

River Beaulieu Habitat Survey



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Introduction.

During 2007 and 2008 the Ness & Beaully Fisheries Trust (N&BFT) undertook a habitat survey of the Beaully catchment in accordance with protocols established by the Scottish Fisheries Co-ordination Centre. This method entails a habitat surveyor walking in an upstream direction recording variables such as water depth, flow pattern, substrate type, vegetation, trampling by animals etc. Such variables are recorded for a stretch of the river, known as a transect, which is typically 250m in length. It should be noted that lochs are excluded from surveys. Some very small tributaries within the Beaully catchment were excluded from the survey – typically these were less than 1m wide.

The Beaully has been extensively impacted by the installation and operation of hydro-electric schemes operated by Scottish & Southern Energy (S&SE). In particular, some sections of the Farrar system have been heavily abstracted and indeed little or no flow is evident in some tributaries. In addition, the installation of the dams is likely to have radically altered the hydrological characteristics of the River Beaully catchment. Additionally, the use of land for agriculture purposes and water abstraction for domestic and commercial supply is likely to have impacted on the natural productivity of the aquatic environment.

The purpose of the present report is to:

- Quantify the areas within the catchment that could potentially be re-colonized by salmon if adequate flows were restored.
- Identify areas that could benefit from habitat upgrade e.g. the establishment of stock fences.
- Identify artificial barriers to migration that could be eased.
- Identify areas prone to log-jams that require annual monitoring.
- Establish areas that could provide suitable locations for artificial stocking of salmon for enhancement purposes and make recommendations based on current advice regarding best practice.

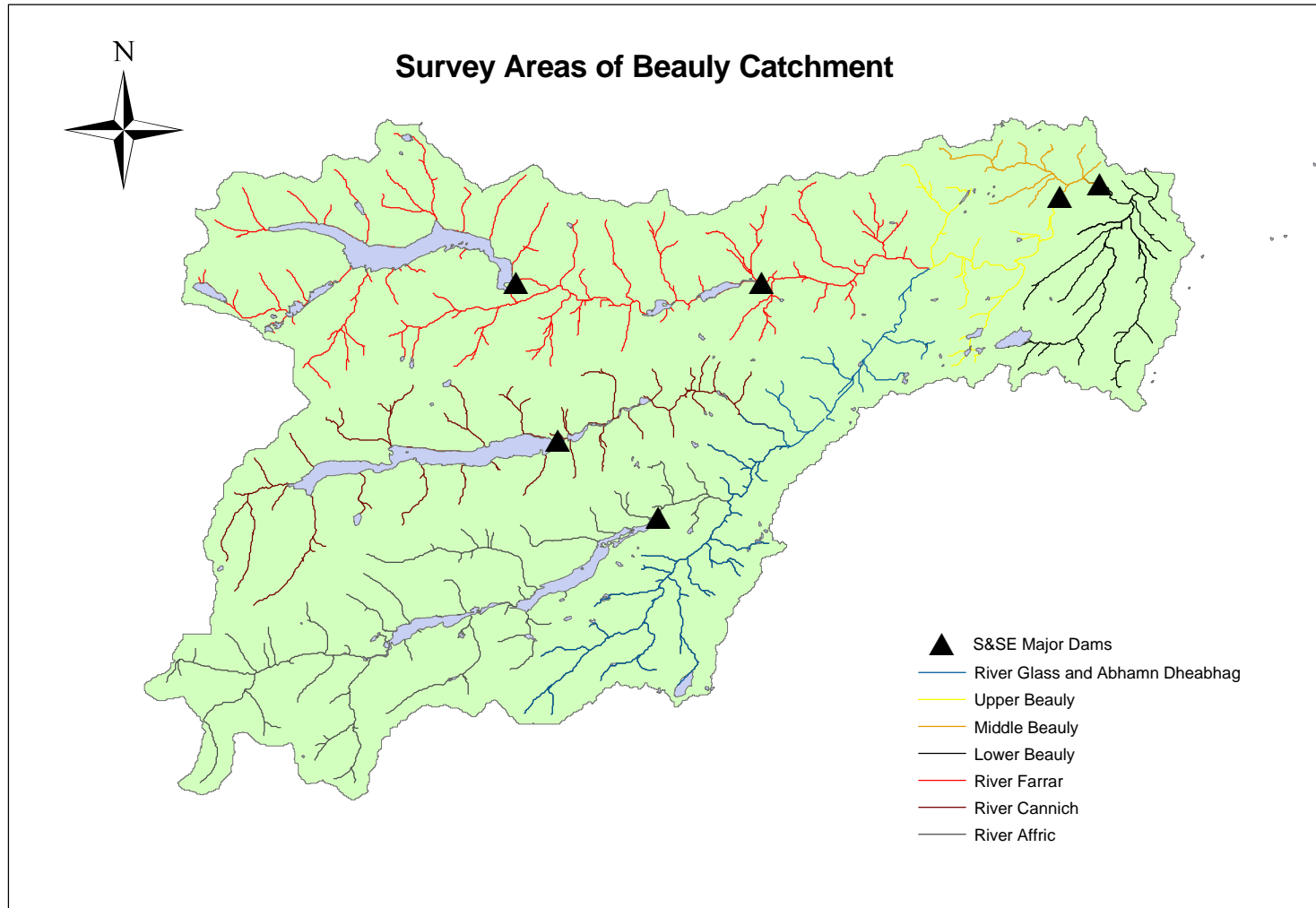
Results of the habitat survey are briefly summarised in the following chapters and areas of special interest highlighted. A summary table is also provided to place any future remedial actions in context and facilitate an assessment of the likely benefits of any intervention by re-watering, stocking etc. Smolt production is likely to be in the region of 1-7 per 100m² of suitable habitat (Simon McKelvey, Cromarty Firth Fisheries Trust, personal communication). For the purposes of this report a generic figure of 3 smolts per 100m² has been applied. It should be noted, however, that the results of this approach to assessment of productivity should be treated with extreme caution. In particular, such figures may represent an over-estimation of production in deep and slow moving areas of main stem river but an under-estimation of production in smaller tributaries. Assessment of numbers of juvenile salmon required to stock areas utilise stocking densities of 3 fry per m² and 0.5 parr per m². These target stocking densities are those utilised on the neighbouring Conon system and are believed to fully saturate the available habitat.

Artificial stocking of juvenile salmon is currently undertaken on the Beaully system in an effort to increase stocks. Typically, but not exclusively, such stocking is targeted at areas upstream of natural barriers to upstream salmon migration. This is aimed at reducing competition with naturally spawned salmon juveniles and in turn maximising the efficiency of stocking. A growing body of evidence suggests that most Scottish river systems have multiple, highly structured salmon populations that interbreed only to a limited degree. Inappropriate stocking of juveniles is likely to have the potential to be counterproductive and may damage the long-term viability of stocks. During the summer of 2008, N&BFT collected in excess of 1000 tissue samples from juvenile salmon in order to make an initial assessment of the spatial distribution (if any) of salmon populations in the Beaully system. The samples will ultimately be analysed as part of Focusing Atlantic Salmon Management on Populations Project (FASMOP). Until the results of genetic analyses are available for the Beaully system, it is suggested that the code of good practice drafted by The Association of Salmon Fishery Boards in relation to stocking of juvenile salmon is adhered to.

Where relevant, reference is made to electro-fishing data held by N&BFT and is integrated into the report although specific figures for densities obtained in surveys etc are not given.

For presentational purposes, the Beaully catchment has been split into sections. Figure 1 illustrates the main areas covered by the habitat survey.

Figure 1 Map of Beaully catchment.



Chapter 1 Lower Beaully (including Belladrum, Bruiach and associated tributaries).

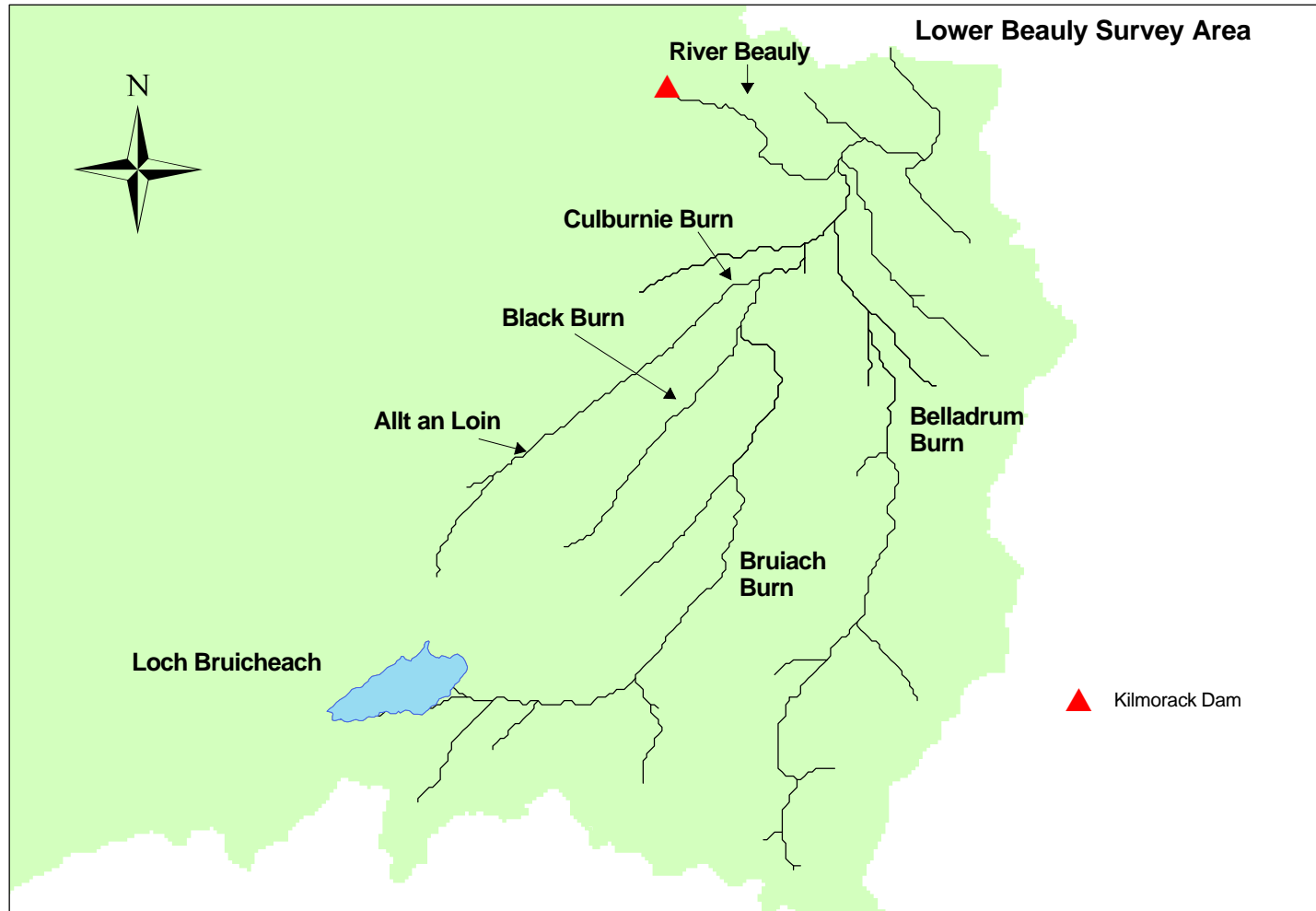
General Description.

This section comprises of the main stem of the River Beaully running from Kilmorack Dam to Lovat Bridge plus major tributaries. The Lower Beaully represents the most productive salmon fishery in the catchment and also supports a historically important sea trout fishery. Fish assemblage in this part of the Beaully system is more diverse than the majority of the catchment upstream of Kilmorack Dam. Presumably this is an artefact of the effects of the installation of hydro-electric structures on fish distribution upstream of this section. Thus, known fish assemblage in this section includes: salmon; migratory and non-migratory trout; sea, river and brook lamprey; eel and stickleback. The Belladrum and Bruiach rivers and associated tributary complex are of especial importance given that they remain unaffected by hydro-electric installations, although the latter is affected to some degree by the abstraction of water in its upper reaches by Scottish Water. It is the understanding of N&BFT that the main stem of the River Beaully is stocked annually, usually with autumn parr, and that the Belladrum, Bruiach and some associated tributaries are stocked with salmon fry.

