Monitoring of the River Dee Fishery Season Extension 2010

The River Dee Trust

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Executive Summary

The River Dee was granted a licence in 2008 to extend its rod and line fishing season from 30 September to 15 October for a trial period of three years, from 2008-2010. This extension period operates under the Dee Conservation Code which requires that all caught salmon and sea trout be returned. This is a report of the final year of the three year monitoring programme to assess the potential impact of angling in October on Dee salmon stocks.

After a pilot monitoring study in 2008, full monitoring of the season extension in the Lower Dee (downstream of Banchory) was undertaken in 2009 (this was reported on separately in 2010) and in 2010 full monitoring was undertaken in the Middle Dee (between Aboyne and Banchory), which is the subject of this third report. The four methods used to assess the impact of the October fishery on the salmon stocks were: rod catch analysis; scale sampling; radio tracking of individual salmon; and redd count surveys.

894 grilse and Multi Sea Winter (MSW) salmon were caught in the October 2010 fishing extension period (10% of 2010 rod catch), as well as 45 sea trout. 99.6% of October-caught salmon were released (compared to a return rate of 97.7% for the rest of the season). The majority of fish caught in the Middle Dee (Aboyne Bridge – Banchory Bridge) in September and October were coloured/stale (73%). The Lower Dee (Banchory Bridge – Aberdeen harbour) had a significantly greater proportion of fresh (silver) salmon than the Middle Dee in both September and October. However, the proportion of fresh/silver fish in the Lower Dee fishery did decline between September and October.

There was no difference in the proportions of grilse and MSW salmon caught in September and October. MSW salmon dominated the Middle Dee fishery in this autumn period but grilse had a slight majority in the Lower Dee. There was also no difference in the composition of the September and October fisheries in terms of spring salmon and summer/autumn salmon. For both months, the proportion of spring salmon in the fishery was low (4% confirmed plus 8% that were spring or early summer entrants).

60 fish that were caught by anglers in the Middle Dee were radio tagged. Tracking of these fish found no significant difference between the movements of fish that were captured, tagged and released in the last two weeks in September compared to fish caught, tagged and released in the first two weeks of October; 71% of all tagged fish migrated further upstream, 12% showed little directional migration (less than 2 miles up- or down-stream) and 18% migrated downstream. The distribution of fish that were captured and tagged in September and October did not differ significantly; overall, approximately half of the tagged fish remained in the Middle Dee for spawning and half migrated into the Upper Dee (above Aboyne Bridge). The time at which the tagged fish reached their final (spawning) destinations also did not differ for fish tagged in September and October; both groups reached their destinations, on average, in the second week of November.

Redd count surveys highlighted that spawning occurs earlier in the Western catchment. At sites in the Upper River (sites west of Dinnet), spawning started the fourth week of October and in some tributaries peak spawning also occurred in October. In the Middle and Lower Dee, spawning started only slightly later, in the first or second week of November. However, previous surveys show that spawning in the Middle and Lower Dee may continue much later into the winter period than in the Upper Dee.

There was no evidence that, in the Middle Dee, capture and handling of salmon in the October extension period had any impact on fish survival or ability to migrate for spawning, compared to the capture of fish in the last two weeks of September. There was no evidence that different stocks of fish were being targeted in the October fishery compared to the September fishery and there was no evidence that different stocks (particularly the spring salmon stock) were differentially impacted by being caught in the Middle Dee fishery. Therefore the overall conclusion is that extending the angling season in the Middle Dee to 15 October will cause no greater impact than continuing with the current angling season which finishes on 30 September and thus will not impact on fish stock sustainability.

This report, together with a summary report for the three year monitoring period, is presented to the Dee DSFB in March 2011 so that a decision on whether to apply for a permanent extension to the fishing season can be made.

Contents

Introduction

In 2007 the Dee DSFB applied to the Scottish Government to extend the angling season from 30 September until 15 October for a trial period of three years (2008-2010). Following a public consultation, in which more than 109 out of 129 responses were in favour of the trial, the trial extension was granted from 2008. The October fishing extension would allow fishing beats to benefit from the increasing autumn runs of salmon that the Dee has been experiencing since the 1980s (Fig. 1). In particular, numbers of multi sea winter (MSW) salmon entering the Dee in August and September, and the number of one sea winter salmon (1SW; grilse) entering the Dee from June to September, has increased (River Dee Trust 2006).

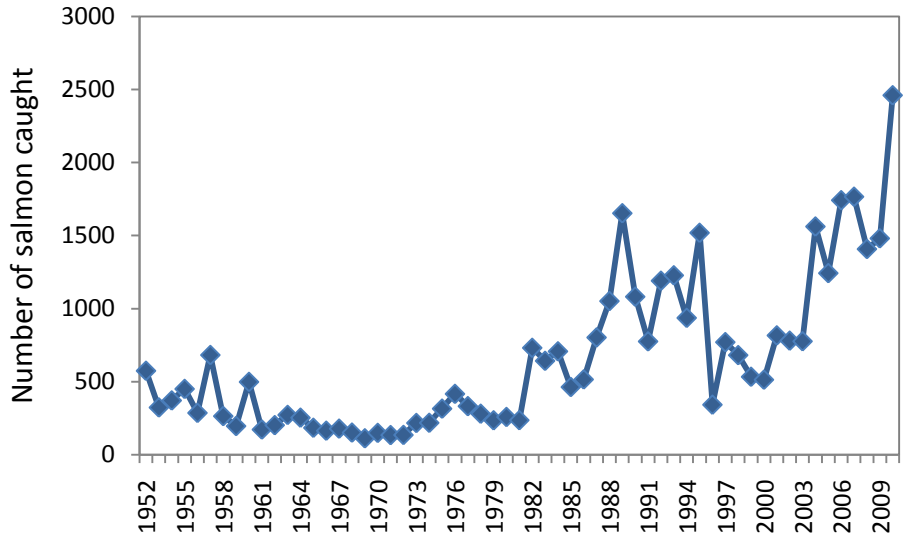


Figure 1. Rod catch of MSW salmon and grilse on the Dee in September, 1952-2010.

The October fishing extension was requested for a trial period only. During the three trial years, monitoring was undertaken to determine whether fishing in October is sustainable or whether it has any potential to harm the Dee salmon stock. To this extent, it is essential that the Dee Conservation Code policy be maintained during the season extension period; in particular that all salmon and sea trout caught are released. The Dee DSFB monitored adherence to the Conservation Code closely during the trial. The decision on whether to make the fishing extension permanent will be based on the findings of the monitoring.

The trial extension period encompasses the whole river but was restricted to downstream of Aboyne Bridge (i.e. the Middle and Lower Dee). This restriction was placed because of evidence from redd count surveys that spawning occurs earlier (starting late October) in the Upper Dee. There is also evidence from radio tracking studies on several rivers that salmon that enter the river earlier tend to penetrate further into the catchment (e.g. Saunders 1967, Laughton & Smith 1992). The upstream limit was thus designed to minimise impact on Spring salmon and early-spawning fish.

The pilot study conducted in 2008 was primarily to test the logistics of running a radio tracking programme (RDT 2009). Of the 20 salmon radio tagged in October 2008, there was no evidence of

subsequent mortalities. Therefore in 2009 (RDT 2010) and 2010 a full radio tagging programme was undertaken, designed to compare fish radio tagged in September with fish tagged in October such that any potential impacts of capture and handling salmon in October, relative to any impact in September (the traditional angling period), could be identified. In 2009 the radio tracking concentrated on fish captured in the Lower Dee (downstream of Banchory) and in 2010 concentrated on fish captured in the Middle Dee (between Aboyne and Banchory).

In 2009 and 2010 the aims of the season extension monitoring were:

1 To assess whether fish caught by rod and line and released in the first two weeks of October have the same chance of successfully surviving to spawn as those caught in the last two weeks of September.

2 To determine if Aboyne Bridge is the correct upstream limit of the season extension.

3 To determine what stocks of salmon are being caught in the first two weeks of October and whether there is an impact on the more vulnerable stocks of spring-running salmon.

The first two elements of the monitoring programme were undertaken through a radio tracking programme and redd count surveys. A salmon scale survey and rod catch analysis addressed the third element of the programme.

In the following sections of this report the four methods of data monitoring (fishing records, scale analysis, radio tracking, redd counts) and the results obtained are analysed.

Rod catch analysis

Introduction

To allow an assessment to be made on whether there can be a viable October fishery it is necessary to establish what the rod catch is likely to be in the October period. This includes information on the number of salmon and sea trout caught in October (collected by the Dee DSFB). It also includes the colour (freshness) of the fish caught in October, as this may have some bearing on the viability of an October fishery. To this end, the RDT conducted a survey to assess autumn rod catches from a business perspective. Note, though, that fish colouration does not indicate time until spawning and such inference cannot be made.

Methods

Numbers of fish caught in October were collated and are provided below. In addition, ghillies and angling club representatives covering 17 fishing beats recorded information on all fish caught between 16 September and 15 October 2010. This allowed a comparison to be made of rod catch in the last two weeks of the traditional season with the two weeks of the trial extension. In particular, colour of fish caught was recorded, categorised as either: sea liced; silver; clean; coloured; or very coloured.

Records of 379 salmon caught in the October extension (42% of total October rod catch) and 398 salmon caught in the last two weeks in September (32% of this period's rod catch) were taken by the participating ghillies and angling club representatives.

Results

Statutory catch returns reported a total of 894 salmon caught in the October extension period, of which 63% were caught in the Lower Dee and 37% in the Middle Dee. A total of 45 sea trout were also caught in this period. 99.6% of salmon caught in October were released (1.9% higher release rate than for February - September 2010) and 95.6% of the sea trout caught in October were released (2.5% higher release rate than for February - September 2010).

A comparison of the rod catch in the Middle Dee (between Aboyne and Banchory Bridges) and the Lower Dee (downstream of Banchory Bridge) showed a significant difference in the colour of fish caught in these river sections, for both time periods (shown statistically; chi square; Figs. 2 and 3). In the Middle Dee there were fewer silver (fresh) fish caught in both September (14% of total catch) and October (9% of total catch) compared to the Lower Dee (50% in September, 29% in October). The proportion of coloured fish caught in the Middle Dee was high in both September (71%) and October (74%) and lower in the Lower Dee (38% in September, 62% in October).

There was no significant difference in the colour of fish caught between September and October in the Middle Dee in 2010 (shown statistically; chi square), although a small statistical difference between these time periods was found in 2009 (in which more coloured fish were caught in October). In the Lower Dee there was a (statistically) increased proportion of coloured fish caught in October compared to September in 2010 (which was not found in 2009).

Overall, catches in 1 - 15 October in the last three years in the Middle Dee have averaged 18% silver or clean and 82% coloured salmon. For the Lower Dee, 43% of the salmon have been classed as silver or clean and 58% as coloured.

