinity of the 30 aquatic survey sites were investigated in detail. To encourage lamprey ammocoetes to emerge from their burrows, a slow pulse frequency was used (2-3pps). This was achieved by using a Samus Electronics 725G microprocessor controlled electrical fishing unit. This slow pulse frequency method has been used effectively to sample juvenile lampreys in North America (Weisser & Klar, 1990).

**Otter Survey**

The otter survey involved a five day walkover study of the main sub catchments. Seven distinct areas were looked at including six sub catchments and the River Fergus main channel. These areas (see figure 2) were as follows:

1 Claureen/Inch/Kilmaley catchment
2 Shallee/Ballygriffey/Poulacorry catchment
3 Inchicronan catchment
4 Castle/Moyree catchment
5 Cullaun/Muckanagh catchment
6 Elmvale/Lough Inchiquin catchment
7 River Fergus main channel

Cursory examinations of the shoreline of the following Loughs were also undertaken:

1 Inchicronan Lough
2 Ballyteige Lough
3 Muckanagh Lough
4 Ballyeighter Lough

Full surveys of the entire length of each of these sub catchments, the River Fergus main channel, and lakeshores were impossible due to time constraints on the survey. Otters are secretive animals. Because of this, it is difficult to estimate numbers of individual otters in an area (Chapman 1982). Riverine habitats may support up to one otter per four kilometres of river. The density of otters along a river channel will be influenced by food availability and productivity of the channel. Owing to the difficulty in observing or counting otters the only reliable way of ascertaining their presence on a stretch of water is to study the signs that they leave behind them. The most important signal that an otter leaves behind is the spraint. The occurrence of spraints confirms the presence of otters and in many cases allows an ecologist to

assess diet and sex. The most reliable method of surveying for otter presence is to survey 600m longitudinal transects (in suitable habitat) for the presence spraints (Chapman 1982). Counting spraints per unit length of riverbank will give the observer an index of the actual number of otters present.

The key objective of the current survey was to provide an index of otter site usage (presence/relative abundance). During the current study physical signs of otters i.e. spraints (droppings), slides and holts (breeding dens), were recorded. Although, the exact locations of active holts will not be given in this report (information sensitivity), details have been forwarded to the local National Parks and Wildlife Service (NPWS) Conservation Rangers.

# RESULTS

## Fisheries Habitat Assessment

*Water quality*

The summary of the results of the EPA water quality assessments in the Fergus catchment are provided in table 2. Details of the EPA River Quality Classification Scheme are provided in appendix one along with detailed results for each river catchment. Overall, over 90% of all river channel surveyed during the 1998-2002 survey was classified as Class A or unpolluted. The other 10% of river channel was considered to have unsatisfactory water quality. Overall, a total of 7.5km (7.2%) of river channel in the Fergus catchment was classified as slightly polluted (class B). A total of 4.5km of the main River Fergus channel was classified as Class B, and a total of 3km of the Shallee channel was also assigned to this class. A total of 2km of the main channel of the River Fergus was classified as moderately polluted (class C).

The areas where water quality was recorded as unsatisfactory are on the Fergus channel are located within the urban area of Ennis. Water quality on the Fergus near Corofin improved significantly since the previous EPA survey (1996).

**Table 2** Summary of the EPA water quality investigations in the Fergus Catchment 1998-2000 (adapted from McGarrigle *et al*, 2002).

| | | | Channel length (km) in Class | | | | |
|---|---|---|---|---|---|---|---|
| **River** | **Code** | **Grid Reference** | **A** | **B** | **C** | **D** | **Total (km)** |
| *Craggaunboy* | *27/C/04* | *R265883* | 6.5 | | | | 6.5 |
| *Fergus* | *27/F/01* | *R363700* | 28.5 | 4.5 | 2 | | 35 |
| *Inch* | *27/I/01* | *R333782* | 20 | | | | 20 |
| *Millbrook* | *27/M/03* | *R364859* | 9.5 | | | | 9.5 |
| *Moyree* | *27/M/02* | *R358878* | 16 | | | | 16 |
| *Shallee* | *27/S/01* | *R338815* | 8 | 3 | | | 11 |
| *Spancelhill* | *27/S/03* | *R350771* | 6.5 | | | | 6.5 |
| **Total** | | | 95 | 7.5 | 2 | 0 | 104.5 |
| **Percentage** | | | 90.9 | 7.2 | 1.9 | 0.0 | |

*River Flows*

In table 3, hydrometric statistics for the River Fergus at Ballycorey (station 27002, grid reference R344803) and at Corofin (station 27003, grid reference R286885) are provided in McCarthaigh (1997). The long average runoff at Ballycorey is estimated at 13.74 $m^3$ $sec^{-1}$. The Fergus has a total catchment area of 1041$km^2$ so the flow at Ballycorey represents the runoff from 53% of the total catchment area. Hydrometric statistics for the River Claureen at Inch Bridge (station 27001, grid reference R301753) are also provided in table 3. The long average runoff at this station is estimated at 1.39 $m^3$ $sec^{-1}$. Runnoff and river flows from the Fergus catchment are affected by the karst features and underground drainage in the area.

**Table 3** Hydrometric statistics from the Fergus catchment (adapted from McCarthaigh (1997).

| **River Fergus, Ballycorey (27002)** | |
|---|---|
| Catchment area (upstream of gauge) | 562.0 |
| Long Average (50 years) Rainfall (mm/year) | 1252 |
| Estimated Losses (mm/year) | 481 |
| Long Average (50 years) Runoff (mm/annum) | 771 |
| Long Average (50 years) Runoff ($m^3$ $sec^{-1}$) | 13.74 |
| **River Fergus, Corrofin (27003)** | |
| Catchment area (upstream of gauge) | 168.0 |
| Long Average (50 years) Rainfall (mm/year) | 1398 |
| Estimated Losses (mm/year) | 481 |
| Long Average (50 years) Runoff (mm/annum) | 917 |
| Long Average (50 years) Runoff ($m^3$ $sec^{-1}$) | 4.89 |
| **River Claureen, Inch Bridge (27001)** | |
| Catchment area (upstream of gauge) | 48.0 |
| Long Average (50 years) Rainfall (mm/year) | 1395 |
| Estimated Losses (mm/year) | 481 |
| Long Average (50 years) Runoff (mm/annum) | 914 |
| Long Average (50 years) Runoff ($m^3$ $sec^{-1}$) | 1.39 |

*Physical Habitat Assessment*

The results of the physical aquatic habitat assessment are presented in table 4. The variation of substrate composition at each site investigated is shown in figure 3. The stream structure (i.e. % riffle/glide/pool) at each of the 30 aquatic survey sites is presented in figure 4. The rating of the aquatic survey sites as habitat for salmonid spawning, nursery and adult holding is presented in table 5.