Plate 1 Lower Beaully.



Figure 2 Map of river section and burns surveyed covered in this chapter.



Section 1 Lower Beaully.

The estimated wetted area of this section, covering Lovat Bridge to Kilmorack is in excess of 375,000 m². Whilst the section is the most productive fishery in the Beaully catchment, it also provides habitat suitable for spawning and nursery areas in some locations. No major obstacles to migration are present in this section other than the Cruives and Kilmorack Dam. The habitat provided by this section is highly varied with deep water usually favoured by adult salmon and trout interspersed by shallow riffle habitat suitable for juvenile salmon. Small areas of silt in the margins are also evident in a number of locations and these provide ideal habitat for lamprey ammocoetes. Salmon spawning areas appear to be largely stable and uncompacted except for one small area. The section does not appear to suffer from unduly high levels of erosion and bank maintenance appears to have been historically undertaken where it has been deemed necessary.

Plate 2 Looking upstream to the Cruives.



Concern has been expressed by a number of individuals to the N&BFT regarding the condition of the Cruives. Particular concern has centred on the belief that large quantities of silt are likely to have built up upstream of the structure and that future deterioration of the cruives could release this material and potentially impinge on the quality of spawning habitat further downstream. An assessment on the likelihood of this occurrence is beyond the remit of the N&BFT although given the significant levels of spawning below the Cruives this matter is likely to warrant attention.

Prior to 2008 it appears that no electro-fishing has been undertaken on the main stem of the River Beaully. Wide rivers such as the Beaully (often in excess of 60m) present logistical difficulties for accurate, effective fish census surveys. Nevertheless, N&BFT undertook timed surveys in a number of locations in order to establish the presence/absence of fish species and the year classes present. A secondary reason for electro-fishing surveys was to garner tissue samples for future genetic analysis. Salmon fry and parr were found at a number of locations indicating that, as expected, natural spawning takes place within this section. Lamprey ammocoetes were also located in most of the silt areas targeted. Other fish species captured included trout, eels and minnows. Electro-fishing could only be undertaken where the water was sufficiently shallow to permit safe fishing. Additionally, salmon parr in particular are adept at avoiding capture in wide rivers where stop-nets cannot be deployed. As such, abundance of larger juvenile salmon in particular is likely to be underestimated in such sections compared with smaller tributaries that are logistically easier to fish effectively.

Section 2 Belladrum.

The Belladrum is an important tributary of the lower Beaully and offers a considerable area of spawning and nursery habitat. Total wetted area is estimated to be in excess of 50,000m². The Belladrum and Bruiach combine a short distance prior to decanting into the River Beaully within the grounds of Beaufort Castle. Stocking of the Belladrum Burn takes place annually, largely targeted at the upper reaches of the burn.

Plate 3 Small waterfall on the Belladrum. Such potential obstacles may be easily passable in high flow conditions but may prevent migration in low flows.



Overall habitat quality appears to be good with habitat suitable for spawning and nursery areas available through much of the area surveyed. Tree cover is also good for most of the

length of the burn. The survey has, however, highlighted some issues of concern. Previous surveys (e.g. Auris 1990) have highlighted the presence of fallen trees and other woody debris that may cause obstacles to the upstream migration of salmon and sea trout and indeed potential obstacles of this nature were observed in the summer of 2007 in the form of a fallen tree. Whilst not deemed to be impassable at the time of the survey, such potential obstacles require to be monitored. Stock fences are in place in some sections of the river but are absent in others and this is particularly apparent in the upper reaches of the Belladrum where some trampling by livestock was evident. Additionally, some historical interference in the river channel was observed in the upper reaches of the Belladrum. Some erosion and man-made measures aimed at reducing such erosion were in evidence but these did not seem to be excessive.

Plate 4 Rock utilised to prevent erosion.



Electro-fishing data held by N&BFT suggests that the lower reaches of the Belladrum are highly productive in terms of salmon production. However, juvenile distribution further upstream is patchy, particularly in terms of salmon fry. A site that has been fished regularly near Tomnacross, for example, has displayed high variability in terms of fry density whilst being fairly consistent in terms of parr production. It is suggested that the degree of penetration by adult salmon into the Belladrum catchment is likely to be strongly related to river flow patterns during the spawning period. Due to the fact that the upper reaches of the Belladrum are stocked, it is not currently possible to ascertain the distribution of naturally spawned fish within the Belladrum. Fry survival in stocked areas appears reasonable but parr

densities are often low. This may be due to poor survival, the likelihood of parr moving away from stocked areas and eventually becoming more thinly spread or a combination of these two factors.

Plate 5 Water gate trapping debris on Belladrum. Such obstacles can prevent upstream migration by adult fish and represent potential sources of mortality to smolts etc migrating downstream.



Plate 6. Fallen tree in lower reaches of the Belladrum likely causing a partial barrier to migration. An alien plant species, rhododendron is also in the foreground.



Section 3 Bruiach.

The Bruiach flows parallel with the Belladrum Burn for much of its length and is broadly similar in nature. The area surveyed covered a wetted area of approximately 69,000m². Some areas of the Bruiach in the upper reaches were excluded due to the narrow nature of the burn.

Generally, the quality of habitat found in the Bruiach was deemed to be highly favourable for juvenile salmonids with substrate likely to provide spawning opportunities available in addition to areas with a larger substrate that are likely to provide good cover for older age classes of juveniles. As with the Belladrum, fallen timber and other obstacles represent a problem in this burn as illustrated in the following photographic plates.

Distribution of salmonid juveniles would appear to follow a similar pattern to the Belladrum with high densities of salmon and other species found in the lowermost reaches. Again, it is suggested that the spatial distribution of spawning activity will be a function of flow magnitude. Fish assemblage in the Bruiach is particularly diverse with salmon, trout, eels and both river and brook lamprey known to be present. Distribution of salmon juveniles resulting from natural spawning is currently unknown due to the fact that the upper reaches of the burn are stocked. Salmon fry and parr densities in the stocked sections appear to mirror the situation in the Belladrum i.e. reasonably good fry density and low parr density.

Plate 7 Water gate on Bruiach Burn.



Plate 8. Log jam on the Bruiach.



Section 4. Culburnie, Black Burn etc.

The Bruiach has a number of ostensibly minor tributaries that provide suitable habitat for juvenile fish. Although typically narrow in nature (2-6m wide), the tributaries are of reasonable length and thus provide a wetted area of approximately 30,000m² in total.

Plate 9 Junction of Culburnie with the Black Burn.



Habitat within the burns is varied with good substrate evident in most sections. Water depth in these burns is typically shallow (the vast majority being less 20cm in depth and with very little in excess of 40cm in depth) and as such probably offers greatest potential for the youngest age classes of salmonids as against older age groups. The substrate matrix in these burns is dominated by the smaller size categories, particularly pebble and cobble which would tend to favour utilisation by the youngest age classes of juveniles.

These burns are utilised by the Lower Beaully Syndicate for stocking purposes. The electro-fishing data held by the N&BFT suggests that a similar pattern to the Belladrum and Bruiach stocked areas is evident i.e. good numbers of fry but low densities of parr. As these areas are stocked it is not possible to assess if the burns are utilised for natural spawning by migratory fish.

A feature of the small burns in this area is the number of potential barriers to migration, both manmade and natural. These are likely to restrict movement of both returning adult fish and juveniles. Salmon parr, for example, are known to undertake considerable migrations during their freshwater residency in order to locate the desired habitat niches. Barriers such as large

timber blockages may be particularly pernicious when salmon and sea trout smolts are migrating downstream as they tend to migrate in periods of high flows and/or at night. Contact with such feature may damage smolts or prevent further migration.

Plate 10 Obstacle to migration in the Culburnie Burn.



Plate 11 Woody debris dam in lower reaches of Culburnie Burn.



Recommendations.

1. The nature of genetic structuring of salmon and sea trout populations, if any, in the Lower Beaully and associated tributaries is currently unknown. During the summer of 2008 N&BFT collected tissue samples of juvenile salmon from sites on the main stem of the Lower Beaully and areas of the Belladrum and Bruiach not stocked with fry of hatchery origin. It is envisaged that these samples will eventually be analysed as part of the Scotland-wide FASMOP (Focusing Atlantic Salmon Management on Populations) project. Until the results of this analysis are available it is strongly recommended that the code of good practice issued by the Association of Salmon Fishery Boards is adhered to i.e. brood stock is collected in the same river or tributary that the progeny are destined for. As such the progeny of brood stock collected on the Lower Beaully should not, for example, be stocked in the upper reaches of the Belladrum or Bruiach.
2. Autumn parr are currently stocked on the main stem of the Lower Beaully. It would appear, however, that no assessment of the contribution to the fishery derived from this stocking practice has been made. It is suggested that fin-clipping a proportion of the stocked parr (i.e. the removal of the adipose fin) would facilitate such an assessment. Anglers capturing returning adult salmon would simply need to check for the presence or absence of the adipose fin and record if it is missing.
3. Woody debris in streams fulfils numerous ecological functions and in general it is likely to be highly beneficial to fish populations. However, on occasions such material

can form dams and prevent fish migration. In such circumstances judicious removal of some material may be prudent. It is suggested that the N&BFT should undertake annual walk-up surveys of the Belladrum, Bruiach etc to monitor woody debris build up and other potential obstructions. These should be undertaken bi-annually and targeted at the period immediately prior to spawning and the commencement of the annual smolt run. The repositioning of such material would require liaison with the relevant landowners.

4. The upper reaches of the Belladrum, if they are to continue to be stocked, would likely benefit from some habitat improvement e.g. better stock fencing, riparian tree planting in some areas etc.
5. It is not currently possible to formulate an assessment of the areas of the Belladrum, Bruiach etc that would benefit from stocking. It is suggested that maximum benefit from salmon stocking is obtained by utilising areas that do not already have a juvenile salmon population. As the burns are currently stocked annually it is not possible to derive accurate distributions of natural spawning activity and identify areas where little or no spawning activity takes place and could hence be stocked if required. It is suggested that stocking should not take place in some years in order to allow distributions to be better understood via electro-fishing surveys.

Lower Beaully Summary Table

Due to the lack of information on natural distribution the following assumes that all available habitat is utilised by salmon as a result of natural production and artificial stocking.

Section	Accessible Wetted Area m²	Natural Smolt Production Estimate	Inaccessible Wetted Area m²	Suitable Stocking Habitat	Stocking Required	Additional Smolt Production
Lower Beaully	376,212	11,286	?	?	?	?
Belladrum	55,075	1,652	?	?	?	?
Bruiach	69,250	2,078	?	?	?	?
Black Burn etc	29,900	897	?	?	?	?
Total	530,437	15,913				

Chapter 2 Middle Beaully – Kilmorack Dam to Aigas Dam (including Breakachy and Alt an Aifrinn).