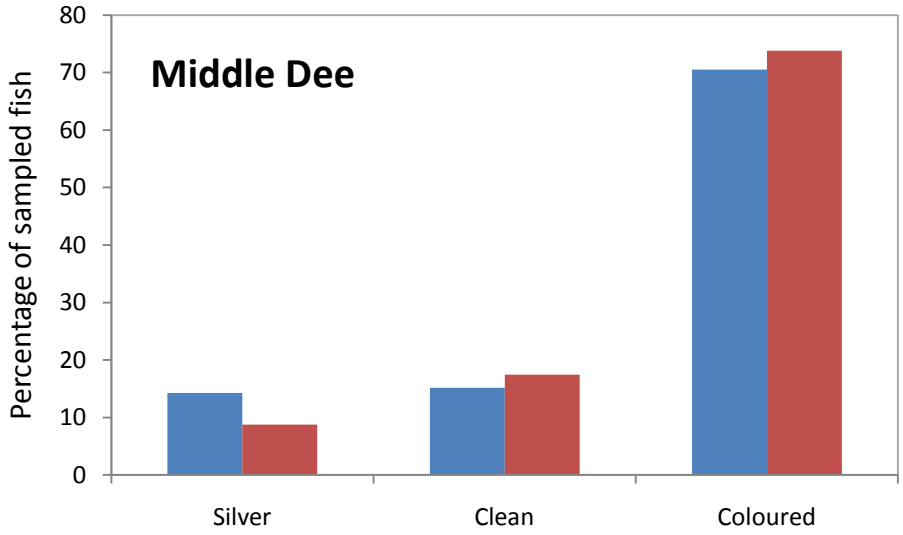


Figure 2. Colour of salmon and grilse (silver, clean or coloured) landed in the Middle Dee between 16 - 30 September (■) and 1 – 15 October (■) 2010.

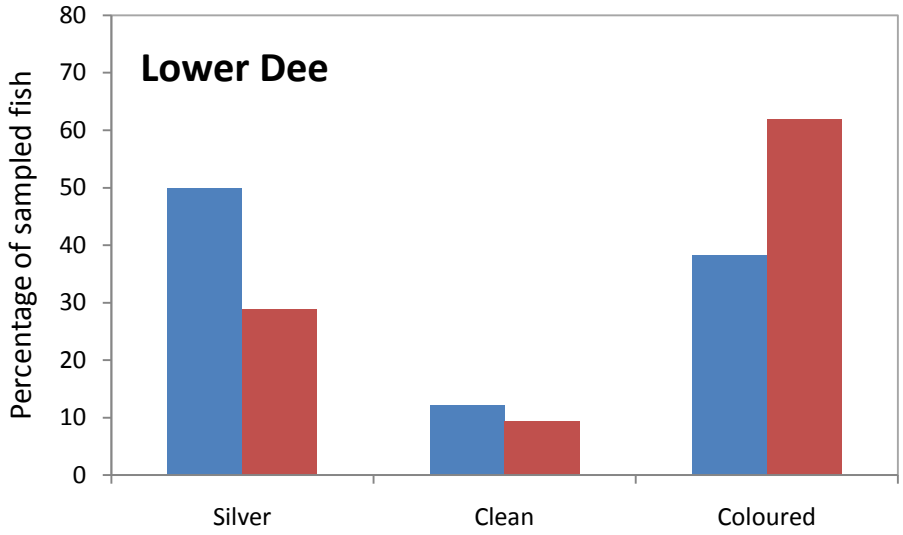


Figure 3. Colour of salmon and grilse (silver, clean or coloured) landed in the Lower Dee between 16 - 30 September (■) and 1 – 15 October (■) 2010.

The number of sea trout sampled was low (21 in September and 11 in October). 83% of these sea trout in September were classed as coloured, as were all of the sea trout sampled in October.

Conclusions

The number of salmon caught in the October extension period was high (nearly 10% of the total rod catch for 2010). Significantly more fresh (silver) fish were caught in the Lower Dee (downstream of Banchory) than the Middle Dee (between Aboyne and Banchory). There was very little difference in the proportions of coloured to non-coloured fish caught between 15 - 30 September and 1 – 15 October for the Middle Dee, but there was a small, significant increase in the proportion of coloured fish caught in the Lower Dee between 15 - 30 September and 1 – 15 October. In 2009, this difference between fish caught in the September and October periods was found in the Middle but not the Lower Dee. Together, this suggests there may be a small (and sometimes insignificant) increase in the proportion of coloured fish caught in October, compared to September, for the river downstream of Aboyne.

Such variability between years is likely to occur because of factors such as river flow levels, temperature and weather conditions prior to and during the fishing period. It is important to note that the colour of the fish does not reflect the approximate time until spawning, although it tends to reflect the length of time the fish has already spent in the river.

Scale Sampling

Introduction

Scales from salmon provide information on the fish, including the age at smolting, the number of years spent at sea, the approximate entry time into the river as an adult and occurrence of previous spawning. A fish scale reading programme was set up on the Dee by the RDT in 2008. Scale samples are collected strategically at different locations along the main stem and this relies on the support of ghillies and angling club representatives. Analysis of scales from fish caught in October will help determine what stock components comprise the October fishery, for example, grilse (1 SW salmon) versus MSW salmon, or spring versus summer runs of salmon. Note that spring salmon are fish that do not grow after their final winter at sea; scale analyses from the RDT sampling programme show that spring salmon enter the Dee before mid June ('summer' salmon may enter the river from mid May onwards).

Methods

25 ghillies, covering 26 fishing beats, collected scales from salmon and sea trout. In total, scales were obtained from 53 fish between 15 and 30 September and from 39 fish between 1 and 15 October.

Results

MSW salmon dominated the autumn rod catch in the Middle Dee, in both September (64%) and October (68%) periods, with the remainder of the catch being grilse. In contrast, grilse showed a slight majority over MSW salmon in the Lower Dee (56%; Fig. 4). This difference in rod catches of the Middle and Lower Dee was significant (statistical test; chi square). However, there was no significant difference in the proportion of grilse to MSW salmon caught in the September and October periods (statistical test; chi square).

There were no difference between the proportion of the fish that were spring salmon or summer/autumn salmon in September and October (Middle and Lower Dee combined; Fig. 5). There was slightly more 'spring or early summer' fish in October (13%) than September (4%) (Fig. 5); however, this difference was not (statistically) significant and hence could be attributed to natural/random variation.

The proportion of salmon in the Lower and Middle Dee that were spring fish or summer/autumn fish were similar (i.e. not statistically different; chi square), although there was a tendency for more fish to be assigned as 'spring or early summer' in the Middle Dee (12%) than the Lower Dee (3%), and therefore less summer/autumn salmon in the Middle Dee (84%) than the Lower Dee (93%). Overall (Middle and Lower Dee combined), 4% of the sample comprised Spring salmon, 88% comprised summer and autumn salmon and 8% could not be determined because of scale erosion, being either spring or early summer fish. 2009 saw a greater proportion of Spring salmon occurring in the Lower Dee sample (in both September and October).

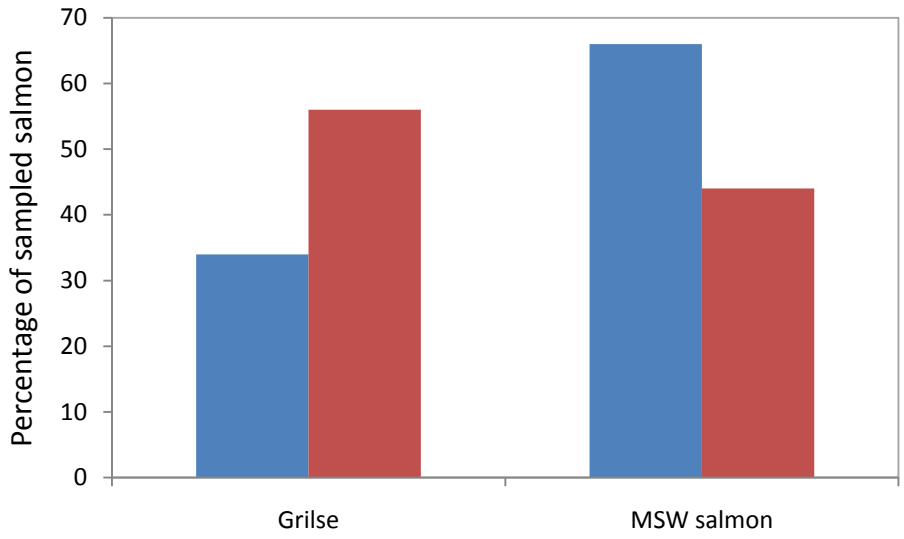


Figure 4. Percentage of grilse and MSW salmon scale sampled in the Middle (■) and Lower (■) Dee between 15 September and 15 October 2010.

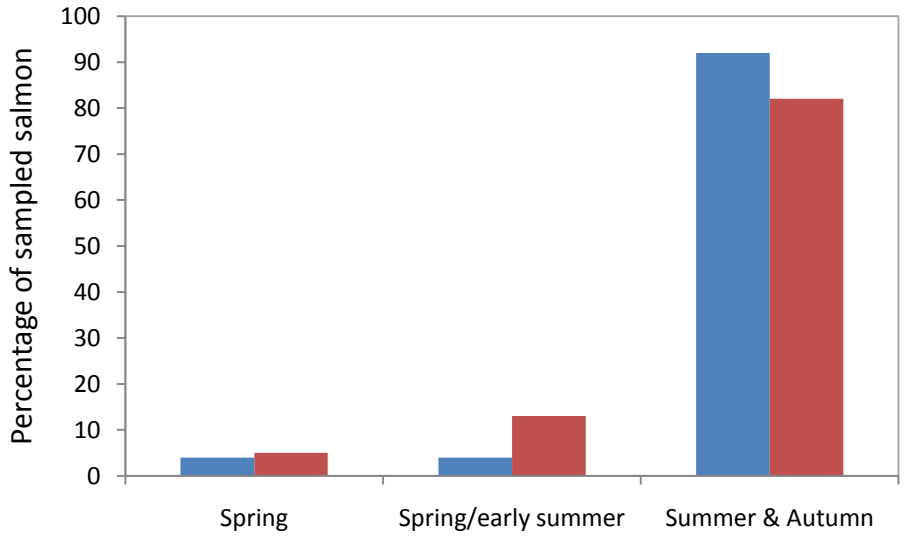


Figure 5. Time of entry into the river of salmon caught in the Middle and Lower Dee between 15 - 30 September (■) and 1 – 15 October (■) 2010.

Conclusions

There was no evidence of a difference in the stock composition of the September and October fisheries, in either the Middle or Lower Dee. The proportion of grilse to MSW salmon were consistent between September and October, as were the proportions of spring and summer/autumn fish captured in September and October.

The autumn fishery in the Lower Dee comprised a slight majority of grilse (over MSW salmon) in 2010 whereas the Middle Dee autumn fishery comprised mostly MSW salmon. In 2009, the Lower Dee had a dominance of MSW salmon, suggesting that the impact of the grilse run at the end of the season is variable.