A total of five sites were investigated on the main channel of the River Fergus main channel between Lough Inchiquin and Ennis town. These sites were located at Ennis (site 1), Nutfield (sites 13, 14), Dromore (site 20), and near the outflow from Inchiquin Lake (site 24). The results of the aquatic habitat assessment clearly show that the main channel of the River Fergus has significant potential for producing juvenile salmonids. Site one was located at Ennis town. This stretch of the Fergus was considered to be ideal habitat for the production for juvenile salmonids. The area is also ideal for holding adult salmon and trout, and is of course an important angling area. The area surveyed had artificially modified banks and was 25m wide. It had a mean depth of 50cm, and a maximum depth of over 1m. The thalweg width was estimated at 5m. The stretch surveyed consisted of glide (70%), riffle (20%), and pool (10%) habitats. The substrate was dominated by cobbles (60%) and gravels (30%). Instream vegetation cover was estimated to be 70% at the time of survey. Site numbers 13 and 14 were located on the main Fergus channel upstream and downstream of Nutfield Bridge respectively. This stretch of river was considered to be highly modified and exhibited an artificially lowered

and straightened channel. Despite this, it was considered to be ideal salmonid habitat providing areas for salmonid holding and spawning. Indeed, a potentially important angling pool was present at the lower end of site 13. It was concluded that the aquatic habitat of the River Fergus at Nutfield is more suited to the production of juvenile salmon than trout due to the strong flow and dominance of cobble (rather than gravel) in the substrate. Canopy cover was 10% at site 14 and shading was 20%. The landowner recently removed the trees on the right bank of this stretch. Canopy cover and resultant shade were significantly higher at site 13. Instream vegetation cover ranged from 5-10% between the two sites.

Site number 20 was located on the main River Fergus at Dromore Park. This site was located approximately 750m downstream of the Castle River confluence. This stretch of river was also considered to be a modified channel. This work was likely to have been carried out during the 19$^{th}$ century for drainage/flood conveyance. Mean wetted width along the section investigated was 9m. A mean depth of 40cm and a maximum depth of 70 cm were recorded. This section was composed of 20% riffle and 80% glide with a gravel dominated substrate. Instream vegetation cover was estimated at 40%. This section was considered to ideally suited to salmonid spawning and nursery. It also had areas suitable for trout and salmon angling. Site 24 was located approximately 0.5km downstream of the outflow from Lough Inchiquin. This was recorded as being a highly modified drainage cut and had a substrate dominated by bedrock. The section surveyed was dominated by glide habitat and had a mean depth of 30cm. It was considered to be suitable for use as a salmonid nursery, but not as an area for spawning. Holding pools were present upstream and downstream of the section investigated. Canopy cover was estimated at 30%, shade was moderate at 10% and instream vegetation cover was considered low at 10%.

A total of five sites were investigated in the Claureen/Inch/Kilmaley sub-catchment (sites 2-5, Q1). This is the lowermost of the major tributaries of the Fergus, and joins the Fergus from the west. Site 2 was located approximately 100m downstream of Inch Bridge. This site had a wetted width of 4.5m. The right bank of the stream was contained by a retaining wall. Mean depth was estimated at 20cm and the maximum depth recorded was 30 cm. The area surveyed comprised exclusively of riffle and the substrate composition was rock 10%, cobble 70%, gravel 15% and silt 5%. Bank cover along this stretch was 50%. Canopy cover was estimated at 5% and shading was low at 10%. Instream vegetation cover was estimated to be 60%. Approximately 5% of the area investigated was considered to be suitable for spawning, however extensive areas suitable for spawning were present upstream of the survey site. The entire stretch was considered to be suitable for use as a nursery habitat for juvenile salmonids. Site 3, 4, Q1 and 5 were also located on this river. Wetted width ranged from 10m at site 2 to 4m at site 5. Mean depth ranged from 20cm to 30cm at these four sites. Maximum depth of the three sites ranged from 25cm to 50cm. Site 3 was composed primarily of glide habitat, while riffles and glides dominated site 4. The stretch of river assessed at site 5 was structurally composed of 10% riffle, 50% glide, and 40% pool. Site 3, 4 and Q1 had adequate quantities of cobbles and gravels for salmonid reproduction, however conditions for salmonid spawning at site 5 were considered poor. Canopy cover and resultant shading was high at site 5 and Q1, and this is typical of the upper reaches of this river. All sites surveyed were suitable for use a salmonid nursery.

One site (site 12) was investigated on the Gaurus sub-catchment. This small river joins the left bank of the Fergus downstream of the Claureen confluence. The site surveyed was near Spancil Hill/Tullyuoghan. The site investigated had a wetted width of 2m, a mean depth of

10cm, and a maximum depth 30cm. Stream structure comprised of 90% riffle % and 10% pool. The substrate consisted of 30% cobble %, 40% gravel, and 30% silt. Bank cover was 95% and the stream had an estimated canopy cover of 10%. Moderate shading of the channel was recorded. Instream vegetation cover (%) on the stretch investigated was 10%. Almost 80% of the area surveyed was considered to be suitable for use by young salmonids. Suitable spawning habitat was also present.

A total of 6 sites were investigated within the Shallee/Ballygriffey sub-catchment. The Shallee/Ballygriffy is a major tributary, which joins the Fergus from the west, upstream of Ballyallia Lough. Site 6 was located in the lower reaches of the river. This site had a wetted width of 4 m. Mean depth was estimated at 30cm and the maximum depth recorded was 50 cm. The area surveyed comprised exclusively of riffle and glide habitats and the substrate composition was primarily comprised of rock and cobbles. Bank cover along this stretch was 80%. Canopy cover was estimated at 5% and shading was low at 5%. Instream vegetation cover was estimated to be 10%. None of the area investigated was considered to be suitable for salmonid spawning, however 95% of the stretch was considered to be a suitable salmonid nursery. Site 7, 8, 9, 10 and 11 were also located on this river. Wetted width ranged from 5m at site 8 to 2m at site 11. Mean depth was 20cm at site 11 and 4, and 50cm at site 7. Maximum depth of the five sites ranged from 30cm to 70cm. Site 7 and 10 were dominated by glide habitat, and pools were predominant at sites 8 and 9. The substrate at site 7 was dominated by rock, while 50% of the substrate at site 8 was also comprised of rock. Sites 8, 9 and 10 had good quantities of cobble and gravel. Canopy cover and resultant shading was high at sites 8 and 9. Sites 8 and 10 were considered to be physically suitable for use as a salmonid nursery, while site 7 was considered to be unsuitable.