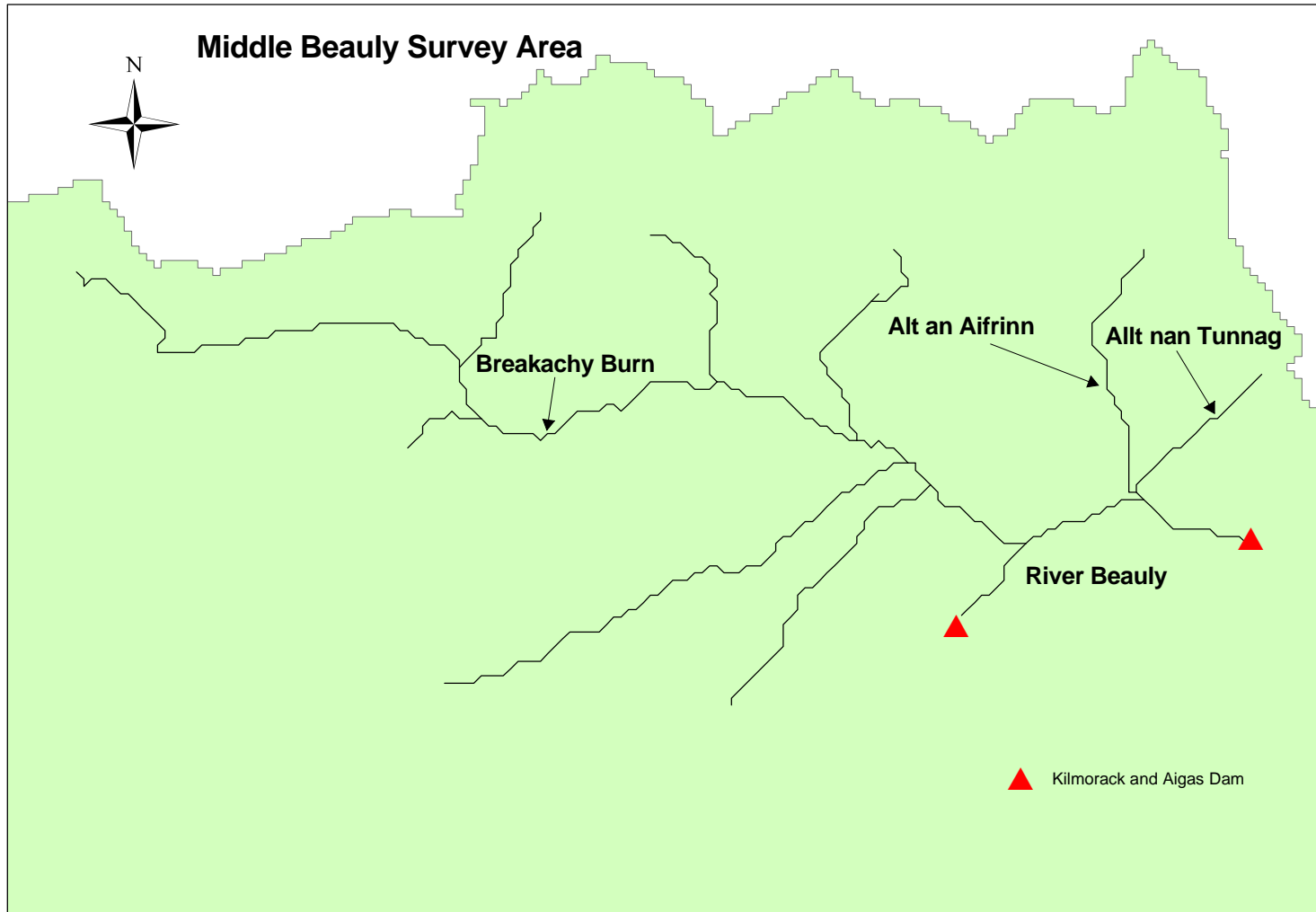
General Description.

The main stem of the River Beaully forms the vast majority of the wetted area between Kilmorack and Aigas Dams. Several small tributaries enter from the left bank (looking downstream). This includes the productive Breakachy Burn (often known as the Teanassie Burn). This section is likely to have been radically altered by the installation of the two dams. Indeed, much of this section resembles a loch as seen in plate 12 below. This section supports a limited rod and line fishery for salmon.

Plate 12 Looking upstream from the top of Kilmorack Dam.



Figure 3 The River Beauly and associated burns between Kilmorack and Aigas Dams.



Section 1 River Beauly between Kilmorack and Aigas Dams.

This section is characterised by slow moving, deep water and would appear to act as a loch except in certain conditions. The wetted area is considerable in size (approximately 165,000m²) but appears to afford little in the way of suitable habitat for juvenile salmon in particular. No electro-fishing has been undertaken in this section of river due to the logistical difficulties involved in surveying deep and wide rivers and lochs.

Plate 13 Looking downstream from Aigas Dam.



Section 2 Breakachy Burn.

This is the only burn of major importance that enters the middle Beauly. Habitat in the lower reaches of the burn is largely of good quality and this is reflected by electro-fishing results from a site immediately upstream of the road bridge which consistently records very high densities of salmon fry. Fish assemblage in this burn is diverse with salmon, trout, eels, minnows and lamprey all historically featuring in surveys. A large, vertical waterfall forms a barrier to upstream fish migration approximately 650m upstream of the confluence of the Breakachy with the Middle Beauly (Plate 14). It is suggested that this will form a formidable obstacle for the downstream migration of smolts (stocking of juvenile salmon is currently undertaken in the upper reaches of the Breakachy Burn) as damage is likely to be incurred by individuals dropping downstream. Physical damage to smolts is likely to seriously impinge on the future survival of smolts in both the remainder of the freshwater phase and the marine

phase of their life cycle. Below the waterfall, available habitat is generally of very good quality for salmon with areas highly suitable for salmon parr interspersed with areas suitable for fry.

Immediately upstream of the impassable falls there are a series of other smaller waterfalls and the burn remains within a gorge section. However, further upstream of this gorge section the habitat improves and the substrate becomes more suitable for juvenile salmonids. It should be noted that as with many of the upland areas surveyed in the Beaully catchment, over-grazing by deer appears to limit vegetation cover. Provided smolts migrating to the sea can survive passage over the waterfall illustrated in Plate 14 there is potential for stocking juvenile salmon in a number of sections above the major waterfall. However, the type of stocking that can be employed is likely to be limited by access issues. Salmon fry and parr can generally only be transported in oxygenated tanks and vehicular access to a reasonable distance from the river bank is needed. Stocking currently takes place in the uppermost reaches of this burn. Electro-fishing results for this stocked area have been positive historically although the area stocked is relatively small in size. There is potential for access to some of the areas that the NBFT understands is not currently stocked and it is suggested that salmon fry could be introduced into such areas. However, it is recommended that this should only be done in conjunction with an assessment in respect of the survival of salmon smolts over the falls and subsequent marine survival. If the outcome of the assessment is positive then other stocking techniques such as the construction of artificial redds in areas without easy vehicular access could be considered.

Considerable numbers of adult salmon attempt to access the Breakachy Burn for spawning purposes and indeed broodstock have been collected from this burn. Examination of the data provided by Scottish & Southern Energy (S&SE) from their new Mk 11 fish counters (these provide an image for each individual fish count or 'event' as it is termed) suggests that there is a considerable difference in counts at Kilmorack and Aigas which is not reflected in the availability of good quality habitat within the section, although it must be noted that usage of deep and slow river sections and lochs by salmon parr, is not fully understood. The reasons for the apparent discrepancy remain unknown. Similarly, it is not known if the lower reaches of the Breakachy Burn retains a genetically distinct salmon population.

Plate 14 Vertical waterfall on Breakachy Burn.



Section 3 Alt an Aifrinn.

This is a small burn that provides a relatively small area of productive habitat. Historical electro-fishing data suggests that the burn is utilised by juvenile salmon. Less than 1000m² is available for migratory fish before a large waterfall is reached (Plate 15). The burn is typically narrow and areas upstream of the falls appear to offer little stocking opportunity.

Plate 15. Steep waterfall on Allt an Aifrinn.



Section 4 Allt nan Tunnag.

This burn is similar to Allt an Aifrinn in that it offers only a limited amount of habitat. The burn rises steeply and the substrate is largely dominated by bedrock. A waterfall is also present on this burn which will prevent migration to all but a small section close to the confluence with the Middle Beauly.

Recommendations.

1. The area upstream of the first major waterfall on the Breakachy Burn offers considerable opportunity for stocking. However, continued stocking should only take place after an evaluation of the survival of smolts passing over the waterfall as there is scope for considerable damage to occur. Stocking should also take cognisance of the results of the genetic sampling undertaken by N&BFT. Should increased stocking of this burn be desirable then the construction of a permanent trap in the lower reaches of this burn should be considered in order to facilitate the collection of broodstock.
2. All burns between Kilmorack and Aigas Dam appear to be highly volatile in nature and contain large amounts of woody debris. Whilst such debris is largely beneficial in nature for aquatic species including fish, timber jams can occur which act as barriers

to migration, both upstream and downstream. It is suggested therefore that the burns are regularly checked for such barriers by the N&BFT.

3. The disparity between the fish counts at Kilmorack and Aigas requires further investigation. It is suggested that N&BFT attempts to investigate this potential problem, if possible.

Middle Beauly Summary Table

Section	Accessible Wetted Area m²	Natural Smolt Production Estimate	Inaccessible Wetted Area m²	Suitable Stocking Habitat m²	Stocking Required	Additional Smolt Production
Middle Beauly	165,416	4,962	-	-	-	-
Breakachy	3,800	114	11,737	11,510	34,530 Fry	345
Afrinn	975	29	-	-	-	-
Tunnag	100	3	-	-	-	-
Total	170,291	5,108	11,737	11,510	34,530 Fry	345

Chapter 3 Upper Beaully (including Eskadale and Erchless burns).

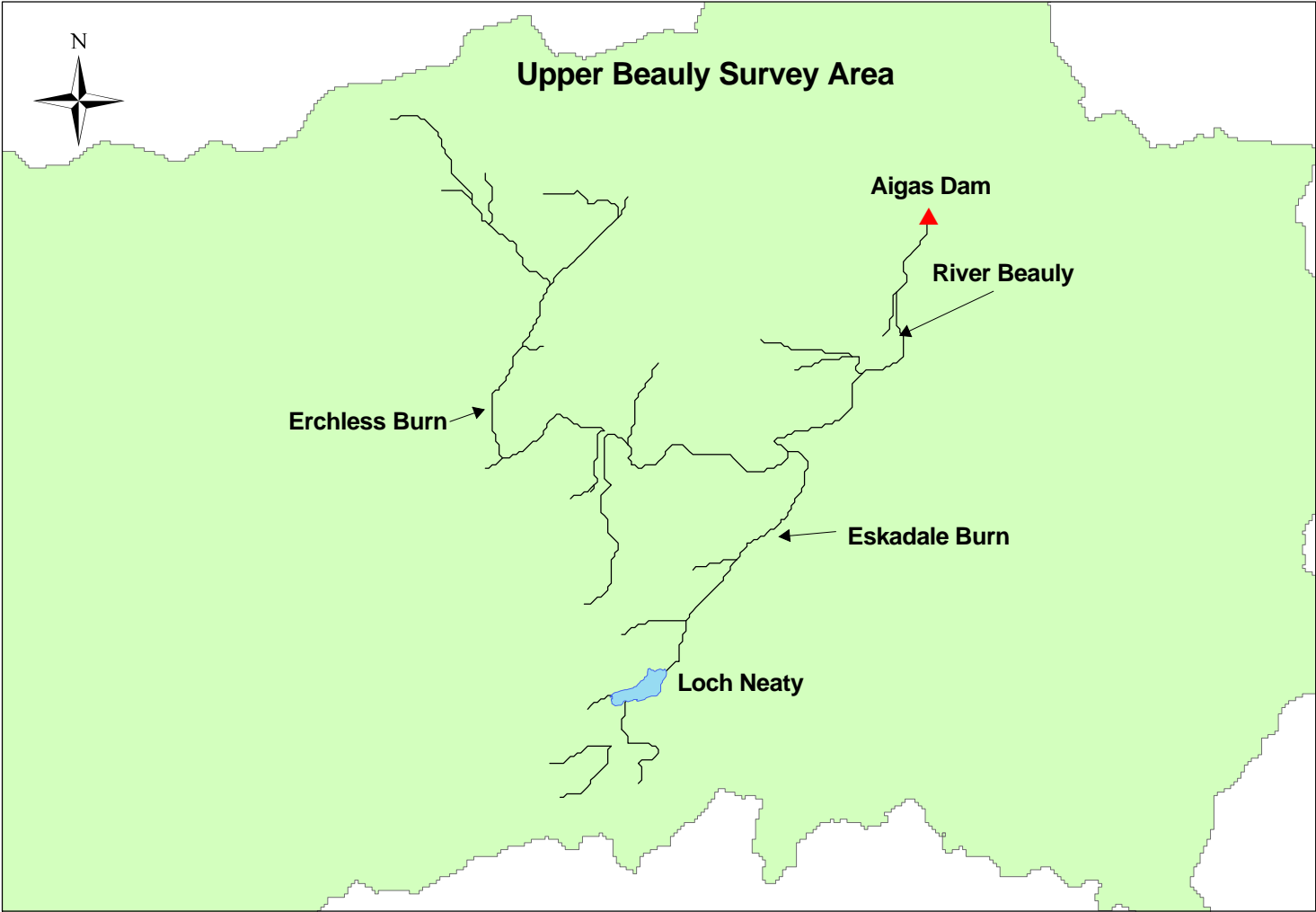
General Description.