In 2010 spring salmon comprised 4% of the autumn fishery in the Lower and Middle Dee. A further 8% of the autumn fishery comprised either spring or early summer fish, but the exact entry time could not be confirmed due to scale erosion. The proportion of spring and spring/early summer fish was significantly greater in 2009 (25%). In addition, in 2008, 2009 and 2010 there was a trend for more spring salmon and 'spring or early summer' salmon to be caught in the Middle Dee compared to the Lower Dee (but this difference was not statistically significant).

It is clear from the RDT scale sampling programme that spring salmon are captured in the autumn fishery, throughout the river. The radio tracking programme conducted in 2009 showed that spring salmon captured in the Lower Dee in October were no more impacted than other stocks of fish; evidence for the Middle Dee (in 2010) is presented in the following section.

Radio Tracking

Introduction

Radio tracking allows movements of individual fish over a period of time to be established. Radio tracking can therefore address whether capture and handling of fish at different times of the year has different impacts on fishes' subsequent behaviour and movements. A previous radio tracking study on the Dee (Smith et al 1998) found no evidence of mortality of fresh salmon that were angled in October.

However, the Dee's autumn fishery comprises more than just fresh fish, indeed, surveys in 2009 and 2010 (see previous sections of report) suggests that at least half of the Lower Dee's autumn fishery is comprised of non-fresh runs of fish, including spring salmon, and the Middle Dee has even lower proportions of fresh fish in its autumn fishery. It is unknown what impact angling (capture and handling) these fish has on their subsequent behaviour.

Radio tracking studies in other Scottish rivers (e.g. Saunders 1967, Laughton & Smith 1992) suggest that fresh fish caught in an October fishery will not migrate upstream long distances. Smith et al's (1998) radio tracking study on the Dee also found that fresh October fish tend to stay in the Lower Dee and spawn. However, the radio tracking for the season extension monitoring in 2009 showed that the Lower Dee autumn rod catch did comprise fish destined for the Middle and Upper Dee. The purpose of the radio tracking in 2010 was to determine (1) whether salmon caught in the Middle Dee autumn fishery comprises just Middle Dee stock or if it includes fish of Upper Dee stock, and (2) whether any of the stocks in the fishery are impacted by angling (capture and handling) in the autumn period. In 2009 it was found that fish from different stocks in the Lower Dee were not differentially impacted by the October fishery.

Overall, the radio tracking study carried out by the RDT and Dee DSFB in autumn/winter 2009 and 2010 had the following aim: *To determine if fish caught in the first two weeks in October show the same ability to migrate and reach spawning grounds as fish caught in the last two weeks in September.*

As part of the RDT's remit to deliver education to schools in Deeside, the radio tracking project in 2010 involved three local primary schools. The RDT delivered two visits per school to talk to the children about the project and named each tagged fish after a school child, who was then able to follow on the progress of their fish through weekly updates on a specially created website, www.riverdeetracking.com.

Methods

Equipment

In autumn 2010 60 fish were tagged with digitally encoded radio transmitters. These radio 'tags' emit distinct numerical codes. All the tags transmitted codes on a single frequency. The tags were 16 mm diameter x 50 mm length, had a weight in water of 7.5 g and an estimated operational life of 1440 days. The tag codes are detected by receivers that automatically scan for the transmitter

codes with the aid of directional (yagi) antennae. Two types of receivers were used for this project: (1) manual tracking receivers and (2) fixed station data loggers.

(1) Manual tracking receivers automatically scan at the correct frequency and when a transmitter code is detected the corresponding tag number is displayed on the receiver. Tracking was carried out on foot and in vehicles and code numbers and location were recorded by the tracker. Two manual trackers were used in the project.

(2) Fixed station data loggers automatically scan the correct frequency and create a record of the date, time, tag number and relative signal strength when a transmitter code is detected. This data is downloaded to a laptop. Data loggers can detect signals from multiple yagi antennae, allowing it to be determined from where the signal is being sent. In this project we deployed five data loggers, each with one or two antennae.

Tagging

The fish caught for radio tagging were caught by anglers on fishing beats in the Middle Dee (Aboyne Water, Lower Dess, Kincardine, Carlogie, Ballogie, Commonty, Borrowstone, Middle Blackhall, Inchmarlo and Little Blackhall), between 35 and 52 km (22 - 32 miles) upstream of the river mouth.

30 fish were tagged between 16 - 30 September 2010 and 30 fish between 1 – 15 October 2010 (Tables 1 and 2).

Tracking of Fish

Manual tracking was carried out from 18 September - 16 December 2010 and from 3 - 14 January 2011. Unfortunately, due to snow, only minimal tracking could be carried out in December (the fixed station data loggers were maintained throughout). Tracking was carried out by Dee DSFB staff, in a vehicle and on foot, with the antennae fixed to the top of the vehicle. Tracking was undertaken twice a week, with the entire main stem from Aberdeen to Aboyne covered on each track. Additional tracking was carried out in November, in particular, covering tributaries and 'difficult' main stem areas (such as around islands).

The five data loggers were positioned at the following locations:

1. Aberdeen (ADAA bothy, Pots & Fords)
2. Lower Feugh (antennae covering the Feugh and the main stem at Banchory Lodge)
3. Sluie (antennae covering the Cattie burn and the main stem at Sluie)
4. Craigendinnie (antennae covering the base of the River Tanar and main stem above Aboyne)
5. Birkhall (antennae covering the main stem just below mouth of River Gairn)

The data loggers ran continuously from 15 September until end of January 2011.

Fish

16 males and 14 females were tagged in each of the September and October periods. Sizes of tagged fish ranged from 59 cm /24" to 92 cm/37" length. Information on individual fish is provided in Tables 1 and 2.

The fish comprising the September-tagged group that could be scale sampled included seven grilse (28%), 14 2 SW salmon (56%), one previous spawner (4%) and three fish that could not be aged due to severe scale erosion (12%). The fish tagged in October included five grilse (21%), 14 2 SW salmon (58%), two 3 SW salmon (8%) and three that could not be aged due to scale erosion (13%). Additionally, scales could not be removed from five September fish and six October fish because of scale re-absorption.

The scale readings indicated that the majority of the radio tagged fish were summer-entry fish (69% of September- and 50% of October-tagged fish). Autumn-entry fish comprised only 3% of the salmon tagged in September and 13% of those tagged in October. Spring salmon comprised 3% and 7% of September- and October-tagged fish, respectively. The remainder (24% of September fish and 30% of October fish) had entered the river in either spring or early summer, but scale erosion made it impossible to confirm.

The majority of tagged fish were classed as 'coloured' (63% of both September- and October-tagged fish). There were slightly more silver (fresh) fish tagged in October (13%) than September (3%) but slightly more 'clean' fish tagged in September (33%) than October (23%).

Examination of fish showed that no females were close to spawning, although three females had (slightly) protruding vents (these fish were caught on 17 Sep, 7 Oct and 12 Oct). No males showed evidence of milt production.

Table 1. Information on fish radio tagged 16 - 30 September 2010

Tag no.	Date of tagging	Tagging location (pool name)	Length cm (inches)	Sex	Description	FW age *	SW age† ‡	River entry
90	17 Sep	M Blackhall (Floating bank)	71 (28.5)	F	Clean	2	2+	Summer
91	17 Sep	Inchmarlo (Roe Pot)	71 (28.5)	F	Coloured	2	2+	Summer
92	17 Sep	Carlogie (Boat)	71 (28.5)	M	Coloured	2	2+	Summer
93	17 Sep	Carlogie (Boat)	76 (30.5)	M	Clean	2	2+	Summer
94	20 Sep	Inchmarlo (Roe Pot)	63 (25)	M	Clean	2	2+	Summer
95	20 Sep	Inchmarlo (Sandy Bay)	63 (25)	F	Clean	?	1+	Summer
96	20 Sep	Ballogie (Top Gannets)	75 (30)	M	Clean	3	2+	Summer
97	20 Sep	Inchmarlo (Otterstone)	64 (25.5)	M	Clean	2	1+	Summer
98	21 Sep	Carlogie (Boat)	81 (32.5)	M	Coloured	2	2+	Summer
99	21 Sep	Carlogie (Boat)	65 (26)	M	Coloured	2	1+	Summer
100	21 Sep	Carlogie (Pitslug)	69 (27.5)	M	Coloured	?	2+	Summer
101	21 Sep	Carlogie (Village)	68 (27)	M	Coloured	?	1++	Spring/ Summer
102	24 Sep	Ballogie (Sands)	92 (37)	M	Coloured	-	-	-
103	25 Sep	Commonty (Loop)	60 (24)	F	Clean	2	1+	Summer /autumn
104	25 Sep	Borrowstone (Greenbanks)	87 (35)	F	Coloured	?	2++	Spring
105	25 Sep	Inchmarlo (The Well)	61 (24.5)	M	Coloured	1	1+	Summer
106	27 Sep	Borrowstone (Greenbanks)	73 (29)	F	Coloured	?	2+	Summer
107	27 Sep	Borrowstone (Greenbanks)	66 (26.5)	M	Coloured	2	1+	Summer
108	27 Sep	Borrowstone (Greenbanks)	80 (32)	F	Coloured	2	2++	Spring/ Summer
109	27 Sep	Ballogie (Middle Slip)	66 (26.5)	F	Silver	2	1+ SM+	Autumn
110	27 Sep	Carlogie (Village)	72 (29)	F	Clean	?	2+	Summer
111	27 Sep	Borrowstone (Greenbanks)	84 (33.5)	M	Coloured	-	-	-
112	27 Sep	Aboyne (Lummels)	78 (31)	M	Coloured	-	-	-
113	27 Sep	Borrowstone (Greenbanks)	81 (32.5)	F	Coloured	2	2+	Summer
114	27 Sep	Inchmarlo (Fawn)	63 (25)	F	Clean	2	1+	Summer
115	27 Sep	Carlogie (Calm)	86 (34.5)	M	Coloured	-	-	-
116	27 Sep	Borrowstone (Greenbanks)	79 (31.5)	F	Clean	2	2+	Summer
117	28 Sep	Ballogie (Mid Gannets)	71 (28.5)	F	Coloured	2	2+	Summer
118	28 Sep	Lower Dess (Pitslug)	66 (26.5)	M	Coloured	-	-	-
119	28 Sep	Inchmarlo (Roe Pot)	85 (34)	F	Coloured	2	2+	Summer

***** FW: years spent in fresh water prior to smolting. ? denotes that FW age could not be determined due to scale regeneration. **†** SW: years spent at sea. '+' denotes summer growth at sea (i.e. the fish was a summer or autumn river entrant). '2++' means that the fish spent a minimum 2+SW but possibly older. **‡:** SM is an abbreviation for Spawning Mark, indicating that the fish has spawned previously.