Sites 15, 16, 17, 18, 19 and Q3 were located in the Inchicronan system. This is a major sub-catchment of the Fergus system and includes Inchicronan Lake, the efferent Millbrook River and two afferent streams. Site 15 was located on the Millbrook River immediately downstream of the N18 Bridge at Ballyline. This river is approximately 2.5km long and joins the Fergus at Dromore Lough (i.e. downstream of site 20). The section investigated had a wetted width of 7m and a mean depth of 25cm. This site was considered to be ideal juvenile salmonid habitat (good riffle/glide frequency and gravel and cobble substrate) and contained extensive areas which were considered suitable for salmonid spawning. Adult holding areas and potential angling areas were located downstream from the site investigated. Sites 16 and 17 were located at Black's Bridge and McNamara's Bridge respectively. Mean wetted width was 1.2m and 3m at sites 16 and 17 respectively. Mean depth was 10cm at site 16 and 15cm at site 17. Percentage riffle was 10% at site 16 and 30% at site 17. The substrate at both sites was comprised of cobble and gravel. Both sites were considered to be ideal nursery habitats for juvenile salmonids. Suitable spawning habitat was available at both sites. Sites 18, 19 and Q3 were located on the Iscudda efferent stream. This stream also contains excellent salmonid spawning and rearing habitat. Mean depth at the three sites ranged from 20-30cm while mean wetted width ranged from 3-4m. Sites 19 and Q3 were comprised almost entirely of riffle habitat with cobble/gravel substrate. There was excessive shading at site 18 and batteries and other rubbish had been dumped here.

Site 21 and Q1 were located on the Castle River at Poulnacally (approximately 1km downstream of the subterranean section of the Castle River). This stretch of river had a mean wetted width of 6m, a mean depth of 25 cm, and a maximum depth of 40 cm. This are was considered to be ideal salmonid nursery and spawning habitat, and pools capable of holding

adult trout and grilse were present in the vicinity. The stream was composed of 40% riffle, 40% glide, and 10% pool. The substrate was composed of 40% cobble and 35% gravel. Instream vegetation cover was estimated to be 25%. Site number 22 was located on the Castle River at Inghed Bridge. This stretch of river was located approximately 4km upstream of the subterranean section of the castle River and is thought to be inaccessible to adult salmon. The river had a wetted width of approximately 3m in this area. Mean depth was 30cm and a maximum depth of 40cm was recorded. This section of stream was composed primarily of riffles (30%) and glides (40%); however pools suitable for holding adult trout were present. Canopy cover was estimated at 30% (shade 40%) This stretch was considered to be an ideal nursery habitat for juvenile trout. Site number 23 was located approximately 3km upstream of site 22 at Cregg Bridge. This stretch of the Castle/Moyree River had a wetted width of 2.2m, a mean depth of 20cm, and a maximum depth 40cm. Riffle habitat accounted for 45% of the section surveyed and the substrate was primarily composed of cobble and gravel. This area was considered to be ideal habitat for juvenile salmonid production. Approximately 10% of the section surveyed was considered to be suitable for spawning.

Site number 27 was located on the Tubber River in the Cullaun/Muckanagh catchment. This stream was though to be an artificial drainage cut. However, despite this it contained salmonid spawning, nursery habitats. Holding pools, suitable for adult trout, were also present. The stream has high banks (3m) reflecting its modified status. Mean depth was 30cm and the stream structure was dominated by glides. The substrate at the study site consisted of 60% rock, 20% cobble, and 20% gravel. Shade was estimated at 10%, and instream vegetation cover was approximately 70% along the survey section.

Sites 25 and 26 were located on the River Fergus upstream of Lough Inchiquin. Both sites were located downstream of the subterranean section of river (see figure 1). The section of stream upstream of the subterranean river channel was not investigated. Both sites had a mean wetted width of 6m. Mean depth was 30cm at site 25 and 30cm at site 26. The stream structure at site 25 was composed of 10% riffle, 80% glide, and 10% pool. Site 25 was dominated by riffle (55%), with glide accounting for 30% of the section investigated. Both sites had moderate shade (30%). Instream vegetation cover was 60% at site 25 and 5% at site 26. Some suitable salmonid spawning habitat was present at site 26, but was absent at site 25. Both areas (particularly site 26) were suitable for use by salmonids as a nursery area. Holding and angling areas were present upstream and downstream of site 25.

**Fisheries Assessment**

During 2002 an estimated total of 35,000 unfed fry and 6,000 parr were released along the main River Fergus (upstream and downstream of Inchiquin, Ardrood bridge, Dromore) and in the Millbrook, Moyree. Shallee, and Claureen tributaries. Because of these releases, only the 0-group salmon recorded during the current survey were regarded as being definitely naturally spawned. However, it is likely that the vast majority of juvenile salmon encountered during the current survey were naturally spawned and the progeny of wild fish. This is because the artificial releases are comparatively insignificant (representing the production of only 10-12 females).

*Results of the semi-quantitative electrical fishing survey*

The results of the semi-quantitative electrical fishing assessment are given in table 6. Additional results related to salmon are also given in table 7. In figure 5, the relationships between trout and salmon catch and site electrical fishing characteristics are presented. Figure 6 illustrates the electrical fishing, salmon catch and trout catch characteristics for each site. In figure 7, a pie chart shows the species community recorded for all sites combined. A total of 1,151 individual fish comprising of 8 species were recorded. The length percentage frequency distributions of all trout and salmon recorded during the survey are presented in figures 8 and 9 respectively. In figures 11 and 12 the percentage of brown trout and salmon which were less than one year old are shown.

A total of 2,678 $m^2$ of river channel were investigated in a continuous fishing time of 337 minutes at the 27 sites. A total of 863 brown trout *Salmo trutta* and 549 Atlantic salmon *Salmo salar* were captured. Trout were the most common species accounting for 57% of the total. Salmon was the second most common species recorded accounting for 36% of all fish recorded. Other species captured were European eel *Anguilla anguilla* (5.71%), three-spined stickleback *Gasterosteous aculeatus* (0.59%), flounder *Platichthys flesus* (0.26%), brook lamprey *Lampetra planeri* (0.19%), stone loach *Barbatula barbatula* (0.19%), and Northern pike *Esox lucius* (0.13%). Brown trout were present at 24 of the sites investigated. They were absent from the upper reaches of Shallee (Ballygriffy) and from the main channel of the Fergus at Nutfield. Salmon were present at 18 out of the 27 sites investigated (66%). Zero group (0-group) salmon were absent from all sites investigated on the Ballygriffy-Shallee catchment. No 0-group salmon were found at site 24 (Fergus upstream of Inchiquin) or at two sites upstream of Inchicronan lough. Salmon were absent from the Castle River upstream of a subterranean section of channel.