The main stem of the Upper Beaully begins upstream of Aigas Dam and is largely characterised by deep and slow moving water although the habitat improves in the upper reaches of the section, particularly in the area close to the junction with the River Farrar. The junction with the Farrar represents the upstream extent of the Upper Beaully. It is likely that the flow characteristics of this section have been greatly altered by the construction of Aigas and Kilmorack dams. The Upper Beaully supports a rod and line fishery for salmon. There are two tributaries of major importance in this area, namely Eskadale and Erchless although neither support fisheries.

Plate 16 Slow moving section of the Upper Beaully.



Figure 4 River Beauly upstream of Aigas Dam to junction with the River Farrar.



Section 1 Upper Beaully.

The Upper Beaully immediately upstream of Aigas Dam is similar in nature to a loch i.e. deep with little or no perceptible movement. Substrate features etc are therefore obscured. Access to the section downstream of Aigas Island is difficult due to the gorge-like nature of the area. Depth is dominated by areas in excess of 80cm and deep pool is the dominant flow characteristic for most of the Upper Beaully. Where depths are shallower and substrate is visible it would appear that considerable amounts of sand are present. Some habitat conducive to salmon production, both in terms of spawning and juvenile nursery areas, is present in the Upper Beaully. The habitat of best quality within this section is to be found in the vicinity of the confluence of the Upper Beaully with the Farrar (for approximately 800m downstream of the confluence) although there are pockets of good habitat elsewhere.

No records of electro-fishing are held for this section by the Ness and Beaully Fisheries Trust and much of the area is logistically difficult or impossible to survey due to the depth of water. However, juvenile salmon were seen by the surveyors whilst the habitat assessment was taking place. It is likely that most of the available habitat of requisite quality is being utilised by juvenile salmonids in this section.

Plate 17 Slow moving water with extensive reed beds.



Section 2 Eskadale Burn.

The Eskadale Burn has been historically utilised for salmon aquaculture and has suffered from problems associated with escapees and disease. Electro-fishing surveys in the lower reaches of the burn, however, suggest that it is currently productive, particularly in respect of salmon parr. It is the understanding of N&BFT that historically there was an agreement with the fish farming interests that stocking with juveniles would not be carried out by the wild fishery interest in this burn. Habitat available to migratory fish is currently restricted by the presence of a large waterfall approximately half a kilometre upstream of the confluence of the Eskadale with the Upper Beauly. Upstream of the road bridge, which is located in close proximity to the impassable fall, there are intensive forestry plantations for much of the burn's length.

Plate 18 Good salmon parr habitat on the lower reaches of the Eskadale Burn.



Upstream of the impassable waterfall there is a section of further waterfalls and a considerable amount of bedrock for approximately 1.2km prior to the burn running through a flatter section for approximately 2km up to the outlet of Loch Neaty. Several weirs are also found in the section just upstream of the road bridge presumably resulting from the use of the burn for aquaculture purposes and a small dam also exists at Loch Neaty. The substrate size generally decreases in the flatter areas and the stretch appears to offer some potential for

stocking, although in some areas habitat would appear to be more suited to parr rather than fry production. Neither the weirs nor the waterfalls would appear to represent significant obstacles for downstream passage of smolts if salmon were to be stocked in the burn. Some areas of substrate suitable for spawning were also identified although this tended to be found in relatively small pockets.

Access to the burn is reasonable in most areas due to the presence of forestry tracks. However, care would need to be taken to ensure that juvenile fish could safely be transported to the area for stocking. Alternatively, salmon eggs could be placed in artificial redds in some areas making transportation less of an issue.

Plate 19 Area of Eskdale Burn offering potential for salmon stocking.



Section 3 Erchless Burn.

The Erchless Burn joins the Upper Beaully a short distance downstream of the confluence of the latter with the River Farrar and flows through the grounds of Erchless Castle in its lower reaches. The burn is characterised by a series of waterfalls the first of which is approximately 750m upstream of the confluence with the Upper Beaully. This waterfall may be passable under certain flow conditions but a number of waterfalls further upstream will limit the degree of penetration of migratory fish to a relatively small area.

Electro-fishing results for this burn have been routinely disappointing in terms of salmon fry abundance although parr numbers have generally been more encouraging. The burn appears to suffer from considerable over-shading by riparian trees in places and also has large quantities of rhododendron (an alien species). Over-shading and infestation by rhododendron can lead to a lack of light reaching burns and reduce overall productivity. It would appear that the Erchless burn is particularly prone to timber jams which can lead to difficulties in fish migration if not routinely monitored.

Plate 20 Section of lower reaches of the Erchless Burn with little light penetration due to a high percentage of canopy cover. Note the rhododendron bush encroaching over the burn in the foreground.

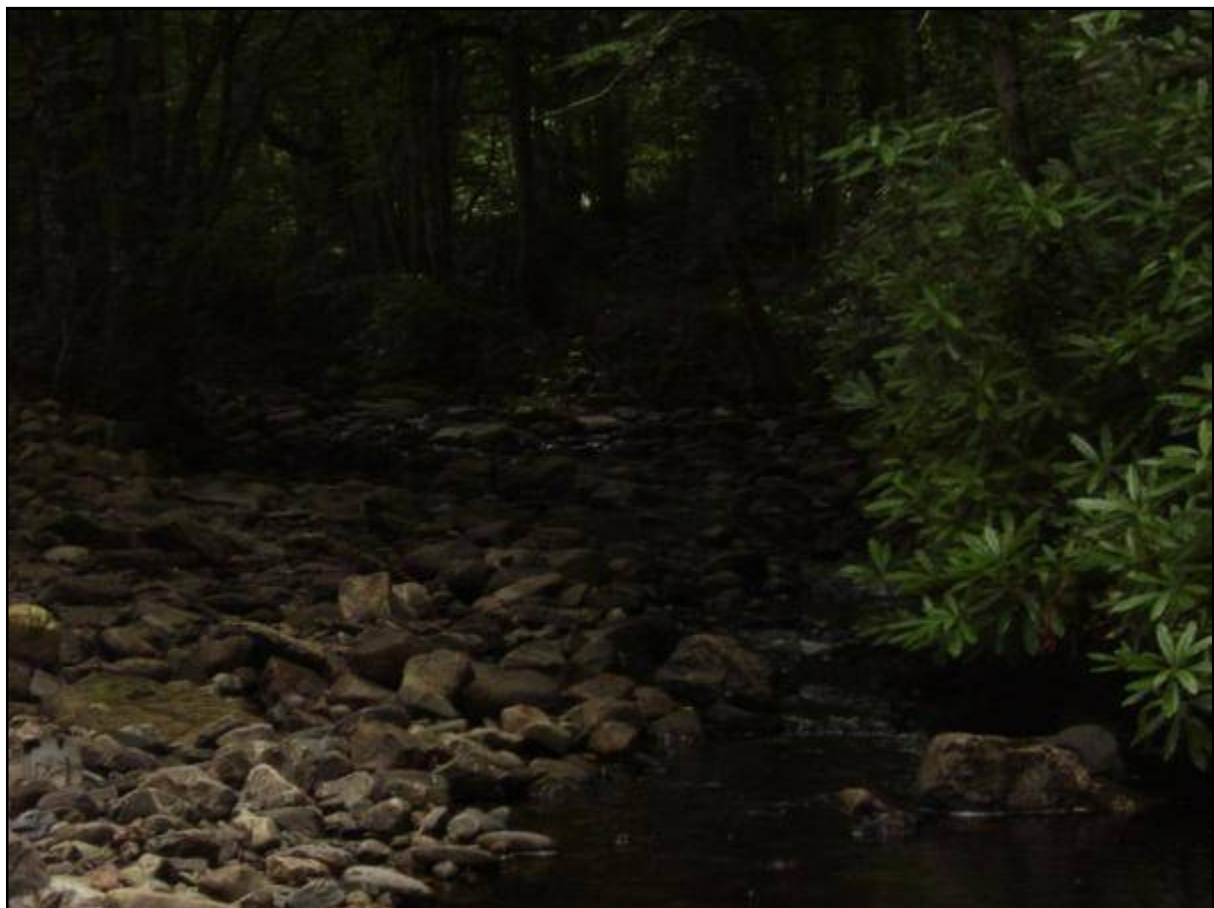


Plate 21 Log jam on Erchless Burn.



The Erchless Burn contains a considerable amount of habitat that is currently not accessible to migratory fish due to the presence of natural impassable barriers. However, the majority of this habitat is of a poor quality in that the substrate comprises predominately of bedrock and boulder. An exception to this is a relatively small area of good habitat in the Allt na Traighean tributary and a section of the Erchless downstream of Loch Fada. These areas are annually stocked with hatchery fry. The upper reaches of the Erchless is also characterised by commercial forestry plantations although the effects of this on water quality etc, if any, are unknown.

Recommendations

1. The Upper Beaully appears to offer little in the way of stocking opportunities due to the limited amounts of nursery habitat available and the general dearth of good quality habitat.
2. The Eskadale Burn has some suitable areas of habitat available upstream of an impassable waterfall. This could be stocked with fry or eggs subject to the logistics of accessing the suitable areas. Cognisance should be taken of the results of genetic sampling prior to this taking place.

- 3.** The Erchless Burn is unlikely to be currently achieving its maximum potential and would be likely to benefit from better riparian management. Grants are potentially available from Scottish Rural Development Programme and similar funding sources in order to remove rhododendron, for example. It is suggested that the N&BFT approach the owners of the Erchless Burn with a view to developing a suitable project. Limited stocking could be continued upstream of the impassable falls subject to the results of the genetic sampling undertaken by N&BFT.

Upper Beaully Summary Table

For the purposes of this assessment, the accessible area of the Erchless is considered to be the first waterfall.

Section	Accessible Wetted Area m²	Natural Smolt Production Estimate	Inaccessible Wetted Area m²	Suitable Stocking Habitat m²	Stocking Required	Additional Smolt Production
Upper Beaully	839,576	25,187	-	-	-	-
Eskadale	2,875	86	10,875	5,625	16,875 Fry or 2,813 Parr	169
Erchless	2,650	80	7,400	4,350	13,050 Fry	130
Total	845,101	25,353	18,275	9,975	29,925 Fry or 13,050 Fry and 2,813 Parr	299

Chapter 4 Farrar System.

General Description

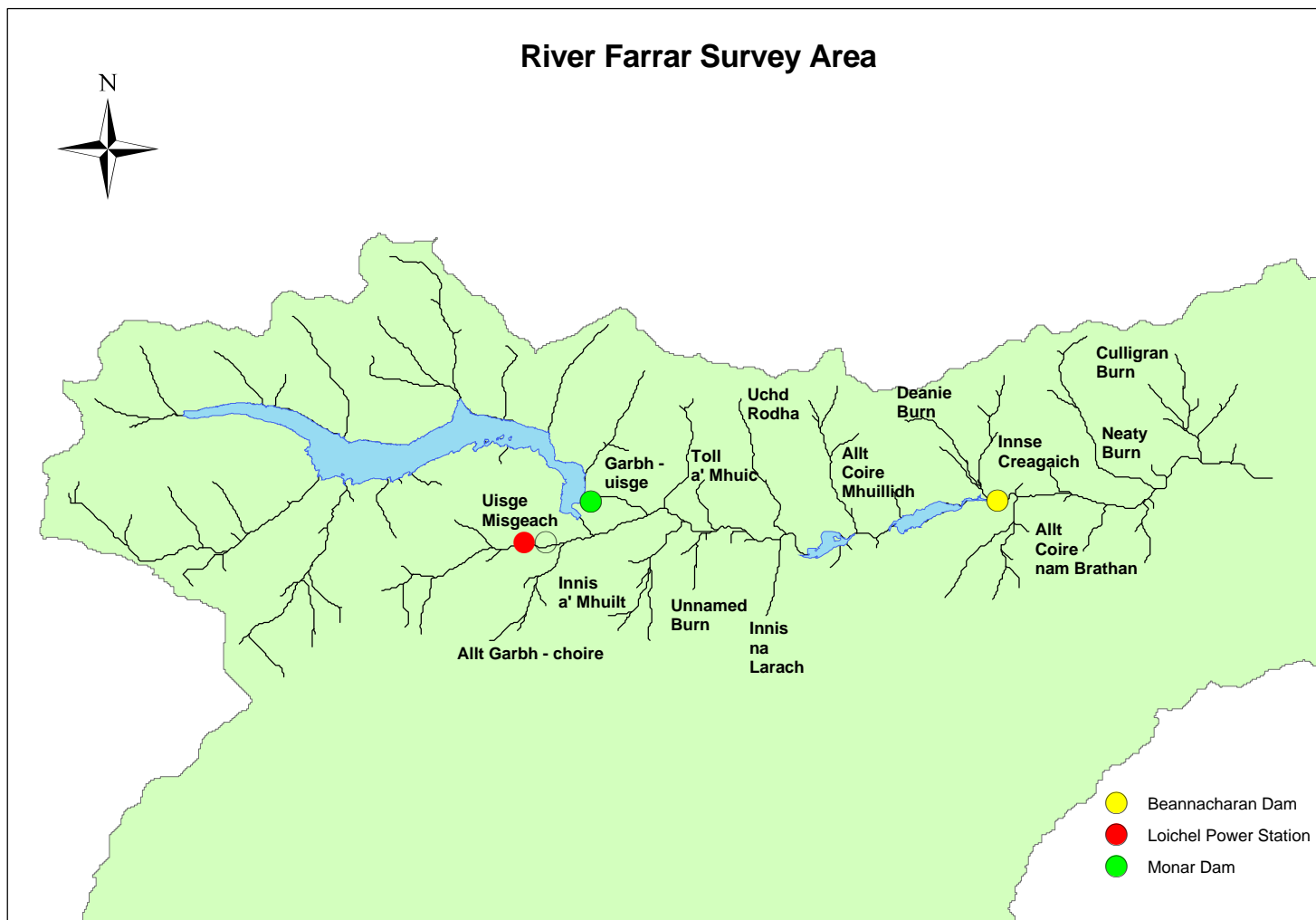
The Farrar represents a large sub-catchment within the Beaully system and supports a significant rod and line fishery. Habitat is particularly varied in the Farrar system with large areas of high quality spawning and juvenile habitat interspersed with rocky gorges, falls and lochs. Anecdotally, it is the belief of some that the Farrar was traditionally an important area for early-running salmon although there would appear to be little in the way of corroborating evidence to substantiate such claims.