Table 2. Information on fish radio tagged 1 - 15 October 2010

Tag no.	Date of tagging	Tagging location (pool name)	Length cm (inches)	Sex	Description	FW age *	SW age†	River entry
120	4 Oct	Borrowstone (Greenbanks)	80 (32)	M	Coloured	2	2++	Spring/ Summer
121	4 Oct	Commonty (Otter trap)	68 (27)	M	Coloured	2	1+	Summer
122	4 Oct	Ballogie (Bulwarks)	71 (28.5)	F	Coloured	2	2+	Summer
123	4 Oct	Borrowstone (Greenbanks)	79 (31.5)	F	Coloured	2	1++	Spring/ Summer
124	4 Oct	Carlogie (Village)	65 (26)	M	Coloured	?	1+	Summer
125	4 Oct	Borrowstone (Greenbanks)	71 (28.5)	F	Coloured	2	2+	Summer
126	6 Oct	Carlogie (Village)	71 (28.5)	F	Coloured	2	2+	Summer
127	6 Oct	Carlogie (Boat)	65 (26)	M	Clean	3	1+	Summer
128	6 Oct	Little Blackhall (Roe pot)	76 (30.5)	F	Coloured	2	2+	Summer
129	6 Oct	Carlogie (Village)	73 (29)	M	Coloured	-	-	-
130	6 Oct	Carlogie (Village)	69 (27.5)	F	Coloured	2	2+	Summer
131	7 Oct	Little Blackhall (Roe pot)	76 (30.5)	M	Sea liced	2	2+	Autumn
132	7 Oct	Commonty (Otter trap)	70 (28)	F	Clean	2	2+	Summer
133	7 Oct	Inchmarlo (Floating bank)	59 (23.5)	M	Clean	2	1+	Autumn
134	7 Oct	Ballogie (Bulwarks)	64 (25.5)	F	Coloured	2	2+	Summer
135	8 Oct	Kincardine (Village)	76 (30.5)	F	Clean	?	2+	Summer
136	9 Oct	Little Blackhall (Roe pot)	85 (34)	M	Silver	2	2+	Autumn
137	9 Oct	Inchmarlo (Fawn)	64 (25.5)	F	Silver	2	1+	Autumn
138	9 Oct	Carlogie (Mill)	65 (26)	M	Coloured	?	1++	Spring/ Summer
139	11 Oct	Carlogie (Pitslug)	69 (27.5)	M	Coloured	-	-	-
140	11 Oct	Borrowstone (Greenbanks)	86 (34.5)	M	Coloured	2	3	Spring
141	11 Oct	Commonty (Bend)	79 (31.5)	M	Coloured	-	-	-
142	11 Oct	Commonty (Bend)	74 (29.5)	M	Silver	2	2+	Summer
143	11 Oct	Borrowstone (Greenbanks)	79 (31.5)	F	Clean	2	2+	Summer
144	11 Oct	Borrowstone (Greenbanks)	65 (26)	M	Coloured	-	-	-
145	12 Oct	Carlogie (Village)	79 (31.5)	M	Coloured	-	-	-
146	12 Oct	Commonty (Loop)	88 (35)	F	Coloured	2	3	Spring
147	12 Oct	Commonty (Bend)	71 (28.5)	F	Clean	2	2+	Summer
148	12 Oct	Carlogie (Boat)	85 (34)	F	Clean	2	2+	Summer
149	12 Oct	Borrowstone (Inchbrae)	80 (32)	M	Coloured	-	-	-

*,† See footnotes to Table 1.

Results

Fish behaviours

43 of the 60 tagged salmon (72%) were tracked through the spawning period and into January. Due to snow preventing tracking for three weeks after late November, 11 salmon (18%) were lost from the study in November and a further five fish (8%) were lost in December. A single fish was lost in late October, after moving 37 km (23 miles) upstream.

No fish were confirmed as having died during the tracking period, although one fish was tracked at Aberdeen on 2 November and was not recorded again, so may have left the river. Of the fish lost early in the season (October/November), six of these fish had previously migrated upstream, four downstream and two had showed no directional migration. It is suggested that the lack of tracking, due to weather conditions, was responsible for the loss of these fish from the study.

In total, three fish tagged in September and six fish tagged in October are excluded from subsequent analyses due to: (1) movements of four October-tagged fish could not be confirmed as they were 'lost' for at least one month during the tracking period (probably due to weather conditions) and it is unknown whether they migrated upstream (although they were all located in the river in January); (2) two September- and two October-tagged fish were excluded as they showed (almost) no movement and it is possible that their tags were regurgitated shortly after tagging, and; (3) one September-tagged fish showed erratic upstream and downstream movements, before being lost after 2 November.

There was no significant difference in the number of September- and October-tagged fish that migrated upstream, downstream or showed no directional migration (shown statistically; chi square; Fig. 6). 18 September-tagged fish (67%) and 18 October-tagged fish (75%) showed upstream migration after tagging. Five September-tagged fish (19%) and four October-tagged fish (17%) showed downstream migration after tagging. The remainder (14% of September-tagged fish and 8% of October-tagged fish) showed no significant directional movement, but stayed within 3 km (2 miles) of the tagging site.

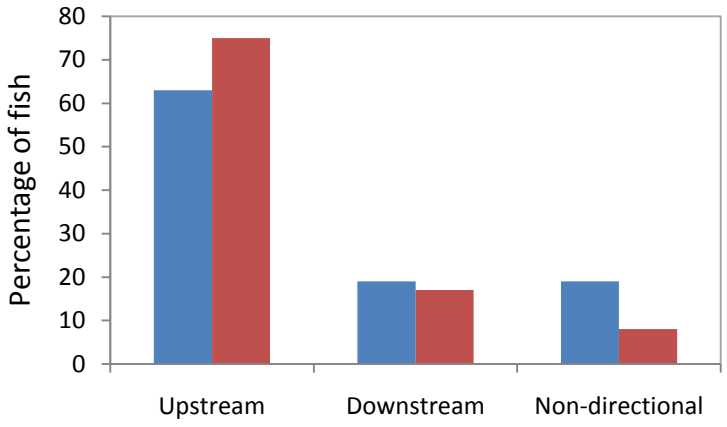


Figure 6. Movements of September- (■) and October-tagged (■) fish.

The movement of each tagged fish is shown in Fig. 7. The movements and behaviour shown by these tagged fish could be categorised by the following groups:

1. Tributary fish. Nine fish went into tributaries, including six September-tagged fish and three October-tagged fish (15% of all tagged fish). These fish migrated an average distance of 27 km (17 miles) upstream, with one fish migrating 65 km (40 miles). The tributaries were in the Upper (Gairn, Clunie, Muick, Tanar) and Middle (Cattie, Birse, Beltie) Dee. These fish reached their maximum upstream location between 1 and 24 November. Three of these fish were captured and tagged upstream of the tributaries they later entered (Cattie and Beltie burns) and so dropped downstream after tagging to enter them. Seven of these fish had left the tributaries by January.

The fish that entered the tributaries included five males and four females, most of which (seven fish) were summer entrants to the river. Two autumn entrants also entered the River Gairn and Cattie burn.

2. Long distance (> 20 km) upstream migration. This included four September-tagged fish and three October-tagged fish (12% of all tagged fish). These fish migrated, on average, 35 km upstream (22 miles). These fish reached their furthest position upstream in the second and third week in November, with the exception of one fish which reached its upstream position on 4 October. Most of these fish (six) were males that were summer entrants to the Dee.

3. Short distance (4 - 20 km) upstream migration. This included seven September-tagged fish and 12 October-tagged fish (32% of all tagged fish) which migrated upstream, on average, 9 km (6 miles). These fish reached their maximum distance upstream between the end of October and mid December. The group comprised mostly summer-entry females and spring/early summer-entry males.

4. Little direction migration. This group included seven September-tagged fish and three October-tagged fish (17% of all tagged fish). These fish travelled 3 km (2 miles) or less from the tagging site (upstream or downstream). Four of these fish showed (almost) no movement and it is considered possible that these fish regurgitated their tags near the tagging site, soon after tagging (Table 3); hence movements of these four fish are uncertain. Regurgitation of radio tags has been found in other studies and, for comparison, a study on the River Tweed found that 13 - 17% of salmon regurgitated their radio tags (SOAEFD 1997).

This group comprised equal numbers of males and females, grilse and MSW salmon. An additional fish dropped 4.5 km after tagging but then returned to the tagging site in November, and was subsequently lost at the end of November.

5. Stationary followed by downstream migration. This group included four September-tagged fish and one October-tagged fish (8% of all tagged fish). Four of these fish (all females, spring or summer entrants) stayed at their tagging site for 4-5 weeks before dropping downstream; three of these fish were tracked in the river until January. It is not clear whether these fish moved

downstream before or after spawning. The fifth fish (male) stayed at the tagging site for two weeks and then was recorded in Aberdeen on 2 Nov, after which it was not found again.

6. Downstream migration only. This group included one September-tagged fish and three October-tagged fish (7% of all tagged fish). One female dropped 5 km downstream but remained in the river until January. One male also dropped down but remained in the river into January, whereas two other males were lost in mid November.

7. Unconfirmed. The movements of four fish (all females tagged in October; 7% of total) could not be ascertained, as these fish were not located for at least a month during the spawning period. Although all fish were later tracked in January, it is unknown whether they migrated upstream after tagging. The temporary 'loss' of these fish was probably due to weather conditions.

In addition, there was one fish whose movements involved larger upstream and downstream migrations: a female grilse (tag 114) dropped downstream 32 km to Aberdeen in October and then swam upstream 53 km before being lost from the study in early November.

Fish tagged in both September and October periods showed the complete range of behaviour categories, outlined above. Generally, these behavioural groups comprised males and females, both grilse and MSW salmon, which had entered the river throughout the year. In particular, there was no 'type' of fish that migrated downstream only after tagging. It was noted that most of the fish that migrated upstream long distances were males (which was also the case in 2009). However, in 2009 most fish that showed little directional migration were females but this was not apparent in 2010.

The overall movements (upstream, downstream or non-directional) of tagged salmon were not significantly different between males and females (statistical test; chi square), although slightly more females migrated downstream (23%) than males (13%). The entry time of fish into the river (spring, spring/early summer, summer, autumn) did not appear to influence whether the fish would migrate upstream, downstream or show non-directional movement after tagging; however, it was not possible to test this statistically because of the disproportionate numbers of tagged fish in these entry groups (e.g. only four fish were autumn salmon).

The movements (upstream, downstream or non-directional) of fish tagged in 2009 and 2010 were not statistically different (chi square). More variability was seen in the movements of fish tagged in 2009 (e.g. in 2009 two fish were late spawners, migrating in late Jan/Feb and three fish migrated downstream but subsequently upstream). This could be due to environmental variability that may occur between years (e.g. an early, harsh winter in 2010, flooding in October 2009).