*Results of the quantitative assessments*

Fully quantitative electrical fishing assessments were undertaken at three sites (see figure 1). A total of $40m^2$, $90m^2$ and $45m^2$ were fished at sites Q1, Q2 and Q3 respectively. The results of these assessments are provided in tables 8 and 9.

*Lampreys*

Juvenile lampreys were recorded at two sites during the current survey. These were site 1 on the main Fergus at Ennis where one *Lampetra sp.* lamprey were recorded, and site three on the Claureen where two *Lampetra sp*. lampreys were recorded. All three individuals recorded were at the macrophthalmia stage. No juvenile lampreys were found during the investigation of silt beds within and in the vicinity of the electrical fishing sites.

*White clawed crayfish*

No specimens of this protected invertebrate were recorded during the current survey. The current survey may confirm its absence from this river catchment.

**Table 7** Number of juvenile salmon captured at each of the 27 semi-quantitative electrical fishing sites. Zero group salmon (0 +) are naturally spawned. The 1+ (one year or more) group may include planted individuals. Sites that only contained 1+ salmon are highlighted in bold.

| Site number | River name | Location | Total | O+ | 1+ | ratio |
|---|---|---|---|---|---|---|
| *1* | *Fergus* | *Ennis* | 36 | 19 | 17 | 0.89 |
| *2* | *Claureen* | *Inch bridge* | 53 | 39 | 14 | 0.36 |
| *3* | *Claureen* | *Mahuburgh bridge* | 45 | 40 | 5 | 0.13 |
| *4* | *Claureen* | *Rathkerry* | 111 | 102 | 9 | 0.09 |
| *5* | *Claureen* | *Killclogher* | 21 | 14 | 7 | 0.50 |
| *6* | *Ballygriffy* | *Killcurrish* | 0 | 0 | 0 | |
| *7* | *Ballygriffy* | *Killcurrish Upper* | 0 | 0 | 0 | |
| *8* | *Shallee* | *Moarhaun Bridge* | 0 | 0 | 0 | |
| ***9*** | ***Shallee*** | ***Kilcormick Bridge*** | **1** | **0** | **1** | |
| ***10*** | ***Shallee*** | ***Shallee*** | **1** | **0** | **1** | |
| ***11*** | ***Shallee*** | ***Ballyknock*** | **1** | **0** | **1** | |
| *12* | *Gaurus* | *Spancil Hill - Tullyuoghan* | 0 | 0 | 0 | |
| *13* | *Fergus* | *Nutfield Lower* | 24 | 22 | 2 | 0.09 |
| *14* | *Fergus* | *Nutfield Upper* | 38 | 27 | 11 | 0.41 |
| *15* | *Millbrook* | *Ballyline Bridge* | 53 | 49 | 4 | 0.08 |
| *16* | *Millbrook* | *MacNamaras Bridge* | 0 | 0 | 0 | |
| *17* | *Millbrook* | *Blacks Bridge* | 0 | 0 | 0 | |
| ***18*** | ***Inchicronan*** | ***Tributary*** | **6** | **0** | **6** | |
| ***19*** | ***Inchicronan*** | ***Tributary*** | **1** | **0** | **1** | |
| *20* | *Fergus* | *Dromore* | 86 | 72 | 14 | 0.19 |
| *21* | *Castle* | *Poulnacally* | 28 | 24 | 4 | 0.17 |
| *22* | *Castle* | *Inghed Bridge* | 0 | 0 | 0 | |
| *23* | *Castle* | *Cregg Bridge* | 0 | 0 | 0 | |
| *24* | *Fergus* | *Inchiquin Outflow* | 27 | 23 | 4 | 0.17 |
| ***25*** | ***Fergus**** | ***Poplar Bridge*** | **8** | **0** | **8** | |
| ***26*** | ***Fergus**** | ***Cross Bridge*** | **9** | **0** | **9** | |
| *27* | *Tubber* | *Tubber Stream* | 0 | 0 | 0 | |

**Located upstream of Lough Inchiquin.*

**Table 8** Density estimations (fish $m^2$) for Brown trout at the three study sites.

| Site | Equation | $R^2$ | Population estimate | Density |
|---|---|---|---|---|
| *Q1* | y = -2.1923x + 54.038 | 0.99 | 24 | 0.60 |
| *Q2* | y = -1.5x + 22.667 | 0.96 | 15 | 0.16 |
| *Q3* | y = -1.4184x + 66.673 | 0.95 | 47 | 1.04 |

**Table 9** Density estimations (fish $m^2$) for salmon at the two study sites where three depletions were obtained.

| Site | Equation | $R^2$ | Population estimate | Density |
|---|---|---|---|---|
| *Q1* | y = -4x + 45 | 0.95 | 11 | 0.27 |
| *Q2* | y = -1.7143x + 32.286 | 0.97 | 19 | 0.21 |

## Otters

All the areas that were surveyed exhibited evidence of otter activity. Areas that showed most activity were Muckanagh Lough and Inchicronan Lough. The area north of Inchiquin exhibited the least evidence of otter presence. Spraints were found on instream rocks, bankside rocks and grass tufts close to the waters edge. A total of 46 spraints were found on five of the areas assessed (table 10). The colour of spraints is defined by what the otter eats; a fish diet results in black coloured spraints. These will however become lighter as they dry. Some mucous spraints, which are anal jelly deposits, were found during the current assessment. These items did not contain fish bones. These ranged in colour from light brown-yellow to bright orange (see plates 38-39). The purpose of these anal jelly deposits is not known but they are probable used for lubrication and/or scent marking territories. No spraints were found on the Shallee River or main channel of the River Fergus. All spraints that were found were between 2cm and 6cm long and between 1cm and 2cm wide. Nearly all spraints that were found were black and musty indicating a fish diet. Four active holts were identified during the current survey. Two of these were located on the Cullaun/Muckanagh catchment. One was located on the Inch/Claureen/Kilmaley catchment and one was located on the Inchicronan catchment. Holts identified during this survey ranged from holes in the stonework of bridges (plate 40) to quite big, obvious holes that were dug in embankments with overhanging waterside vegetation. These are typical holts. Otters are also known to use rabbit burrows and rock piles as holts. Otter presence on the Castle River was also evident from injuries seen on fish that were captured during the electrical fishing work (see plate 33). The imprint of the otter's teeth can be clearly seen in the photo. The size of the jaw imprint indicates that the wound was caused by an otter and not by a mink. Otters can be up to 120cm long while mink grow to 60cm. Mink have a narrow jaw while the otter has a broad one. We can see from the photo that the imprint is considerable in breadth. Otter teeth have punctured the skin of the fish causing an initial small wound. The resultant stretching of the skin enlarging the wound can be clearly seen in the photo. Although otters occasional take trout and salmon, their diet mainly consists of eels and coarse fish.