The Farrar has been extensively impacted by the installation and operation of hydro-electric schemes operated by Scottish & Southern Energy (S&SE). In particular, some sections of the Farrar system have been heavily abstracted and indeed little or no flow is evident in some tributaries. In recent years, two tributaries of the system have been re-watered by Scottish and Southern Energy and data held by N&BFT suggests that re-colonisation of these areas by salmon has been successful.

During the habitat survey conducted on the Farrar, surveyors paid special attention to those areas currently de-watered in order to quantify the areas within the catchment that could potentially be re-colonised by salmon if adequate flows were restored. For the purposes of this report, emphasis has been placed on de-watered burns that could be re-colonised without the use of stocking of salmon, although some consideration is given to sites that are presently inaccessible but could produce salmon if they were stocked with juveniles. For the purposes of this report a generic figure of 3 smolts per 100m² has been applied although this may well be conservative when considering potential high quality habitat in relatively small tributaries. It should also be noted that it has been assumed that any river flows restored would re-water the entire width of river bed that is currently dry. This may not be the case in practice, however.

The Farrar system is not currently stocked with juvenile salmon although historically stocking has taken place. Electro-fishing surveys conducted by N&BFT appears to suggest an upward trend in juvenile salmon abundance in recent years and indeed data from the fish counter at Beannacharan Dam appears to suggest an increase in the numbers of adult salmon returning to the upper reaches of the Farrar system.

Figure 5 Map of the Farrar system showing major tributaries.



Section 1 Junction of Farrar with Upper Beaully to Beannacharan Dam.

Lower Farrar

The main stem of the River Farrar contains large areas of highly suitable habitat for juvenile salmonids, including spawning areas. Some electro-fishing has been undertaken on the main stem of the River Farrar (all timed fishings due to the large width of the river) and the capture of salmon fry and parr in these surveys suggests that available areas are utilised by spawning salmon and juvenile fish. In total the wetted area of this section is in excess of 175,000m². Due to the compensation flow and freshet regime operated by S&SE and current levels of knowledge of how flow levels impact on juvenile salmon recruitment there would appear to be no scope for increasing the productivity of this section by altering flows at this time. Many of the small burns that enter the River Farrar from the south were dry/very low during the survey. Much of the Farrar in this area appears to be heavily grazed by livestock and could probably benefit from improved stock fencing.

Plate 22 River Farrar close to junction with Upper Beaully.



Culligran Burn

The Culligran Burn is an important tributary of the Farrar system. Regular electro-fishing surveys have been undertaken in the lower reaches of this burn which suggest a high degree of utilisation of the available habitat. Areas suitable for spawning are present in the burn. It is not known, however, how far adult and juvenile salmon penetrate the upper sections of the burn. Approximately 750m upstream of the confluence of the Culligran Burn with the Farrar, the burn splits into several branches and begins to rise steeply. It is unlikely that salmon will utilise habitat upstream of this point to any great degree. A wetted area of approximately 3,000m² is likely to be utilised by salmon in this burn. The Culligran Burn is not affected directly by S&SE operations and there would appear to be little scope for improving juvenile salmon production.

Plate 23 Culligran Burn looking upstream towards Culligran House.



Neaty Burn

The Neaty Burn is heavily impacted by S&SE activities with areas of both low flows and dried up river bed evident. However, it is likely that the salmon productivity in the burn has always been limited due to the presence of a series of waterfalls that commence approximately 100m upstream of the confluence with the River Farrar. Examination of historical electro-fishing data suggests that the small amount of available habitat is utilised by

juvenile salmon although it has been noted on some occasions that fishing has not been possible due to extreme low water conditions. Wetted area currently easily accessible for salmon is approximately 450m² but this could be increased by approximately 1,000m² if a compensation flow was established upstream and the compensation flow was sufficient to cover the full bed width. A small section of suitable habitat is available upstream of the waterfalls prior to the burn entering a narrow gorge area. Out of a total area of approximately 1,100 m², around 300 m² is suitable for juvenile salmon production. Upstream of the gorge section, an area of dry river bed is evident due to the presence of a S&SE dam. The length of dried up river is approximately 1km. Measurements of the dry river bed suggest a mean width of around 10m although widths were highly variable. If re-watered, this suggests that an additional 10,000m² could be made available. The substrate in this section would appear to be suitable for juvenile salmonid production if it was re-watered but the section would require to be stocked due to the presence of the waterfalls downstream. The area upstream of the S&SE dam could only be utilised if smolt passage facilities were installed in the dam structure.

Plate 24 Very low flow on the Neaty Burn.



Plate 25 Waterfall on Neaty Burn.



Innse Creagaich

This is a very small burn but electro-fishing data suggests that it does contain salmon in its lower reaches. When surveyed, only approximately 1m of the bed width was wetted on average. The burn narrows even further upstream of the area surveyed and salmon are unlikely to penetrate far upstream. A bridge apron near its junction with the River Farrar is also likely to prevent fish movement in low flow conditions. Available wetted area is approximately 300m².

Allt Coire nam Brathan

This burn was not surveyed as the lower reaches (downstream of a S&SE dam) were completely dry when surveying took place. This section is approximately 300m in length but due to the steepness of the burn and substrate size it appears to offer little potential for juvenile production even if flows were restored. Auris (1990) noted, however, that approximately 6km of suitable habitat is available upstream of the S&SE dam and a large waterfall. This area offers potential for stocking (at an assumed average wetted width of only 2m this section could offer 12,000m²) but is likely to present logistical problems in terms of access. Use of this habitat would require both the re-watering of the lower section and the provision of smolt passage facilities at the dam.

Section 1 Summary Table

	Current Accessible Wetted Area m²	Estimated Smolt Production	Productive Wetted Area After Remedial Action m²	Estimated Smolt Production After Remedial Action	Compensation Flow Required?	Stocking Required?	Fish Pass Required?
Lower Farrar	179,650	5,390	179,650	5,390	No	No	No
Culligran	3,075	92	3,075	92	No	No	No
Neaty	450	14	10,750	323	Yes	Yes	No
Innse Creagaich	325	10	325	10	No	No	No
Allt Coire nam Brathan	0	0	12,600	378	Yes	Yes	Yes
Total	183,500	5,506	206,400	6,193			

Section 2 Loch Beannacharan to Loch a' Mhuillidh.

This section consists largely of lochs with a relatively small section of river in between plus two major tributaries.

Deanie Burn

Whilst this burn is heavily abstracted by S&SE, anecdotal information and electro-fishing data suggests that the burn does not dry out. The burn decants into Loch Beannacharan close to the S&SE dam and currently provides approximately 2,100m² of wetted habitat downstream of a waterfall. Trout and minnows are routinely found in electro-fishing surveys but on only two occasions have juvenile salmon been found. Reports by Galloway Fisheries Trust have suggested that this may be caused by the lack of flow resulting in salmon not being encouraged to leave Loch Beannacharan. However, N&BFT note that a pH of 5.1 was recorded by Auris in 1990. Acidity at the level recorded by Auris is potentially fatal to salmon eggs and some juveniles. Stocking with juvenile salmon, increasing flows etc is unlikely to be beneficial given the poor water quality.

Plate 26 Deanie Burn in low water conditions.



River Farrar

This relatively short section of the River Farrar links Loch a' Mhuillidh with Loch Beannacharan. The habitat in this section is particularly varied and includes substrate suitable for spawning. An electro-fishing survey undertaken by N&BFT found several year classes of salmon, including fry, close to the junction of the Farrar with the Coire Mhuillidh burn which suggests that spawning takes place in this area. This section of the River Farrar contains approximately 15,000m² of wetted area. The section is unlikely to benefit from changes in flows etc by S&SE.

Plate 27 River Farrar upstream of Loch Beannacharan.



Coire Mhuillidh

In excess of 4,000m² is available to juvenile salmon due to the re-watering of this burn by S&SE. Electro-fishing surveys illustrate that the burn is now utilised by juvenile salmon, particularly parr. It is suggested that the close proximity of spawning areas on the River Farrar has facilitated a speedy re-colonization of this burn. A large waterfall approximately 750m upstream of the lowest reaches of the burn is likely to prevent further penetration by migrating fish. Areas upstream of the waterfall may offer some potential for salmon stocking but appears to be extremely limited in nature.

Plate 28 Re-watered section of Coire Mhuilidh.



Section 2 Summary Table

	Current Accessible Wetted Area m²	Estimated Smolt Production	Productive Wetted Area After Remedial Action m²	Estimated Smolt Production After Remedial Action	Stocking Required?	Fish Pass Required?	Compensation Flow Required?
East Deanie	2,125	0	0	0	No	No	No
River Farrar	14,850	446	14,850	446	No	No	No
Coire Mhuillidh	4,375	131	4,375	131	No	No	No
Total	21,350	577	19,225	577			

Section 3 River Farrar Upstream of Loch a' Mhuillidh to junction with Uisge Misgeach and Garbh-uisge.

This section includes two burns that are currently dry in their lower reaches due to abstraction by S&SE, plus one burn that has been re-watered and successfully re-colonized by salmon.

River Farrar

The habitat in this section is particularly varied and includes a wide and deep canal-like section that is in excess of 1.5km in length. There are, however, some areas suitable for juvenile production and salmon spawning. Overall, the wetted area of this section of the River Farrar is approximately 91,000m².

Plate 29 Slow, canal-like section of Farrar near Braulen Lodge.



Plate 30 Junction of Allt Uchd Rodha with River Farrar. The bed of Uchd Rodha (right of picture) was completely dry on the day of the survey.



Allt Uchd Rodha

The lower reaches of this burn were dry when surveyed due to abstraction by S&SE. The burn joins the River Farrar approximately 1km upstream of Loch a' Mhuillidh. The length of burn likely to be accessible by salmon if it is re-watered is approximately 500m, as upstream of this point it rises steeply. Average width of the dry river bed was approximately 7.5m. The lower reaches close to junction with the River Farrar were quite wide but the burn quickly narrowed as it became steeper. If fully wetted, the burn could provide an additional 3,750m² of habitat. Substrate in the burn is towards the larger end of the scale and is dominated by cobble and boulder. There did not appear to be any areas suitable for spawning, therefore it is likely that salmon parr would be the most likely re-colonisers of this area if it was re-watered.