Table 3a. Summary of movements of fish radio tagged 16 – 30 September 2010

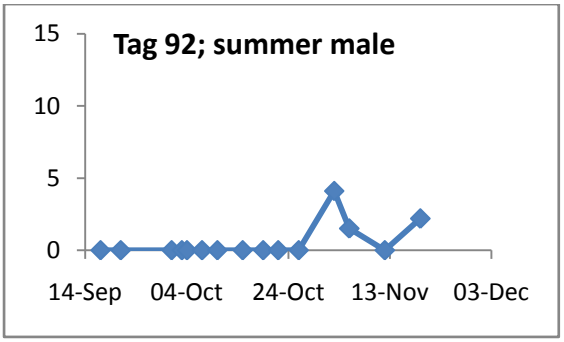
Tag no.	No. of days tracked	Furthest location upstream	Upstream distance travelled (km)	Date upstream location reached	Comments
Female grilse					
95	57	Inchmarlo, Holly bush	0.1	04-Oct	
103	100	Ballogie, Priest's hole	2.3	16-Nov	Re-captured by angler at Park, 3 Feb
114	36	Aboyne Castle, Lorne pool	23	01-Nov	Dropped to Aberdeen, then upstream to Aboyne; lost from study after 2 Nov
Female MSW salmon					
90	112	Sluie, Upper Inchbrae	6	12-Nov	
91	121	Birse, Quithel	18	12-Nov	Recorded down at Aberdeen 16 Jan
104	100	Tagging site	0	-	Dropped downstream in late Oct/early Nov
106	75	Carlogie, Village pool	2.2	02-Nov	Recorded down at Aberdeen 11 Dec
108	102	Tagging site	0	-	Possible tag regurgitation
109	105	Cattie burn	0.7	22-Nov	3.6 km up tributary
110	99	Birse burn	5.5	24-Nov	1.5 km up tributary
113	99	River Clunie	64.9	05-Nov	2.9 km up tributary
116	98	Tagging site	0	-	Dropped down in November; tracked into Jan
117	101	Aboyne Castle, Lorne pool	12.2	01-Nov	
119	105	Tagging site	0	-	Tracked in river until Jan
Male grilse					
97	109	Birkhall,Boat pool	47.8	22-Nov	
99	108	Tagging site	0	-	
105	107	Middle Blackhall, Floating bank	2.5	16-Nov	
107	99	Abergeldie, Fence pool	46.6	09-Nov	
Male MSW salmon					
92	63	Birse, Trees	4.1	02-Nov	
93	121	Cattie burn	0.3	22-Nov	5.3 km up tributary; recorded at Aberdeen 16 Jan

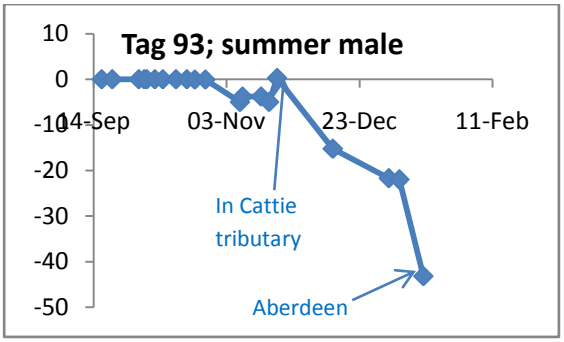
94	109	Middle Blackhall, Floating bank	3	12-Nov	
96	107	River Gairn	41.6	03-Nov	
98	52	Cambus O' May, Long pool	22.7	04-Oct	Dropped downstream in late October
100	86	River Tanar	18.4	18-Nov	5 km up tributary; recorded at Aberdeen 16 Dec
101	112	Tagging site	0	-	Dropped downstream in late September; in river in Jan
102	101	Carlogie, Calm pool	4	14-Dec	
111	30	Morven, Streams of Gairn	37		Lost from study after 27 Oct
112	99	Aboyne Castle, Lorne pool	4	30-Oct	
115	99	Aboyne Castle, Lorne pool	9.4	31-Oct	
118	101	Tagging site	0	-	Possible tag regurgitation

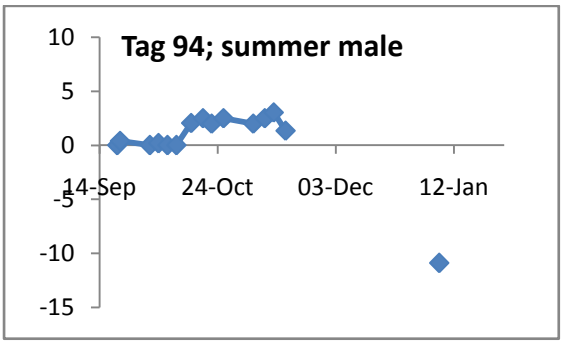
Table 3b. Summary of movements of fish radio tagged 1 – 15 October 2010

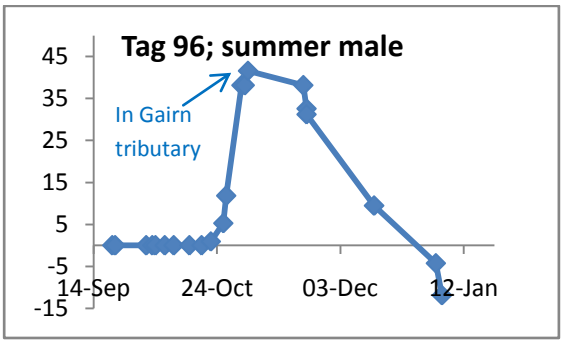
Tag no.	No. of days tracked	Furthest location upstream	Upstream distance travelled (km)	Date upstream location reached	Comments
Female grilse					
137	93	Inchmarlo, House pool	0.3	22-Oct	Tracked in river into Jan
Female MSW salmon					
122	92	Ballogie, Bridge pool	1.3	07-Oct	No movement after 7 Oct - possible tag regurgitation
123	70	Birse, Warren pool	7.3	05-Nov	
125	92	Tagging site	0	-	Tracked in river into Jan
126	102	River Muick	32.7	18-Nov	1 km up tributary; recorded down at Aberdeen 16 Jan
128	97	Tagging site	0	-	Dropped downstream in late Oct; tracked in river into Jan
130	90	Ferrar, Rhunavalla	15.1	09-Nov	
132	70	Aboyne Castle, Lorne pool	16.5	31-Oct	Recorded down at Aberdeen 16 Dec
134	96	Tagging site	0	-	Tracked in river into Jan

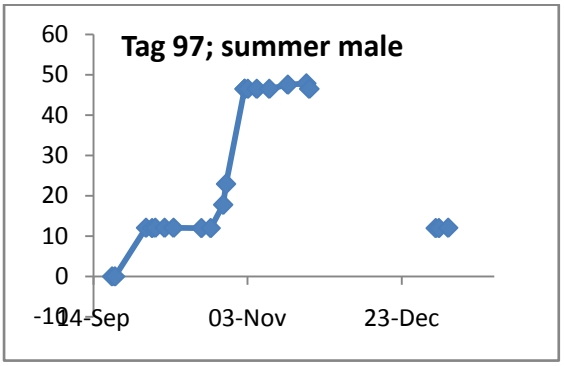
135	120	Aboyne Castle, Lorne pool	11.1	01-Nov	Recorded down at Aberdeen 5 Feb
143	88	Tagging site	0	-	Possible tag regurgitation
146	92	Aboyne Castle, Lorne pool	19.9	22-Nov	
147	41	Woodend, House pool	0.2	12-Nov	Lost from study in late Nov
148	91	Tagging site	0	-	Tracked in river into Jan
Male grilse					
121	93	Aboyne Castle, Lorne pool	15.9	01-Nov	Dropped downstream in early Nov and went 14 km up Beltie burn
124	95	Aboyne Castle, Tanarmouth	11.1	04-Nov	
127	100	Balmoral, Weaver pool	49.5	12-Nov	
133	36	Upper Blackhall, Blue chair	5.6	26-Oct	Lost from study in mid Nov
Male MSW salmon					
120	43	Ballogie, Upper gannets	1.4	07-Oct	Lost from study in mid Nov
129	89	Aboyne Castle, Symons	13.1	14-Dec	
131	92	River Gairn	60.2	12-Nov	10.5 km up tributary; left tributary 21 Nov
136	44	Tagging site	0	-	Lost from study in late Nov
138	27	Tagging site	0	-	Lost from study in early Nov
139	96	Birse, Lummels pool	4.5	05-Nov	Recorded down at Aberdeen 15 Jan
140	88	Birse, mid Belwade	8.4	14-Dec	
141	63	Borrowstone, Greenbanks	4.3	02-Nov	
142	42	Dinnet, Boat pool	24.5	22-Nov	Lost from study in late Nov
144	22	Ballogie, Gannets	1.3	19-Oct	Last recorded down at Aberdeen on 2 Nov
145	87	Aboyne Castle, Lorne pool	10.5	01-Nov	
149	80	Carlogie, Calm pool	5.5	02-Nov	