**Table 10** Summary of the otter assessment.

| Survey date | Area/sun-catchment | Length of channel investigated | Number of spraints | Number of holts |
|---|---|---|---|---|
| 12/08/03 | Claureen/Inch/Kilmaley River catchment | 600 m | 9 | 1 |
| 12/08/03 | Shallee/Ballygriffey/Poulacorry River catchment | 600 m | 0 | |
| 13/08/03 | Inchicronan catchment | 600 m | 11 | 1 |
| 14/08/03 | Castle River catchment (Includes upper Moyree River) | 600 m | 9 | |
| 22/08/03 | Cullaun/Muckanagh catchment | 600 m | 12 | 2 |
| 23/08/03 | Elmvale/Lough Inchiquin catchment | 600 m | 5 | |
| 23/08/03 | River Fergus main channel | 600 m | 0 | |

**Plate 38-39** Examples of otter spraints from a site in the Fergus catchment.

**Plate 40** Otter holt comprising of a hole in the stonework of a road bridge.

## DISCUSSION AND CONCLUSIONS

The results from the current investigation confirm that the Fergus catchment is an important natural heritage resource. The river contains abundant stocks of Atlantic salmon – a species that is now considered to be endangered throughout over most of its range (Cross *et al* 1998). The endangered Eurasian otter is also thriving in the catchment, and other species listed under the Habitats Directive are present. However, the river is not without it problems. The EPA has estimated that water quality along approximately 10% of river channel in the Fergus catchment is unsatisfactory. The current survey has also shown that significant areas of the cathment require development before they can realize their full potential.

The source(s) of the pollution in the lower Fergus and Shallee is not known but appears to be related to agricultural runoff and municipal sewage. The lower reaches of the Fergus are particularly vulnerable to pollution due to the cumulative effect of pollutants along a river system. The unsatisfactory water quality in this area may be impacting on salmonid and lamprey reproductive success. Major drainage schemes in the past have turned many stretches of the main river Fergus into little more than flood conveyance arteries. In many areas riverbanks have been neglected and have become overgrown with scrub. Although trees and scrub are important habitats in their own right, excessive and uncontrolled growth of riparian scrub can result in excessive shading and reduced instream productivity. Moreover, overgrown banks along several kilometer of the main river prevent access by anglers and other user groups.

Despite its problems, the results of the current survey show that the River Fergus catchment is a very important spawning and nursery area for trout salmon. The significant stocks of juvenile salmon present in the river suggest that the river receives a large run of adult fish each year. Naturally spawned salmon are found up as far as the outflow from Lough Inchiquin and in all the tributaries investigated. The absence of salmon from the upper reaches of the Castle River can be explained by the presence of a subterranean section of river channel which prevents access. Likewise, the ephemeral nature of the Fergus above Lough Inchiquin is though to explain the absence of naturally spawned juvenile salmon from this area. Pollution problems in the catchment may also be influencing the distribution of naturally spawned salmon. Only 0-group salmon recorded during the current survey were definitely derived from natural spawning. This is because juvenile salmon (unfed fry and parr) were stocked into the river in previous years. It was also concluded that juvenile trout stocks were excellent in some areas of the catchment. The six highest trout catch rates were obtained at sites where natural spawned salmon were thought to be absent. Salmon were thought to be absent from these areas due to access difficulties (subterranean streams), habitat instability (ephemeral watercourses), and pollution, rather than inter-specific competition with trout. Trout were absent or at low densities in some areas where juvenile salmon were abundant. This is though to be a result of the habitats favouring salmon rather than trout. When both trout and salmon are present together (sympatric) salmon tend to occupy the riffle areas and trout reside in the glide areas in a response termed interactive segregation (Kalleberg 1958; Nilsson 1967). When habitats favouring one species over another are present it is possible that one species would gain dominance over the other.

It is clear from the current results that the stocking juvenile salmon and brown trout into the Fergus is unnecessary. Indeed, this type of 'enhancement' restocking, where existing native stocks are present, is no longer recommended by fisheries scientists (Cowx 1994; Cowx 1999; Brown & Day 2002). In the case of the river Fergus 'enhancement' stocking practice is likely to be counterproductive. In recent years however, salmon restocking levels have been relatively insignificant. For example the total release during 2002 would represent the production of only around 8-10 adult grilse females so these releases would only also only have a negligible impact on returns to the river. For example, the 35,000 unfed fry released would be expected to produce only around 300-400 smolts and less than 5% of these smolts would be expected to return back to the river (maximum 15-20 adult fish). Therefore it is likely that the vast majority of juvenile salmon encountered during the current survey were naturally spawned and the progeny of wild fish. Current fisheries management advice favors habitat rehabilitation and the promotion of naturally renewable fishing resources rather than 'enhancement' stocking (Champigneulle & Cachera, 2003). It is likely that the natural production of juvenile salmonids in the river could be significantly increased following a programme of bankside vegetation management and instream physical enhancement along areas of the main channel and tributaries. Such development work would be expected to increase both trout and salmon production. The installation of deflectors and spawning gravels along the main Fergus channel at Nutfield and Dromore would improve conditions for trout. Bankside vegetation management at overgrown areas such as Nutfield and Addroon on the main channel along areas such as the middle and upper Clareen would benefit both trout and salmon production. Angling could also be developed. Salmon angling on the Fergus at present is almost exclusively confined to the lower reaches of the river. There would appear to be considerable scope to improve angling access and develop new angling pools in the middle reaches of the river. Ideal locations for new salmon angling areas occur along the river around Nutfield for example. There is also considerable scope to develop trout angling within the catchment, particularly on the main channel between Ballyhee Bridge and Addroon Bridge. Most of this development would involve improving angler access.

Although significant efforts were made to detect juvenile lampreys, they were recorded at only two sites during the current survey and no ammocoetes were found. This may indicate that lampreys are scarce in the Fergus catchment. This is certainly possible and it was concluded during the current study that anadromous lampreys (particularly *lampetra fluvialitis*) may have difficulty negotiating the weir and fish pass at Ennis town. However, it is likely that the main lamprey nursery areas were not detected by the current survey. The current investigation had a site density of only 0.02 sites/km$^2$catchment area and was limited to open and shallow wadeable areas. It is possible that ammocoetes were located in deeper shaded sections not investigated by the current survey. During the current survey, sea lampreys were observed spawning along the main channel of the Fergus at Ennis and the ETDAA have recently observed spawning activity of this species along the main river Fergus between Nutfield Bridge and Dromore Lake.