Allt Toll a' Mhuic

Entering the Farrar just downstream of its junction with the Uisge Misgeach and Garbh-uisge, Toll a' Mhuic is very similar in nature to Uchd Rodha. Approximately 300m of the burn is likely to be penetrated by re-colonising salmon as upstream of this point the burn narrows considerably and rises steeply. Average width of the dry river bed is around 6m therefore if fully re-watered there is a potential habitat gain of 1,800m². Substrate is dominated by boulders and cobbles with little potential spawning. There appears to be very limited potential

for stocking above the falls as the nature of the rock structure suggests that smolts dropping downstream may suffer damage.

Plate 31 Toll a' Mhuic looking upstream from the road bridge



Allt Innis a' Mhuilt

This burn has been re-watered by S&SE and electro-fishing data suggests that some re-colonisation has taken place. A waterfall approximately 750m upstream of the junction with the River Farrar probably prevents further upstream access to both adult and juvenile salmon. An estimated 2,100 m² of habitat has been made available by the re-watering of this burn. Electro-fishing results suggest that few salmon fry are utilizing Innis a'Mhuilt but salmon parr are a more regular feature. It is possible that the salmon parr migrate to the area from the nearby main stem of the River Farrar. Due to the presence of a S&SE dam further upstream, there is limited stocking potential in areas not accessible to migrating adult salmon and habitat quality is also generally poor in the upper reaches of the burn.



Innis na Larach and Unnamed Burns

Several small burns flow into the River Farrar, entering the main stem of the river from the south. Available habitat is limited in extent and the total wetted areas before the burns rise very steeply is 1,500m². In the burns surveyed, substrate mainly consisted of gravel, pebble and cobble in the lowermost reaches, with some areas offering spawning potential.

Plate 33 Innis a'Larach.



Plate 34 Unnamed burn.



Section 3 Summary Table

	Current Accessible Wetted Area m²	Estimated Smolt Production	Productive Wetted Area After Remedial Action m²	Estimated Smolt Production After Remedial Action	Stocking Required?	Fish Pass Required?	Compensation Flow Required?
River Farrar	91,875	2,756	91,875	2,756	No	No	No
Allt Uchd Rodha	0	0	3,750	113	No	No	Yes
Allt Toll a' Mhuic	0	0	1,800	54	No	No	Yes
Allt Innis a' Mhuilt	2,100	63	2,100	63	No	No	No
Innis na Larach & Unnamed burns	1,500	45	1,500	45	No	No	No
Total	95,475	2,864	101,025	3,031			

Section 4 Garbh-uige (Junction with River Farrar to Monar Dam).

An extensive area of the Garbh-uige is virtually totally de-watered. The length of river de-watered is approximately 1.75km. Access to parts of the river bed is difficult due to the steep banks and a full assessment of habitat has not been undertaken by the Trust. A large falls exists close to the junction with the Farrar and other falls exist further upstream. Substrate is generally of a large size, consisting largely of bedrock, boulder and some cobble. It would appear that even if the river was re-watered access for adult salmon would be difficult and spawning opportunities limited. The only realistic management option for a re-watered section would appear to be stocking with juveniles, although even this would present logistical difficulties due to access problems. Assuming an average wetted bed width of 25m, re-watering the Garbh-uige would increase available habitat by 43,750m². Given the quality of the substrate, smolt production estimates for this section may be highly optimistic.

Plate 35 Looking downstream from Monar Dam (Garbh-uige).



Section 4 Summary Table

	Current Accessible Wetted Area m²	Estimated Smolt Production	Productive Wetted Area After Remedial Action m²	Estimated Smolt Production After Remedial Action	Stocking Required?	Fish Pass Required?	Compensation Flow Required?
Garbh-uisge	0	0	43,750	1,313	Yes	No	Yes
Total	0	0	43,750	1,313			

Section 5. Uisge Misgeach and Allt Doire nan Gillean.

Habitat in the lower reaches of the Uisge Misgeach is characterized by large substrate size, including sections of exposed bedrock, and areas of deep glide and pool. As such, it is suggested that the lower reaches of the Uisge Misgeach offer limited habitat for juvenile salmon. Electro-fishing data held by the N&BFT suggests that the upper reaches of the Uisge Misgeach, however, are utilised by spawning salmon and provide significant nursery habitat for both fry and parr. Spawning areas and juvenile salmon are present a short distance downstream of a waterfall close to Loichel Power Station. Electro-fishing was undertaken in the area just downstream of the waterfall by N&BFT in 2008 and both salmon fry and parr were captured. Even if salmon are able to ascend the waterfall, a weir at Loichel Power Station probably prevents further upstream access. The section represents approximately 30,000m² of wetted area habitat.

Upstream of Loichel Power Station (Allt Doire nan Gillean) there would appear to be limited scope for salmon stocking. Approximately 1km of potential habitat is available between Loichel Power Station and the junction of Allt Doire na Feithe and Allt Doire nan Gillean. This section is largely dewatered due to the presence of a S&SE diversion dam and substrate is generally of a poor quality. Upstream of the diversion dam the burn rises very steeply with large waterfalls that would potentially pose problems for downstream smolt migration. There are also a number of waterfalls further downstream of the diversion dam that would be likely to pose problems for downstream migration. Stocking above the diversion dam would require the construction of a fish pass and the re-watering of the section of the burn between the dam and Loichel power station.

Allt Garbh-choire

The lower reaches of this burn are affected by abstraction for S&SE activities. However, a large waterfall close to its junction with the Uisge Misgeach suggests that it has always had little value in terms of the provision of habitat for salmon. On the day of inspection, flow was negligible. An inspection of areas upstream of the falls suggests that it has little to offer in the way of stocking opportunities. Both re-watering and smolt passage facilities would be required to take advantage of the habitat available should this be considered desirable.

Plate 36 Productive juvenile salmon habitat on the Misgeach.



Plate 37 Dry river bed upstream of Loichel Power Station.



Plate 38 Large waterfall upstream of diversion dam on Allt Dorie nan Gillean.



Section 5 Summary Table

	Current Accessible Wetted Area m²	Estimated Smolt Production	Productive Wetted Area After Remedial Action m²	Estimated Smolt Production After Remedial Action	Stocking Required?	Fish Pass Required?	Compensation Flow Required?
Uisge Misgeach	25,425	763	25,425	763	No	No	No
Allt Doire nan Gilleán	0	0	4,800	144	Yes	No	Yes
Garbh-choire	0	0	0	0	No	No	No
Total	25,425	763	30,225	907			

Recommendations

1. S&SE activities impinge on the productive potential of the River Farrar system at a number of locations. In particular, there are several sections that are dry except during periods of heavy rain. The most seriously affected tributaries of the Farrar system that would once have provided habitat for salmon are the Neaty Burn, Uchd Rodha and Toll a' Mhuic, with the latter two burns offering the most readily accessible habitat if re-watering took place. In addition, N&BFT have little information regarding salmon distribution prior to the construction of the hydro- schemes, therefore it is not known if Garbh-Uisge and the area of the Uisge Misgeach upstream of Loichel power station were once utilised by salmon. Estimated smolt production from the current wetted area of the Farrar produced by this report is 9,710 based on a generic figure of habitat productivity of 3 smolts per 100m². Re-watering of Uchd Rodha and Toll a' Mhuic would, all other things remaining equal, potentially increase smolt production by 167 to 9,877, an increase of 1.7%. Given marine survival of salmon smolts of 5-10% this may equate to 8-16 adult returning fish. Should existing compensation flows be required to be altered elsewhere in order to facilitate the re-watering of any burns, it is suggested that careful consideration be given to the potential effects on production in the relevant sections of river. In particular, it is clear from electro-fishing data that the Uisge Misgeach is a productive area of habitat and the results of any alterations to flow in this area would need to be carefully monitored.
2. Much of the assessment of the potential smolt output is based on a generic figure derived on a neighbouring catchment. However, when considering smaller tributaries this may well be an underestimate. It is therefore suggested that the N&BFT increase monitoring of the two burns already re-watered in order to obtain an improved estimate of smolt production.
3. Some of the River Farrar would probably benefit from improved quality of riparian buffer zones in order to reduce over-grazing and increase vegetation levels. This would, of course, require the co-operation of the owners.
4. It is likely that the Farrar presents little in the way of opportunity for the artificial stocking of salmon juveniles. Given that there are a number of lochs, waterfalls etc on the Farrar system it is also likely that the overall salmon stock is composed of a number of discreet populations. Tissue samples were obtained from juveniles at a number of locations in 2008 and the eventual analysis of these samples should shed more light on any stock structure present. Until the results of the analysis are available the precautionary approach should be adopted and great care should be taken with any proposals to stock salmon. Collection of tissue from salmon captured in the rod fisheries within the Beauly catchment is also being undertaken. Ultimately, fish captured should be able to be assigned to their geographic region of origin. In turn this may provide an insight into any areas that are particularly utilised, for example, by early-running salmon.

Chapter 5 River Glass including Abhamn Deabhag and Glass Burn.

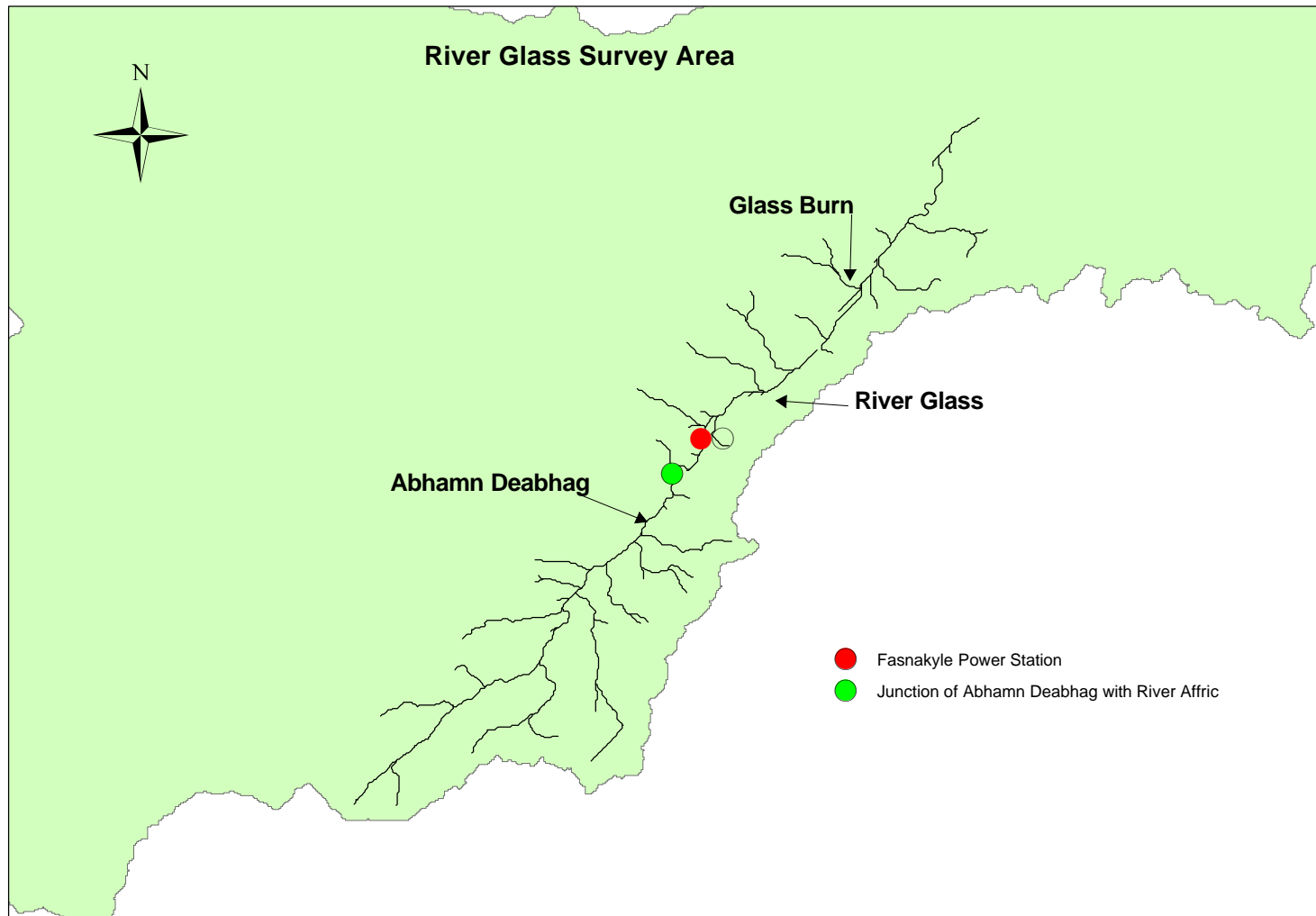
General Description

The River Glass is situated upstream of the junction of the Upper Beaully with the Farrar system. The Glass supports a rod fishery for salmon and trout fishing is also undertaken in some areas. Abhamn Deabhag is located upstream of the Fasnaklye Power Station and represents an important spawning and nursery area. Two large sub-catchments of the Beaully system enter the Glass and Abhamn Deabhag, namely the Cannich and Affric systems. These are considered individually in separate chapters. With the exception of the Cannich and Affric few other tributaries of note are found in this area, although one (Glass Burn) is known to contain salmon. Access for migratory fish is limited by the presence of a large waterfall close to Plodda on Abhamn Deabhag although there have been claims that the falls can be negotiated under certain flow conditions. Extensive areas of high quality habitat exist in the upper reaches of Abhamn Deabhag and indeed the area is currently utilised for salmon stocking. Electro-fishing data held by N&BFT, although limited in extent, suggests that the main stems of both the River Glass and Abhamn Deabhag are heavily utilised by spawning salmon.