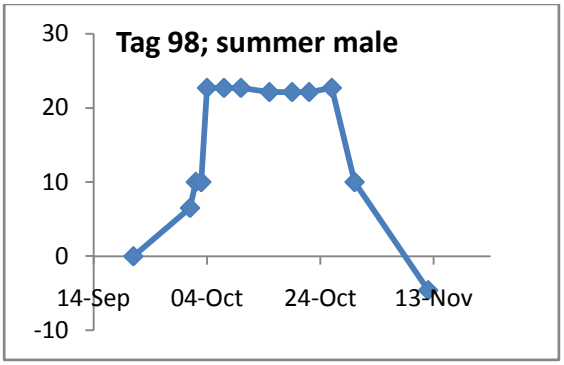


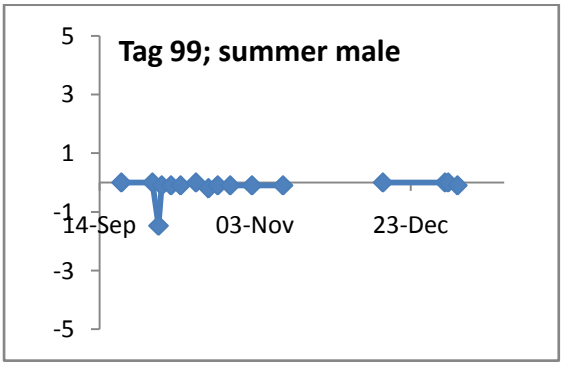












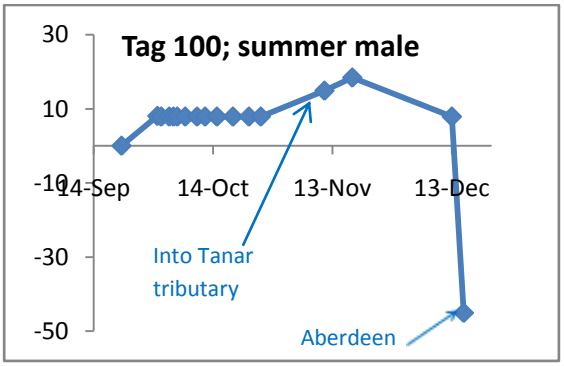
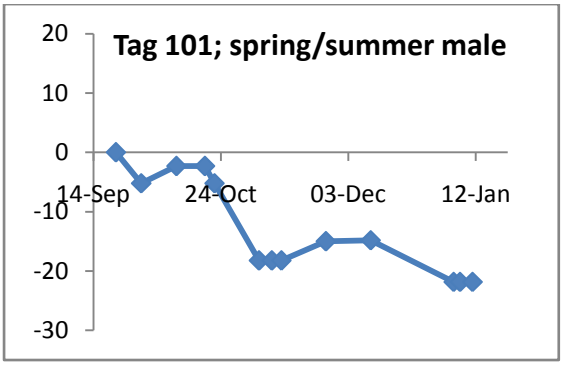
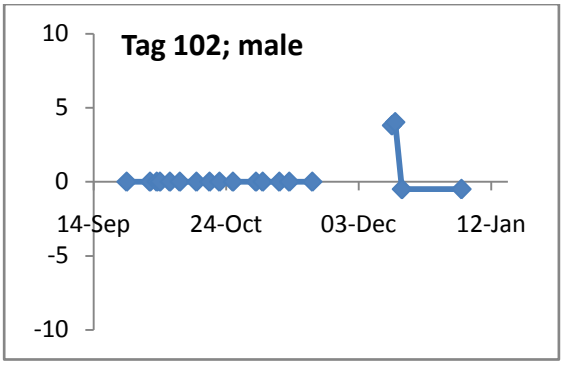
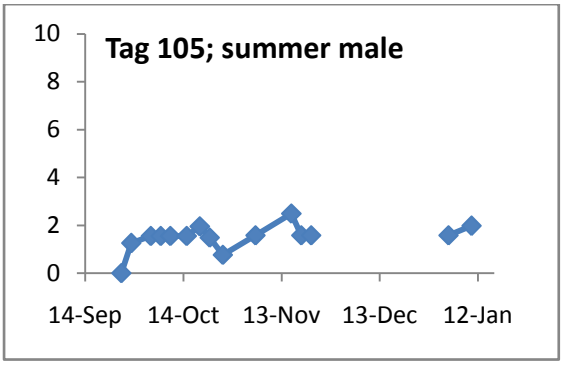
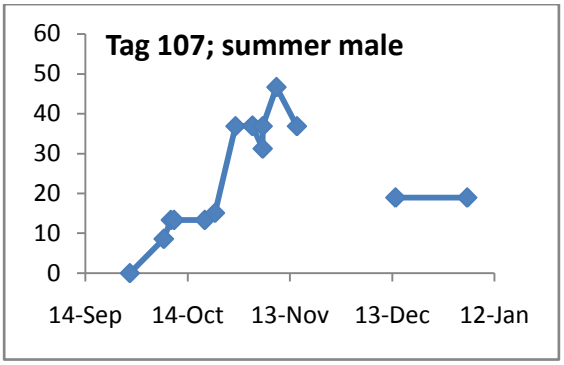


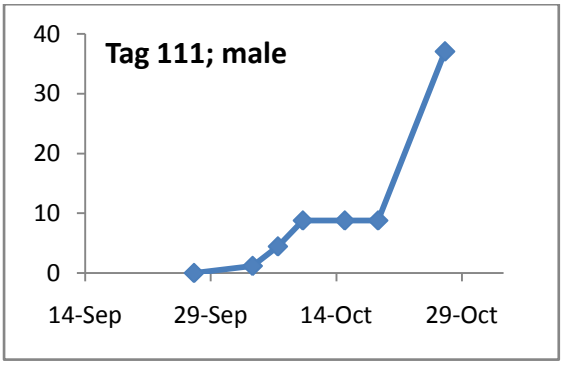
Figure 7a. Plots of migration of male salmon tagged in September 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

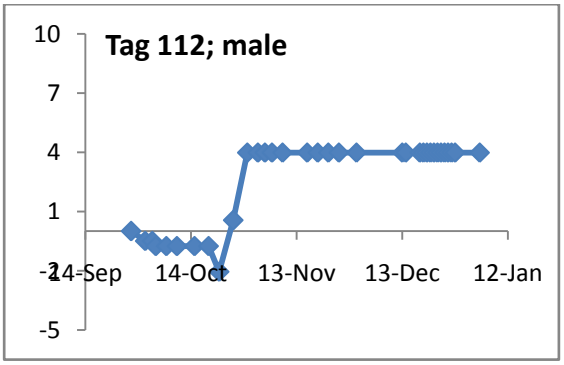


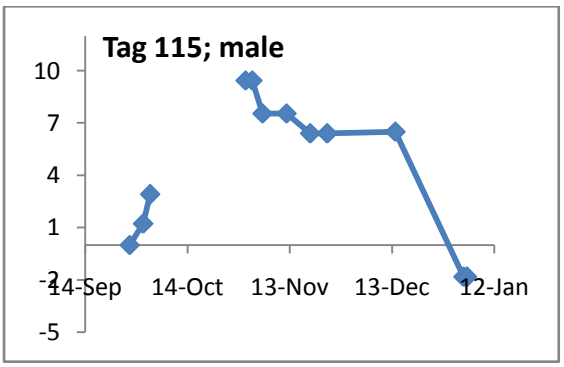












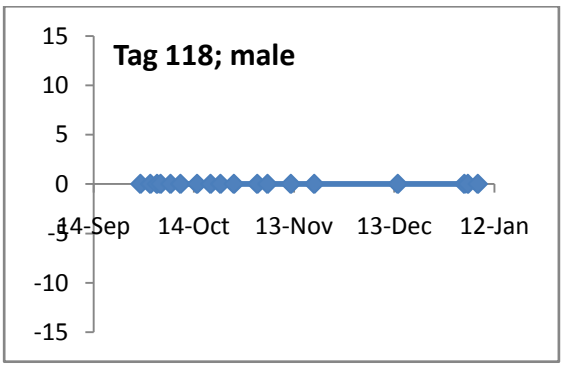
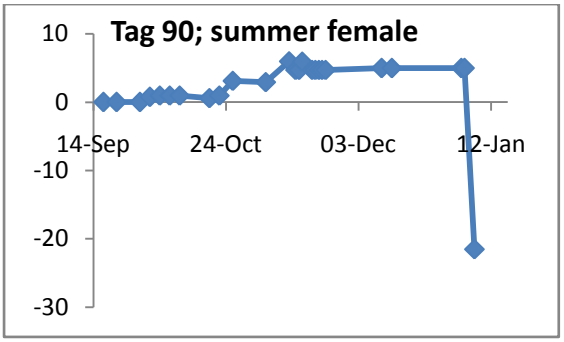
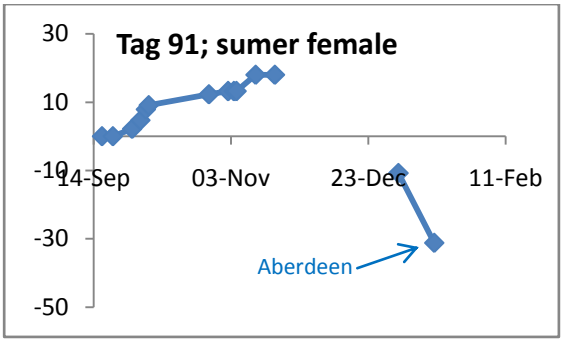
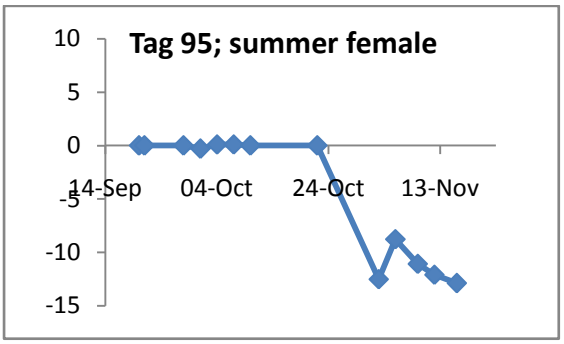
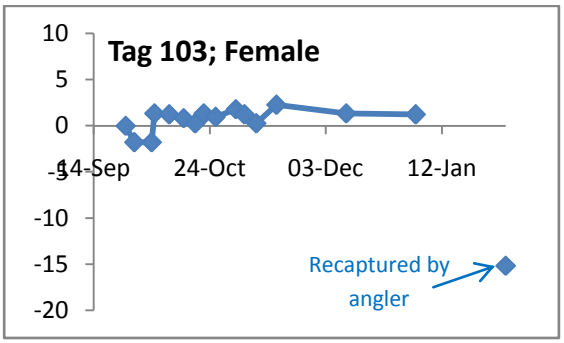


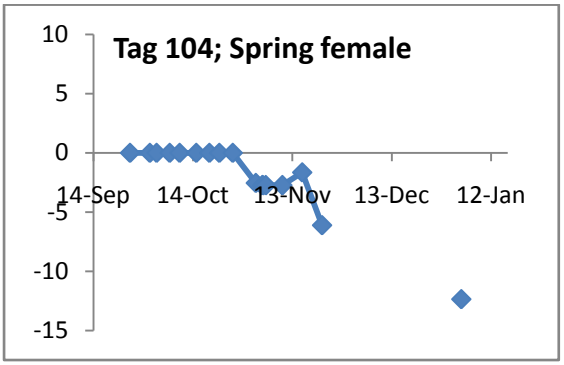
Figure 7a continued. Plots of migration of male salmon tagged in September 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