With the Eurasian Otter declining in many European countries, the Irish population of this species is of increasing importance. Presently otters are widespread in Ireland retaining both freshwater and marine territories. Ireland now holds the densest population of otters in Western Europe (Hayden et al, 2001). Although no otters were seen during the survey the signs of otters were very obvious throughout the system. Spraints were found within five of the seven survey areas. The two survey areas that recorded no spraints provide good habitat for otters and from the electrical fishing survey we know that there are ample food sources

available. Accordingly it is felt that these two areas could support otters and that spraints may have been missed. Fish scales were noted from spraints from Inchicronan Lough. These were from coarse fish. The otter however has a preference for eels. No scales were found in any other spraints. However the black nature of spraints recorded and their fishy smell indicates a large percentage of their diet comprises eel. A high incidence of otter spraints was noted within the Muckanagh and Inchicronan catchments. Active otter holts were evident on each of these catchments also. The other catchment that recorded a holt was the Inch/Claureen River. Elmvale, above Lough Inchiquin however showed little sign of otter activity. Spraints were noted but not that many and the ones that were seen were grey and dry illustrating that they were old spraints. This section of the river is known to dry out in sections during periods of dry weather and this may be the reason for the limited use by otters of this section.

It is obvious that there is good otter activity throughout the system. Although all the information acquired during this short survey is useful, spatial and temporal distribution as well as the health of the population can only be decided through detailed surveys on particular stretches. With the future of an Annex II species at risk from water pollution, habitat destruction and dwindling eel stocks it is important that we quantify the number of otters that are using the system presently. A recent survey in the UK by The Environment Agency (EA) has revealed that otters are becoming more and more widespread in the rivers of England. This survey (Fourth Otter Survey of England 2000-2002) was initiated in 2000 and was finished during 2002. It reports the findings of a comprehensive two-year otter surveillance programme carried out on major rivers throughout the country. A similar survey on the River Fergus should be undertaken to enable the identification of areas that may be unproductive for otters due to disturbance, habitat destruction and water pollution. With this information a rehabilitation programme could be put in place.

Overall, the results from the current investigation clearly show that the River Fergus catchment is an important natural heritage resource. It is an important stronghold for two species listed under the EIS Habitats Directive, namely Atlantic salmon and Eurasian otter, and has considerable potential for development as a nationally important angling and out door recreations recourse. Indeed, with further protection and enhancement, it is clear that the catchment could become an internationally important conservation unit providing significant recreational and educational activities for locals and tourists alike.

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# APPENDIX 1

## Surface Water Quality

### EPA River Quality Classification Scheme

The Q values are a measure of the EPA's Biological River Quality classification system. The EPA conducts a rolling programme of biological surveys of selected rivers. The higher the biological diversity and the greater the abundance of invertebrate species sensitive to organic pollution, the higher the water quality is assumed to be, and the higher the 'Q value' assigned to that sampling station. The EPA's water quality classification systems are summarised below:

Biological River Quality Classification and River Water Quality Class System (McGarrigle *et al* 2002):

| **'Q' value** | **Community Diversity** | **Water Quality** | **Condition*** | **Status** | **Quality** |
|---|---|---|---|---|---|
| *Q5, 4-5, 4* | High | Good | Satisfactory | Unpolluted | Class A |
| *Q3-4* | Much Reduced | Doubtful | Unsatisfactory | Slightly Polluted | Class B |
| *Q3, 2-3* | Low | Poor | Unsatisfactory | Moderately Polluted | Class C |
| *Q2, 1-2, 1* | Very Low | Bad | Unsatisfactory | Seriously Polluted | Class D |

* 'Condition' refers to the likelihood of interference with beneficial or potential beneficial use.

Class A waters are those in which problems relating to existing or potential uses are unlikely to arise. They are therefore regarded as being in a 'satisfactory' condition. Classes B, C and D are to a lesser or greater extent 'unsatisfactory' in this regard. For example, the main characteristics of Class B and C waters is eutrophication, which may interfere with the amenity, abstraction or fisheries uses of such waters.

## Summary results of the EPA water quality surveys of the Fergus catchment

River and Code : **CRAGGAUNBOY** **27/C/04**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 265 883

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| Sampling Stations | | Biological Quality Ratings (Q Values) | | | |
|---|---|---|---|---|---|
| No. | Location | **1988** | **1991** | **1997** | **1998** |
| 0200 | Br d/s Trib ex L Nagowan | **3-4** | 4 | - | 4 |
| 0400 | Bridge N.W. of Cloncarragh | 4 | 4-5 | - | - |
| 0600 | Bridge u/s Fergus River | 4 | 4 | **3-4** | 4 |

River and Code : **FERGUS** **27/F/01**
Tributary of : Sea - Shannon Estuary OS Catchment No: 158
OS Grid Ref : R 363 700

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| Sampling Stations | | Biological Quality Ratings (Q Values) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Location | **1971** | **1975** | **1979** | **1982** | **1985** | **1988** | **1991** | **1996** | **1998** |
| | *Main Channel* | | | | | | | | | |
| 0100 | Poplar Bridge | - | - | - | 4-5 | 4-5 | 4 | 4 | **3-4** | 4 |
| 0200 | Riverstown Bridge | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 0300 | Bridge in Corofin | - | - | **3-4** | 4 | 4 | 4 | 4 | **3-4** | 4-5 |
| 0350 | Second Bridge d/s L Atedaun | - | - | - | 4 | 4 | 4 | 4 | - | 4 |
| 0400 | Addroon Bridge | - | - | - | 4 | 4 | 4 | 4 | 4 | 4 |
| 0500 | Nutfield Bridge | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | *Distributary at Ennis* | | | | | | | | | |
| 0560 | Bridge S.E. of Brookville | - | - | - | - | - | - | **3** | - | - |
| 0590 | Corravarrin Br | - | - | - | - | - | - | **3** | **3** | **2-3** |
| | *Main Channel* | | | | | | | | | |
| 0600 | Drehidnagower Bridge | - | 4-5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 0640 | 2nd Br d/s Drehidnagower | - | - | - | - | - | - | 4 | - | - |
| 0700 | Bridge near Clonroad House | 4-5 | 4-5 | 4 | - | 4 | 4 | 4 | **3-4** | **3-4** |
| 0720 | Bridge S.W. of Doora | - | - | - | - | - | - | - | - | - |
| 0780 | W Br Clarecastle | - | - | - | - | - | - | - | - | - |
| 0790 | Clarecastle: East Bridge | - | - | - | - | - | - | - | - | - |
| 0800 | Clarecastle Quay | - | - | - | - | - | - | - | - | - |