Plate 39 River Glass at Cannich cemetery. This area has been regularly electro-fished with good numbers of salmon fry usually captured in timed fishings.



Figure 6. Map showing River Glass, Glass Burn and Abhamn Deabhag survey area.



Section 1 River Glass.

The River glass habitat is highly varied in nature. Upstream of Struy there is a deep, slow section little suited to juvenile salmon production which stretches for approximately 5km. Around Carnoch the habitat undergoes a distinct change becoming more conducive to juvenile salmon production. The channel of the Glass is braided in many areas and there are a number of islands present. The Glass also appears to be prone to erosion with banks being undermined in some areas and there are also some small areas of trampling by livestock. These could potentially be remedied by judicious tree planting which may help to consolidate banks and the use of fencing to restrict livestock access to the river.

Some electro-fishing data is available for the River Glass. The site close to Cannich Cemetery (see Plate 39) has been fished on a regular basis since 2000 and the 2008 results were highly encouraging with a high catch per unit of effort for salmon fry. Parr numbers appear to be particularly consistent at this site. Timed electro-fishing was undertaken at several sites on the River Glass for the first time during 2008, particularly in the area just downstream of Glass Burn. Salmon fry were abundant in areas of suitable habitat although parr were less evident. Most of the sites chosen were more suited to fry production, however. The results of the electro-fishing, although based on few sites, suggest that natural spawning in the River Glass is likely to be adequate to utilise the available habitat and that there would be little benefit in the stocking of juvenile salmon.

Plate 40 Erosion combined with trampling by animals on River Glass.



Section 2 Glass Burn

The Glass Burn is one of the few notable tributaries of the Glass system although a large impassable waterfall limits access for migratory fish to approximately 500m. The height of the waterfall would preclude the stocking of juveniles upstream. The Glass burn contains a good mix of substrate and flow types and is thus suited to both trout and salmon fry and parr. There appears to have been some man-made alterations made to the lower reaches of the burn, presumably in an attempt to divert the direction of flow. It is not known when this alteration took place.

Electro-fishing has been undertaken on this burn for a number of years. Results have been variable over time but numbers of juveniles appear to have declined in recent years. It is possible that the alterations in the lower reaches of the burn have limited access to spawning adults.

Plate 41 Glass Burn.



Section 3 Abhamn Deabhag

Upstream of Fasnakyle Power Station there is a section of river dominated by bedrock and waterfalls prior to the habitat improving. There is a considerable area of high quality habitat for juvenile salmon in the section from the junction of the main stem with the River Affric to the village of Tomich. High quality habitat is also found upstream of Tomich village. However, there is a long gorge section, with difficult access for habitat surveying, which stretches for just under 2km upstream of Plodda Falls. Just downstream of Plodda Falls is a large waterfall on the main stem which is believed to be impassable. Habitat improves in the region of Cougie although some forestry plantations encroach on riparian habitat. It is understood by N&BFT the area around Cougie is stocked with salmon fry. The area represents ideal habitat for the stocking of such fish. Upstream of Cougie the river narrows significantly and flows through open moorland before eventually rising steeply.

Plate 42 Upper reaches of Abhamn Deabhag. Tree planting is taking place on the right bank.



Recommendations

1. Much of the river Glass appears to be well stocked with fry of natural origin. Further electro-fishing surveys should be conducted, but currently it appears that there would be little benefit in stocking juvenile salmon in this section.
2. Erosion could potentially be reduced by judicious tree planting or soft engineering techniques.
3. N&BFT have discussed the potential problem of the alterations to the lower reaches of the Glass Burn with the owner. Remedial action may be undertaken in the future.
4. Abhamn Deabhag represents good quality habitat and it is suggested that stocking is maintained and perhaps increased in this section. As with other areas stocked within the Beaully catchment, however, it is suggested that methods of assessing the contribution of stocking to the fishery be investigated by N&BFT. This is particularly important where large waterfalls are present as there appears to be little in the scientific literature regarding survival of salmon that have to undergo downstream passage of such features. Cognisance of the likelihood of genetic stock structuring should be taken if broodstock are being collected for subsequent stocking operations.

River Glass Summary Table

Section	Accessible Wetted Area m²	Natural Smolt Production Estimate	Inaccessible Wetted Area m²	Suitable Stocking Habitat m²	Stocking Required	Additional Smolt Production
Glass	951,665	28,550	-	-	-	-
Glass Burn	1,750	53	-	-	-	-
Abhamn Deabhag	90,900	2,727	48,275	17,450	52,350 Fry	524
Total	1,044,315	31,330	48,275	17,450	52,350 Fry	524

Chapter 6 River Cannich (including Allt Coiltie).

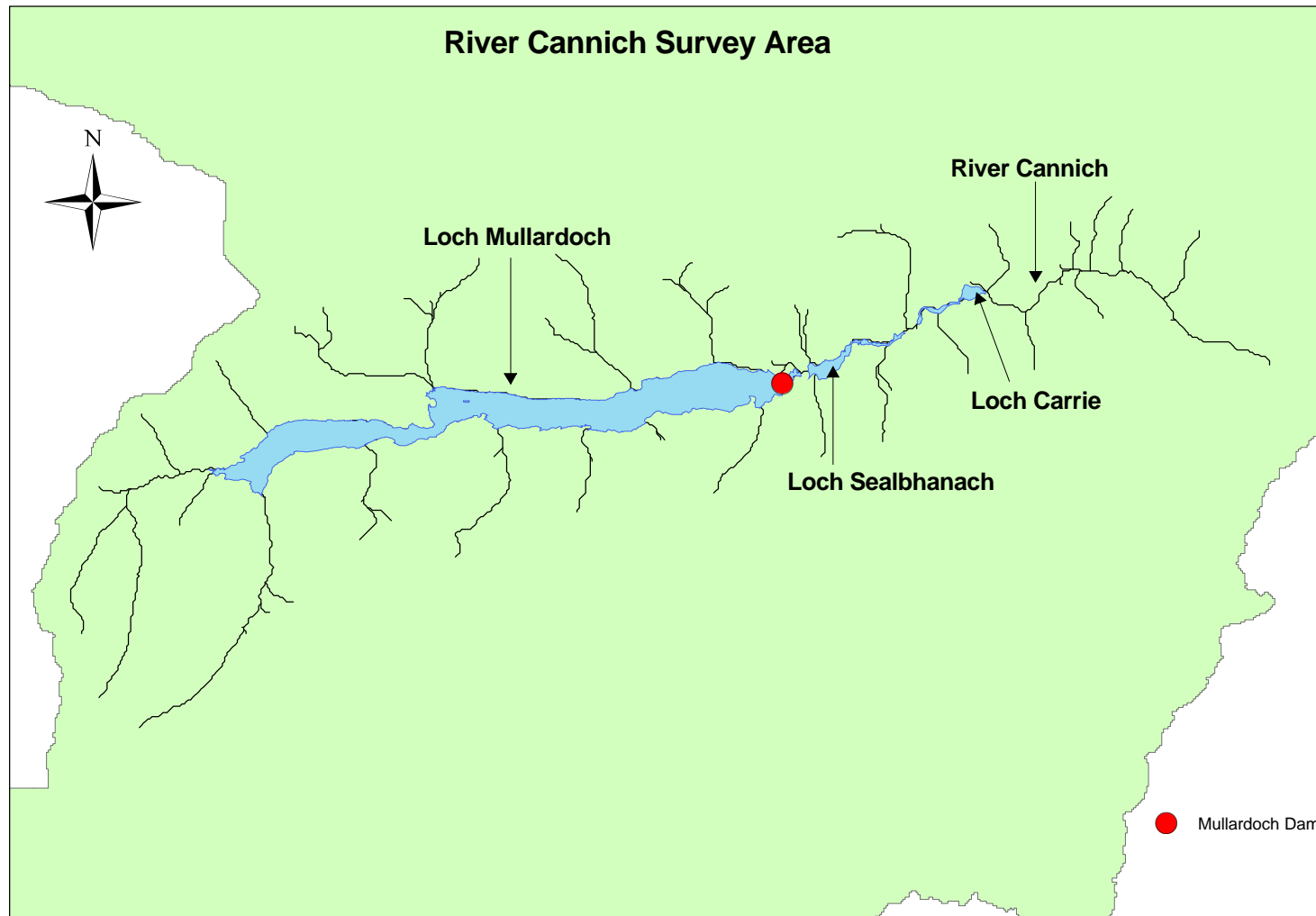
General Description.

The River Cannich enters the River Glass just downstream of Cannich Village. The lower reaches of the river are characterised by a low gradient section that can potentially be utilised for spawning. In the vicinity of Cannich village a small tributary, Allt Coiltie, joins from the left bank looking downstream. The River Cannich does not appear to support any significant rod and line salmon fishery. A number of lochs are present on the system, including several downstream of Mullardoch, a large dam constructed and operated by S&SE. No fish passage facilities are available at Mullardoch. The middle reaches of the River Cannich have extensive afforested areas with large plantations. It is not known if this has affected water quality. A series of large waterfalls upstream of Cannich village appear to limit distribution of salmon. Fish assemblage in the Cannich is diverse, particularly in the lower reaches, with salmon, trout eels and lamprey all being recorded historically.

Plate 43 Gorge section and waterfall on the River Cannich.



Figure 7 Cannich system including lochs.



Section 1 River Cannich

The lowest reaches of the Cannich contain areas conducive to juvenile salmon production, including some substrate suitable for spawning. Substrate for approximately 750m is dominated by cobble with riffle and run flow patterns dominant – ideal for salmon fry and parr. Progressing upstream the habitat deteriorates with bedrock and boulder dominating substrate. A short distance upstream of Cannich access to the river becomes difficult due to the steep nature of the river bank. Within the gorge section there are a series of waterfalls although it is difficult to assess them individually due to difficulties in gaining access to the river. Access to the river becomes easier upstream of the gorge section and in this area there are some sections that could potentially be stocked. Many of the sections that could be stocked, though, are relatively fast with large substrate. This is likely to preclude the successful stocking of salmon fry with salmon parr more likely to be successful. There are many areas of deep water with concomitant slow flows which are unlikely to be productive if stocked and several lochs in the upper reaches of the Cannich. The latter will contain trout populations which are likely to predate on migrating salmon smolts. There are also a number of lochs on the system. Overall, good quality juvenile salmon habitat appears to be at a premium in this river and it would appear to be more suited to trout production.

Plate 44 Potential parr habitat in the upper reaches of the Cannich.



Electro-fishing results for the Cannich appear to suggest that it has a relatively small population of salmon in its lower reaches. Stocking has historically been undertaken

upstream of the waterfalls but data held by the N&BFT would suggest that this was not successful. The reasons for this are unknown.

Section 2 Allt Coiltie.

The Coiltie is a minor tributary of the Cannich that flows just to the east of Cannich village. A small section of burn is available to migratory fish prior to an impassable waterfall. The burn has large substrate for the most part but does contain some habitat suitable for juvenile salmon production. The presence of salmon was confirmed in 2006 when N&BFT conducted timed fishings. The area upstream of the waterfall appears to offer little in the way of opportunities for the stocking of salmon.

Plate 45 Allt Coiltie near the village of Cannich.