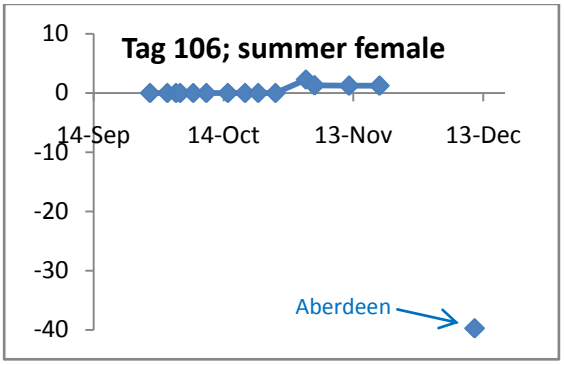


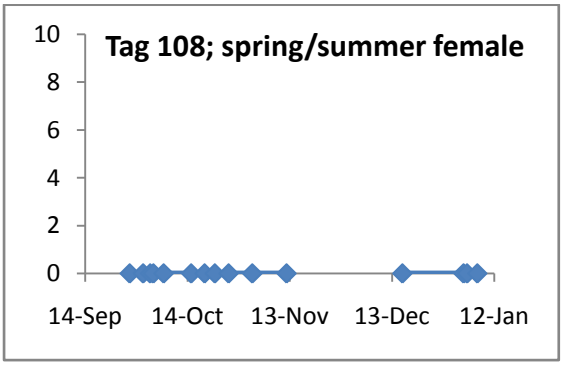












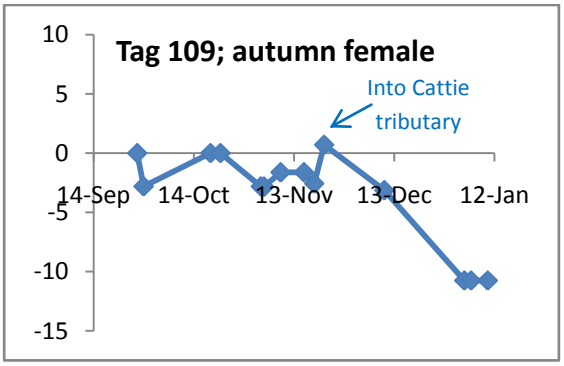
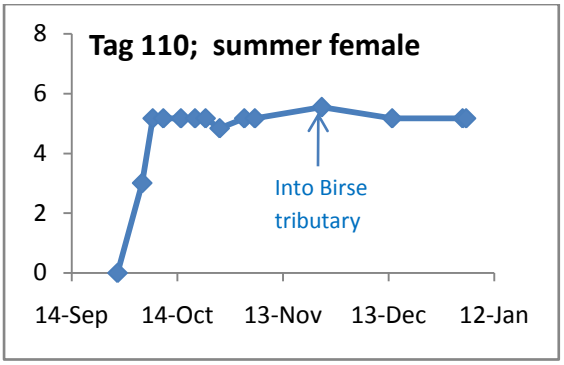
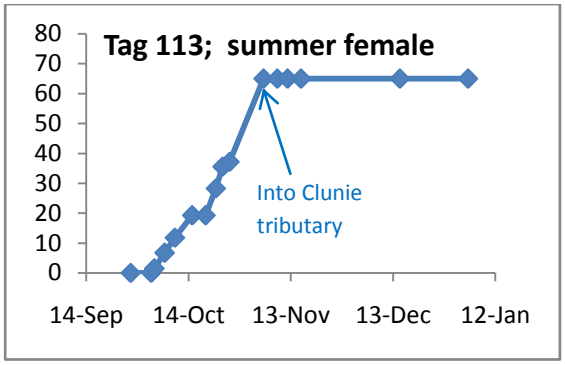
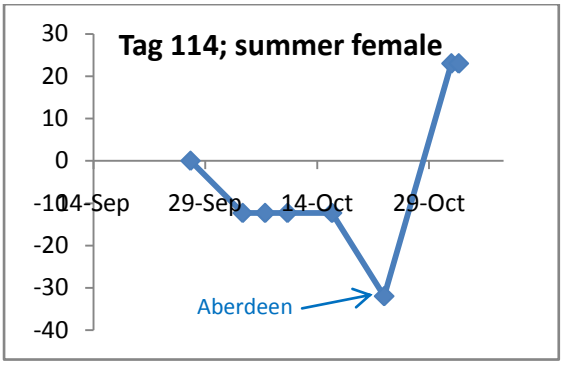
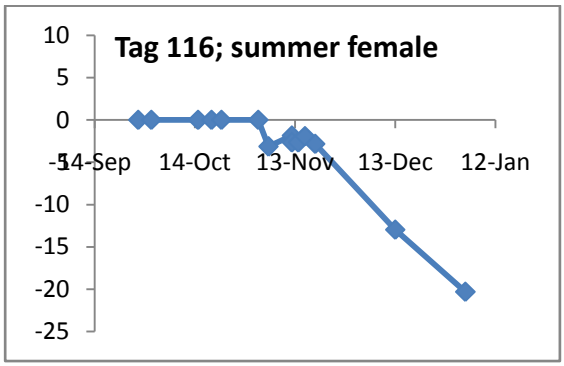


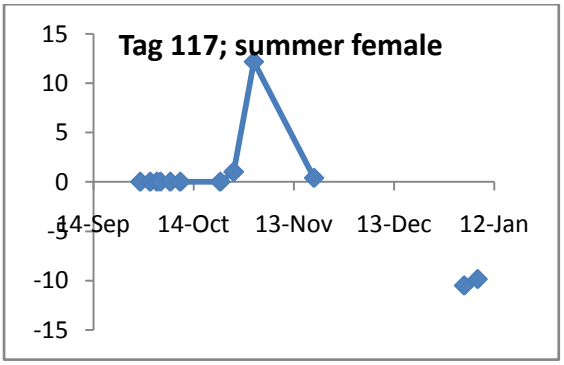
Figure 7b. Plots of migration of female salmon tagged in September 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.











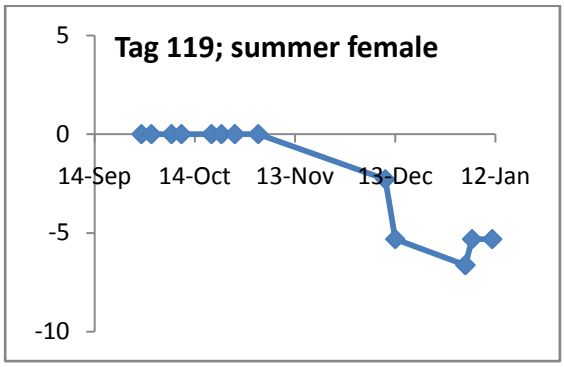
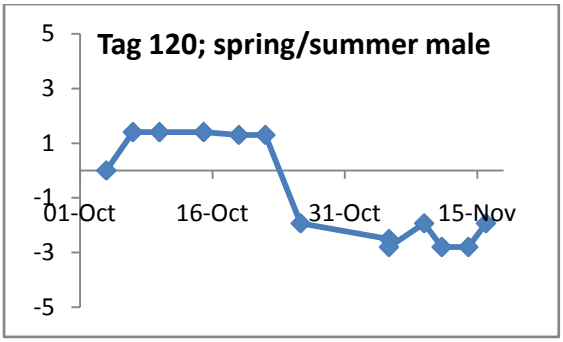
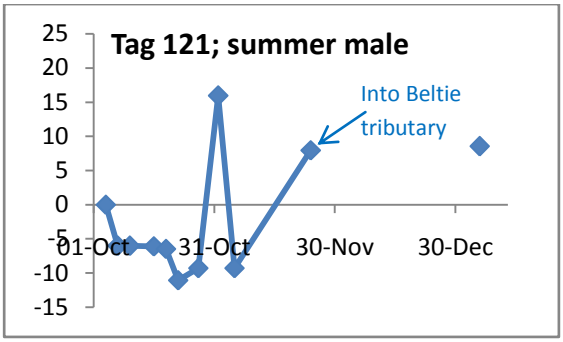
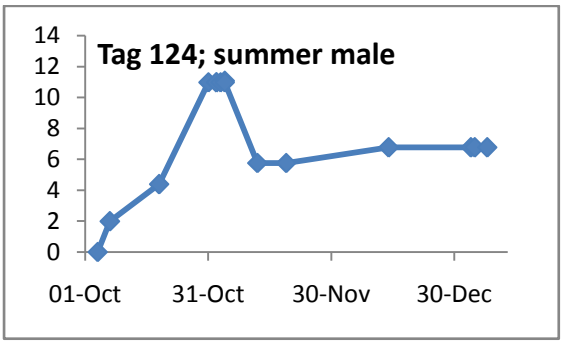
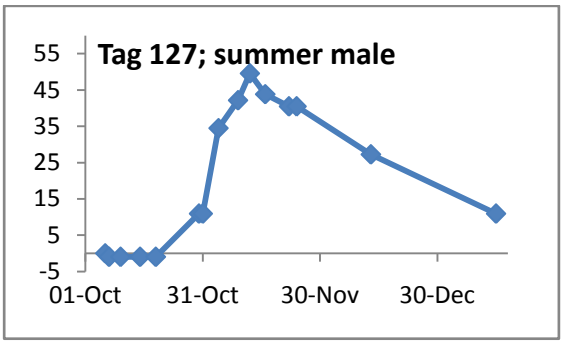


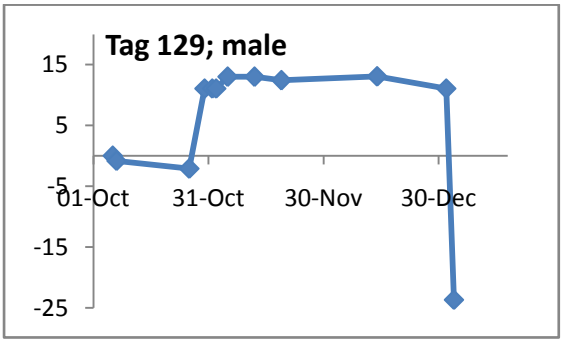
Figure 7b continued. Plots of migration of female salmon tagged in September 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