*Results of Chemical Analyses 1998 to 2000:*
Data Set: 1 27F01 Clare Co Co

| Station No. | pH | | | | Conductivity µS $cm^{-1}$ | | | | Temperature oC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *36* | 7.1 | 7.9 | 8.2 | *36* | 318 | 424 | 518 | *36* | 6.6 | 11.0 | 16.6 |
| 0200 | *36* | 7.6 | 8.1 | 8.7 | *36* | 330 | 375 | 410 | *36* | 5.7 | 11.8 | 20.2 |
| 0300 | *36* | 7.6 | 8.0 | 8.6 | *36* | 308 | 369 | 819 | *36* | 5.3 | 11.8 | 19.9 |
| 0400 | *36* | 7.7 | 8.1 | 8.4 | *36* | 326 | 384 | 432 | *36* | 4.6 | 12.0 | 20.7 |
| 0500 | *36* | 7.7 | 8.0 | 8.4 | *36* | 344 | 391 | 935 | *36* | 4.4 | 11.6 | 21.3 |
| 0600 | *36* | 7.7 | 8.0 | 8.3 | *36* | 357 | 403 | 444 | *36* | 4.7 | 11.6 | 19.7 |
| 0700 | *36* | 7.6 | 8.0 | 8.4 | *36* | 240 | 400 | 727 | *36* | 4.8 | 11.6 | 19.3 |
| 0780 | *36* | 7.6 | 7.9 | 8.2 | *36* | 283 | 430 | 12700 | *36* | 4.8 | 11.6 | 19.6 |
| 0800 | *36* | 7.5 | 7.9 | 8.4 | *36* | 206 | 407 | 2170 | *36* | 4.7 | 11.8 | 19.6 |

| Station No. | Dissolved Oxygen % Saturation | | | | Dissolved Oxygen mg $O_2 l^{-1}$ | | | | B.O.D mg $O_2 l^{-1}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *35* | 73 | 96 | **148** | *35* | 7.8 | 10.8 | 15.5 | *36* | 0.3 | 1.0 | 2.3 |
| 0200 | *36* | 81 | 99 | **134** | *36* | 8.3 | 10.7 | 13.8 | *36* | 0.2 | 1.1 | 1.8 |
| 0300 | *36* | 73 | 96 | 128 | *36* | 7.5 | 10.6 | 13.4 | *36* | 0.2 | 1.2 | 2.6 |
| 0400 | *36* | 70 | 96 | **136** | *36* | 7.7 | 10.3 | 14.0 | *36* | 0.3 | 1.4 | 2.5 |
| 0500 | *34* | **68** | 92 | 121 | *34* | 7.0 | 10.3 | 14.2 | *36* | 0.1 | 1.2 | 2.6 |
| 0600 | *36* | **64** | 92 | 118 | *36* | **6.6** | 9.9 | 12.4 | *36* | 0.2 | 1.2 | 3.0 |
| 0700 | *36* | 77 | 93 | 130 | *36* | 7.9 | 10.2 | 16.0 | *36* | 0.3 | 1.5 | 3.7 |
| 0780 | *36* | **60** | 86 | 120 | *36* | **5.6** | 9.3 | 14.9 | *36* | 0.4 | 1.7 | 5.0 |
| 0800 | *36* | **63** | 88 | 120 | *36* | **6.7** | 9.5 | 14.9 | *36* | 0.4 | 1.8 | 5.0 |

| Station No. | Chloride mg Cl $l^{-1}$ | | | | Total Ammonia mg N $l^{-1}$ | | | | Un-Ionised Ammonia mg $NH_3$ $l^{-1}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *36* | 13 | 23 | 37 | *34* | <0.01 | 0.03 | 0.05 | *34* | <0.001 | <0.001 | 0.001 |
| 0200 | *36* | 15 | 24 | 35 | *34* | <0.01 | 0.03 | 0.06 | *34* | <0.001 | 0.001 | 0.004 |
| 0300 | *36* | 15 | 24 | 45 | *34* | <0.01 | 0.03 | 0.06 | *34* | <0.001 | 0.001 | 0.004 |
| 0400 | *36* | 16 | 23 | 35 | *34* | 0.01 | 0.03 | 0.07 | *34* | <0.001 | 0.001 | 0.003 |
| 0500 | *36* | 11 | 24 | 42 | *34* | 0.01 | 0.03 | 0.05 | *34* | <0.001 | 0.001 | 0.003 |
| 0600 | *36* | 19 | 25 | 38 | *34* | 0.01 | 0.03 | 0.07 | *34* | <0.001 | 0.001 | 0.003 |
| 0700 | *36* | 17 | 25 | 38 | *34* | 0.01 | 0.03 | 0.08 | *34* | <0.001 | 0.001 | 0.004 |
| 0780 | *36* | 20 | 30 | **>999** | *34* | 0.01 | 0.06 | **0.32** | *34* | <0.001 | 0.002 | 0.012 |
| 0800 | *36* | 16 | 25 | 128 | *34* | 0.01 | 0.06 | **0.38** | *34* | <0.001 | 0.001 | 0.015 |

| Station No. | Oxidised Nitrogen mg N $l^{-1}$ | | | | Ortho-Phosphate mg P $l^{-1}$ | | | | Colour Hazen | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *12* | 0.6 | 0.8 | 0.9 | *35* | <0.01 | 0.03 | 0.08 | *36* | 5 | 28 | 100 |
| 0200 | *12* | 0.2 | 0.4 | 0.8 | *34* | <0.01 | 0.02 | 0.05 | *36* | 10 | 30 | 70 |
| 0300 | *12* | 0.2 | 0.6 | 0.8 | *33* | <0.01 | 0.03 | 0.05 | *36* | 10 | 40 | **125** |
| 0400 | *12* | 0.1 | 0.4 | 0.6 | *35* | <0.01 | 0.02 | 0.05 | *36* | 5 | 30 | 70 |

| Station No. | Oxidised Nitrogen mg N $1^{-1}$ | | | | Ortho-Phosphate mg P $1^{-1}$ | | | | Colour Hazen | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0500 | *12* | 0.1 | 0.4 | 0.7 | *33* | <0.01 | 0.01 | 0.05 | *36* | 15 | 35 | 65 |
| 0600 | *11* | 0.2 | 0.3 | 0.7 | *33* | <0.01 | 0.01 | 0.05 | *36* | 5 | 30 | **125** |
| 0700 | *12* | 0.2 | 0.5 | 0.8 | *34* | <0.01 | 0.02 | 0.06 | *36* | 15 | 40 | **175** |
| 0780 | *12* | 0.3 | 0.6 | 0.7 | *35* | 0.02 | **0.04** | 0.14 | *36* | 5 | 50 | **175** |
| 0800 | *12* | 0.2 | 0.4 | 0.7 | *34* | 0.01 | **0.03** | 0.12 | *36* | 5 | 40 | **175** |