Recommendations

1. If the Cannich is stocked above the waterfalls in the future, it is suggested that salmon parr be utilised rather than fry as the habitat is more suited to the latter. In the absence of any evidence to the contrary, it should be assumed that the Cannich has a distinct salmon population and any stocking programme should therefore be tailored to preserving genetic integrity.

2. Close monitoring of the results of any stocking programme would be required.

River Cannich Summary Table

Section	Accessible Wetted Area m²	Natural Smolt Production	Inaccessible Wetted Area m²	Suitable Stocking Habitat m²	Stocking Required	Additional Smolt Production
Cannich	26,250	788	171,750	46,375	23,188 Parr	1391
Coiltie	600	18	-	-	-	-
Total	26,850	806	171,750	46,375	23,188 Parr	1391

Chapter 7 River Affric.

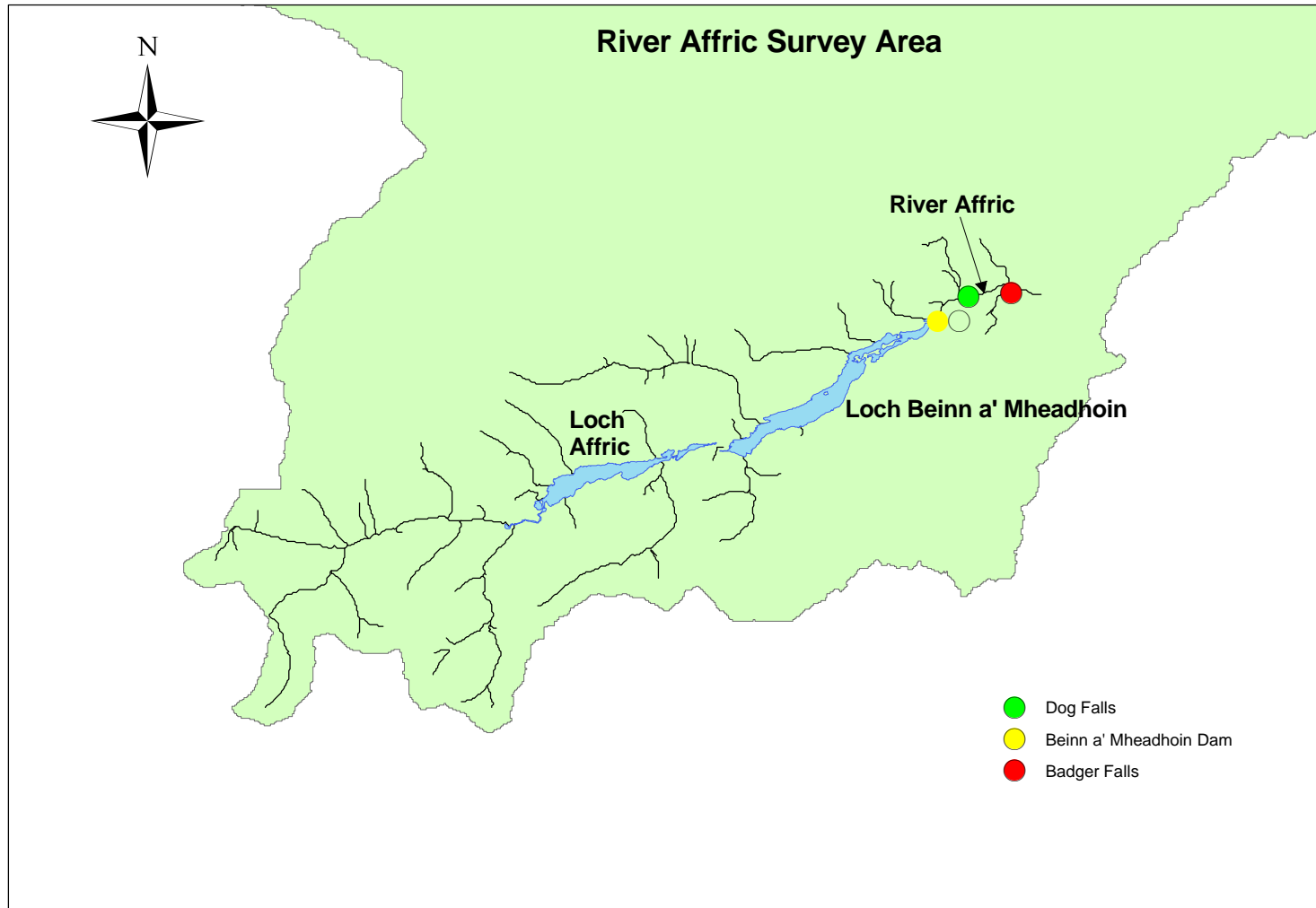
General Description.

The Affric system is broadly similar to the Cannich in that it has a relatively low gradient section in its lower reaches, a section of gorge with impassable waterfalls and is dammed by S&SE further upstream. No fish passage is available at the dam. There are also areas of forestry containing both commercial plantations and native species. The Affric joins the River Glass/Abhamn Deabhag between the village of Tomich and Fasnakyle Power Station.

Plate 46 Typical section of River Affric close to Dog Falls.



Figure 8 River Affric



River Affric.

Substrate in the lower reaches of the Affric (a length of approximately 650m) is of a reasonable quality containing pebble, cobble and boulder. However, upstream of the lower reaches is a gorge section in which access for surveying is difficult. Access to the upper reaches of the Affric is easier due to a network of paths heading downstream from Dog Falls. Habitat quality is largely very poor as substrate is dominated by bedrock and boulder and there are sections of deep pool interspersed with sections characterised by very high velocity flows. There are, however, relatively small sections of better quality habitat upstream of Dog Falls offering some areas reasonably suitable for juvenile salmonid production.

It is the understanding of N&BFT that a limited amount of stocking is carried out in the areas of reasonably suitable habitat upstream of Dog Falls. Electro-fishing results have historically been largely very poor in the stocked areas of the Affric. There is a paucity of electro-fishing data for the lower reaches of the River Affric, however both salmon fry and parr were found in electro-fishing surveys conducted by N&BFT in the summer of 2008. This suggests that salmon spawning may take place in the lower reaches of the river.

Recommendations.

1. Given the paucity of good quality habitat it is suggested that stocking should be discontinued on the Affric system or maintained at low levels. However, if stocking does continue then it is suggested that stocking with salmon parr rather than fry would be likely to be more successful. This would require to be fully monitored. Cognisance should be taken of the potential genetic integrity of the Affric salmon population.

River Affric Summary Table

Section	Accessible Wetted Area m²	Natural Smolt Production	Inaccessible Wetted Area m²	Suitable Stocking Habitat m²	Stocking Required	Additional Smolt Production
Affric	17,750	532	72,375	6250	18,750 Fry or 3,125 Parr	188
Total	17,750	532	72,375	6250	18,750 Fry or 3,125 Parr	188

Chapter 8 Conclusions

The habitat survey undertaken by the Ness & Beaully Fisheries Trust during the summer of 2007 and 2008 have highlighted a number of key areas of possible remedial action that can be undertaken in the future. Firstly, improved management of woody debris in many of the tributaries of the Beaully system is required. Large woody debris generally has considerable benefits for the aquatic environment, including fish, but in certain circumstances barriers to fish migration can be formed. As such, monitoring of such debris is required in order to ensure that migration of both smolts and adults is readily achieved. This is particularly important given that many salmon are stocked in the higher reaches of tributaries and therefore have considerable distances to complete their migrations within the freshwater environment.

Riparian habitat could also be improved in a number of areas within the Beaully system. Poaching of river banks by livestock is evident in some areas, particularly the upper reaches of the Belladrum and parts of the River Glass. This can usually be limited by fencing. The presence of alien species such as rhododendron on the Belladrum and Bruiach is likely to lead to problems of over-shading of riparian habitat and consideration should be given to the removal of these species where practicable. In some areas of the Farrar system livestock and deer also appear to be cropping riparian vegetation down to low levels. However, it is likely that the cost of fencing in such large areas would be prohibitively high. The Erchless Burn suffers from general over-shading and large quantities of rhododendron as well as potential problems with blockages caused by large quantities of woody debris. It is likely that the careful removal of some of the canopy cover will increase the productive potential of this burn.

The River Farrar habitat has suffered in a number of areas due the development of hydro-electric schemes. It would appear that the de-watering of a number of burns has decreased, in particular, the amount of habitat available for salmon and trout parr. It may well be the case that in the future such areas come under increased scrutiny as part of the Water Framework Directive. As such it is vital that fisheries interest are kept at the forefront of the process. The Ness & Beaully Fisheries Trust will continue to respond to consultations etc from SEPA and will actively engage in the provision of data to inform classification processes, proposed remedial actions etc in the future.

Stocking of salmon on the Beaully system has been undertaken for many years. An increasing body of evidence suggests that artificial stocking of salmon has the potential to have negative impacts on wild salmon populations as well as positive influences. The majority of this evidence surrounds the structuring of salmon into distinct populations both between and within river systems. This has led to the development of a code of good practice by the Association of Salmon Fishery Boards and Rivers and Fisheries Trusts Scotland. Currently, the majority of the salmon stocked within the Beaully system are done so within the guidelines as laid down in the code of good practice although it is likely that in the future some alterations to stocking practices will have to be made in order to fully conform to the guidelines. N&BFT collected in excess of 1000 fin clips from juvenile salmon during the summer of 2008. These will ultimately be analysed by the Scotland-wide FASMOP project and it is expected that the results of the project will greatly inform the management of salmon stocks within the Beaully catchment particularly in relation to artificial stocking.

A considerable proportion of the salmon stocked on the Beaully are introduced in areas that are upstream of natural barriers to migration such as waterfalls. This is based on the premise that survival rates of introduced juveniles will be maximised in areas that do not already contain juveniles that are the result of natural spawning activity. However, it would appear that the natural distribution of salmon within the Beaully system has never been fully established, particularly in the lower tributaries of the Beaully such as the Belladrum and the Bruiach and their associated tributaries. It is likely that there will be considerable inter-annual variation in the extent of upstream penetration by spawning salmon and sea trout in these tributaries and that this variation will itself be a function of flow magnitude. Due to the stocking of juveniles in the upper reaches of these tributaries it is not currently possible to obtain meaningful data on the distribution of naturally spawned fish. Until a better understanding of the natural distribution of migratory fish in these tributaries is obtained it is suggested that stocking will be inherently inefficient in nature. In addition, it makes an assessment of the numbers of salmon to be stocked and the likely results of any stocking highly problematical.

The stocking programme as currently undertaken does not appear to have undergone any assessment with regard to the contribution made to the fishery by such measures. Electro-fishing surveys have been undertaken periodically to ascertain if juveniles have survived but little consideration appears to have been given to the ultimate fate of these fish. Given that stocking programmes rely on the removal of adult salmon from the natural spawning population it is strongly suggested that attempts be made to ensure that an appropriate assessment of the contribution to the fishery of any stocking practice is made if possible. This is particularly important when stocking is undertaken in areas upstream of very large waterfalls as damage inflicted to smolts passing over such obstacles may impinge on their survival.

The majority of salmon stocking that is currently undertaken is in the form of fed fry, with the exception of the stocking of autumn parr in the lower reaches of the Beaully system. The approach of putting juveniles out at early stages of the life-cycle is largely to be encouraged as it gives the longest period for natural selection to take place. However, it would appear that certain sections of the river, if continued stocking is considered to be desirable, may benefit from the introduction of salmon parr rather than fry. This is a function of the large size of substrate and powerful flows which are unlikely to be conducive to fry survival. Examples of this type of habitat can be found on the River Cannich and River Affric. The rearing of salmon parr has, of course, economic implications given the greater amount of rearing time and extra food, husbandry etc associated with their production in the hatchery.

The addition of the estimated smolt production figures for the habitat upstream of areas currently accessed naturally by salmon suggests that approximately 2,700 smolts could be produced by the artificial stocking of such areas (not including the Belladrum and Bruiach where natural distributions are currently unknown). This assumes that all wetted areas are sufficiently accessible to enable artificial stocking to take place. Data from the neighbouring Conon system suggests that marine survival of salmon smolts is currently in the order of 5-10%. Extrapolating from this estimate would in turn suggest that in the region of 135-270 adult returning salmon could be expected from the smolts produced by an increased stocking programme. However this would require the increased collection of broodstock, the majority of which would have spawned naturally and would have contributed to the natural smolt run and in turn the fishery to some extent had they been allowed to do so.

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