River and Code : **INCH (CLARE)** **27/I/01**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 333 782

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| Sampling Stations No. | Location | Biological Quality Ratings (Q Values) **1986** | **1988** | **1991** | **1997** | **1998** |
|---|---|---|---|---|---|---|
| 0200 | Kilmaley Bridge | 4-5 | 4 | 4-5 | 4-5 | 4 |
| 0400 | Bridge in Rathkerry | 4 | 4 | 4 | 5 | 4 |
| 0600 | Inch Bridge | 4 | 4 | 4 | 4-5 | 4 |
| 0800 | Claureen Bridge | 4 | 4 | 4 | 4 | 4 |

River and Code : **MILL BROOK** **27/M/03**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 364 859

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| Sampling Stations No. | Location | Biological Quality Ratings (Q Values) **1988** | **1991** | **1997** | **1998** |
|---|---|---|---|---|---|
| 0700 | Third Br d/s Br at Derryboy | 4-5 | - | - | 4 |
| 0800 | Br nr Derrycalliff Lr (side road) | - | 4 | 4 | - |
| 1000 | Bridge u/s Inchicronan Lough | 5 | 4-5 | - | 4 |
| 1100 | Ballyline Bridge | 4-5 | 4 | 4 | 4 |

River and Code : **MOYREE** **27/M/02**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 358 878

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| Sampling Stations No. | Location | Biological Quality Ratings (Q Values) 1988 | 1991 | 1997 | 1998 |
|---|---|---|---|---|---|
| 0300 | Bridge u/s Bunnahow Lough | 4-5 | 5 | 4-5 | 4-5 |
| 0400 | Bridge d/s Bunnahow Lough | 4 | 4 | - | - |
| 0500 | Bridge d/s Carheeny Lough | 4 | 4 | - | - |
| 0600 | Bridge near Lughid House | 4 | 4-5 | 4 | 4 |
| 0700 | Bridge u/s Fergus River | 4 | 4 | 4-5 | 4-5 |

River and Code : **SHALLEE** **27/S/01**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 338 815

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| Sampling Stations No. | Location | Biological Quality Ratings (Q Values) 1980 | 1985 | 1988 | 1991 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|
| 0090 | 250 m u/s Sampling Stat 0100 | - | - | **1-2** | - | - | - |
| 0100 | Bridge N. of Ballyknock | **3** | **3** | **1-2** | **3-4** | 4 | 4 |
| 0200 | Moarhaun Bridge | 4 | **3-4** | **2-3** | **3** | - | - |
| 0300 | Bridge N.E. of Erinagh | 4 | 5 | **3-4** | **3-4** | 4 | 4 |
| 0500 | Bridge d/s Lough Cleggan | - | - | 4 | **3-4** | 4 | **3-4** |

*Results of Chemical Analyses 1998 to 2000:*
Data Set: 1 27S01 Clare Co Co

| Station No. | pH | | | | Conductivity µS $cm^{-1}$ | | | | Temperature oC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *8* | 7.5 | 8.0 | 8.2 | *8* | 217 | 299 | 348 | *8* | 6.9 | 12.4 | 15.7 |
| 0300 | *8* | 7.5 | 7.8 | 7.9 | *8* | 346 | 475 | 581 | *8* | 9.2 | 12.7 | 15.4 |
| 0500 | *8* | 7.6 | 7.9 | 8.1 | *8* | 363 | 483 | 520 | *8* | 9.4 | 14.0 | 16.1 |

| Station No. | Dissolved Oxygen % Saturation | | | | Dissolved Oxygen mg $O_2 l^{-1}$ | | | | B.O.D mg $O_2 l^{-1}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *8* | 89 | 99 | 110 | *8* | 8.8 | 10.3 | 12.4 | *7* | 0.7 | 2.2 | 2.4 |
| 0300 | *8* | 82 | 93 | 101 | *8* | 8.5 | 9.6 | 11.6 | *7* | 0.7 | 1.7 | 2.9 |
| 0500 | *8* | **65** | 84 | 103 | *8* | **6.4** | **8.4** | 10.6 | *7* | 0.5 | 2.0 | 3.1 |

| Station No. | Chloride mg Cl $1^{-1}$ | | | | Total Ammonia mg N $1^{-1}$ | | | | Un-Ionised Ammonia mg $NH_3$ $1^{-1}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | *7* | 25 | 28 | 30 | *7* | <0.01 | 0.03 | 0.06 | *7* | <0.001 | 0.001 | 0.002 |
| 0300 | *7* | 23 | 27 | 29 | *8* | 0.01 | 0.02 | 0.05 | *8* | <0.001 | <0.001 | 0.001 |
| 0500 | *7* | 21 | 25 | 30 | *8* | <0.01 | 0.02 | 0.06 | *8* | <0.001 | 0.001 | 0.002 |

| Station No. | Oxidised Nitrogen mg N $1^{-1}$ | | | | Ortho-Phosphate mg P $1^{-1}$ | | | | Colour Hazen | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *No.* | Min | Med | Max | *No.* | Min | Med | Max | *No.* | Min | Med | Max |
| 0100 | - | - | - | - | *8* | 0.01 | **0.04** | 0.08 | *8* | **70** | **78** | **200** |
| 0300 | - | - | - | - | *7* | **0.03** | **0.04** | 0.06 | *8* | 30 | **65** | **150** |
| 0500 | - | - | - | - | *8* | 0.02 | **0.04** | 0.07 | *8* | 30 | **55** | **150** |

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River and Code : **SPANCELHILL** *(Gaurus)* **27/S/03**
Tributary of : Fergus OS Catchment No: 158
OS Grid Ref : R 350 771

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| Sampling Stations No. | Location | Biological Quality Ratings (Q Values) **1988** | **1991** | **1997** | **1998** |
|---|---|---|---|---|---|
| 0200 | Bridge near Spancelhill | 4 | 4 | 4 | 5 |
| 0400 | Br d/s Aughavaddy Bridge | **3-4** | **3-4** | 4 | 4 |