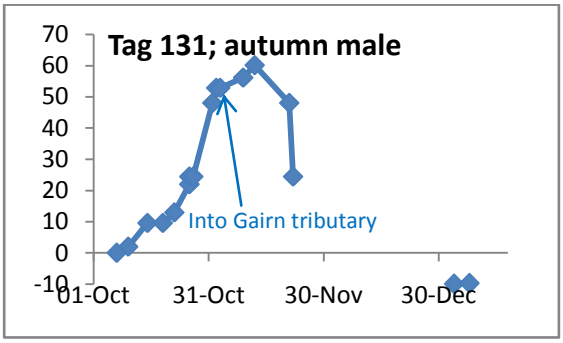


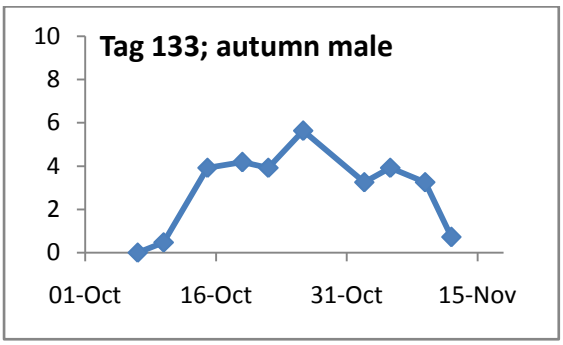












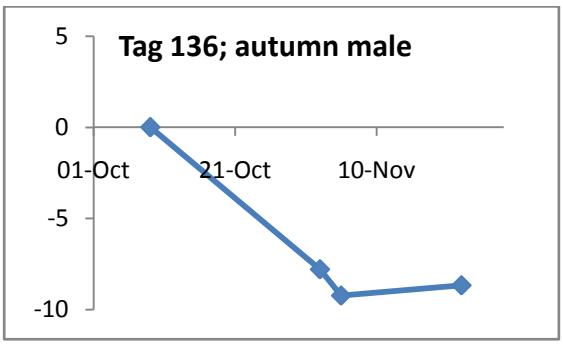
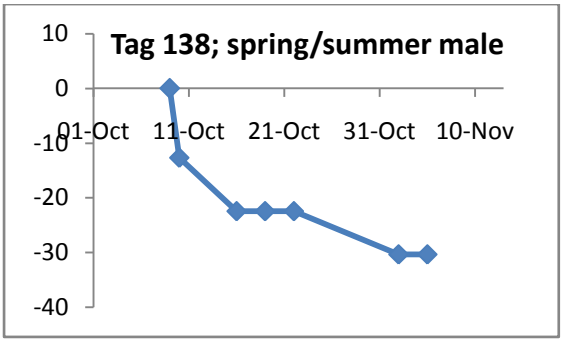
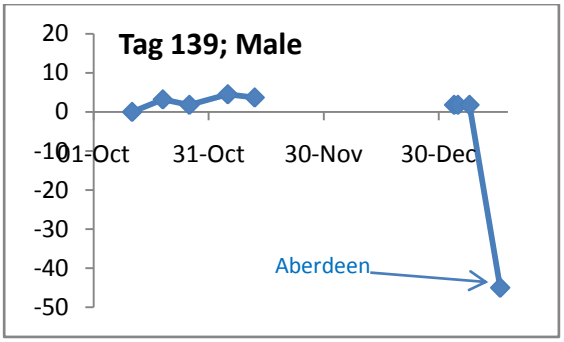
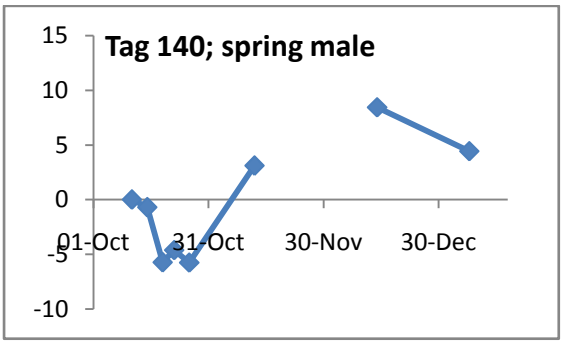
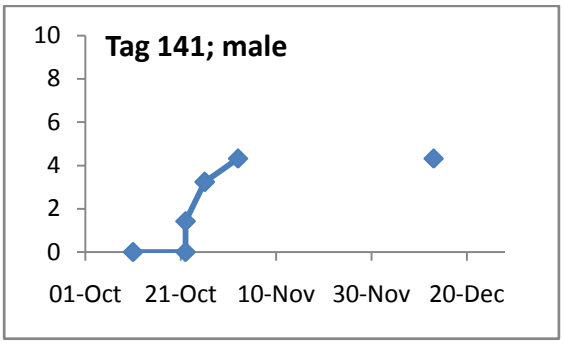


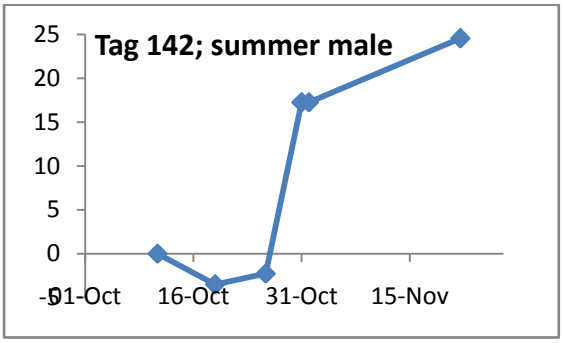
Figure 7c. Plots of migration of male salmon tagged in October 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

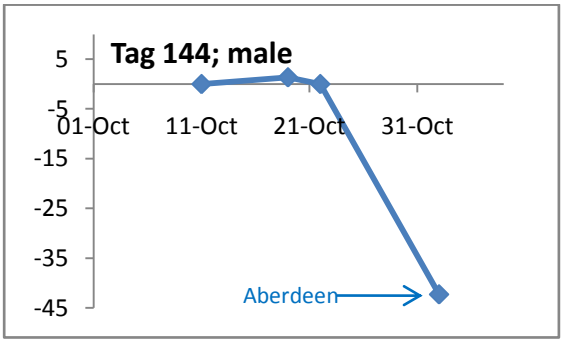


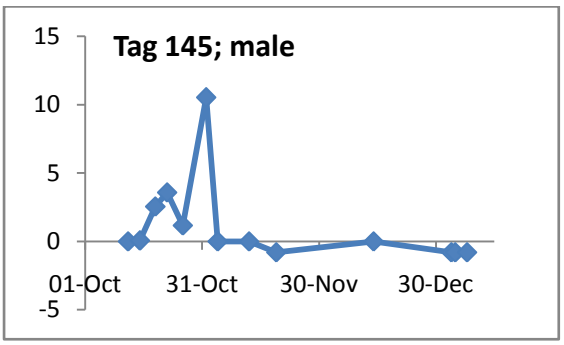












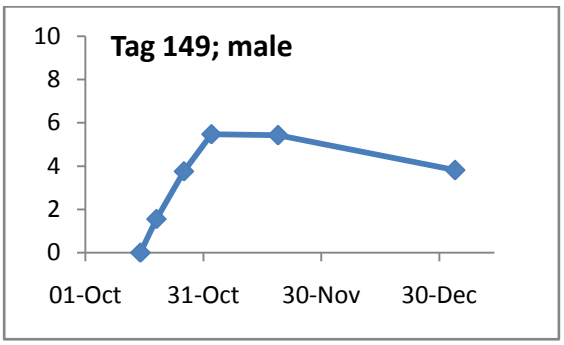
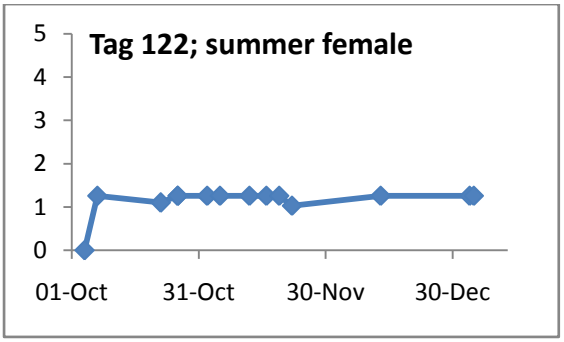
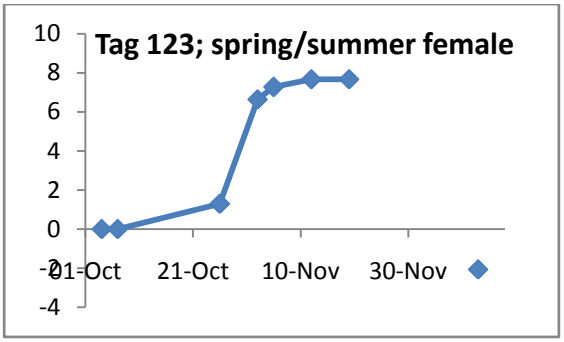
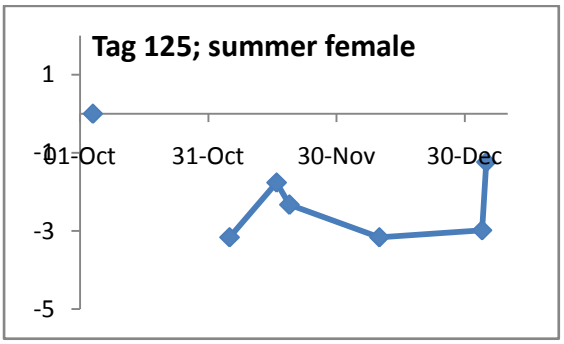
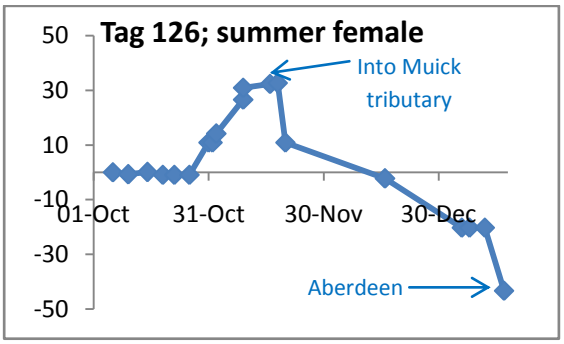


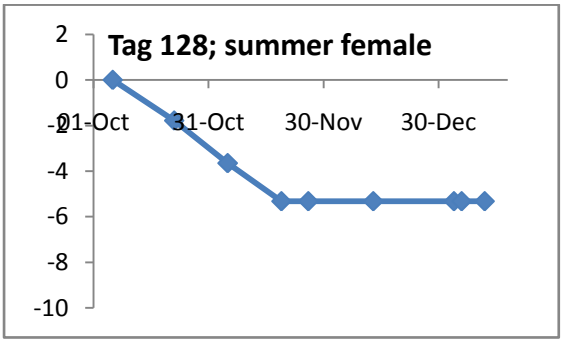
Figure 7c continued. Plots of migration of male salmon tagged in October 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

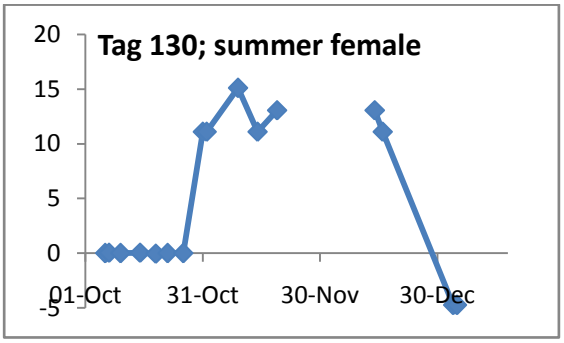


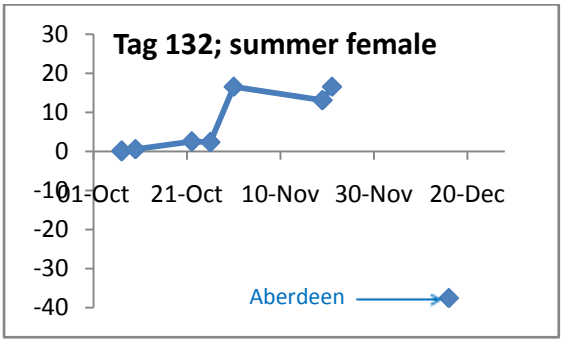












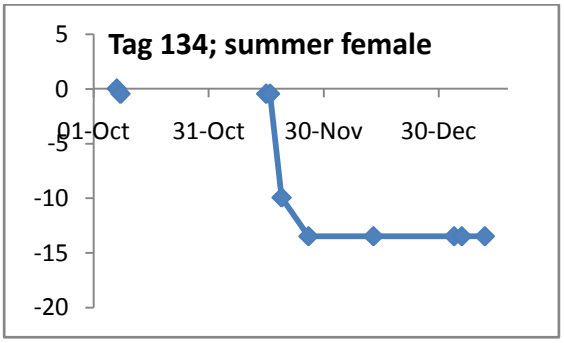
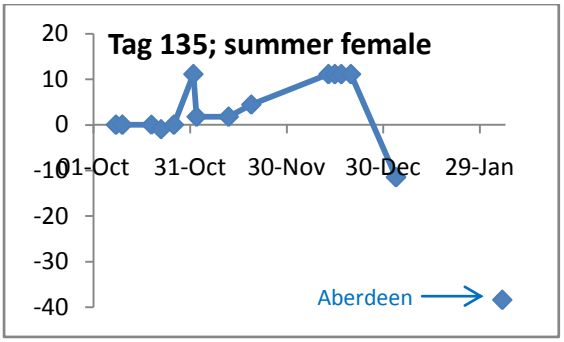
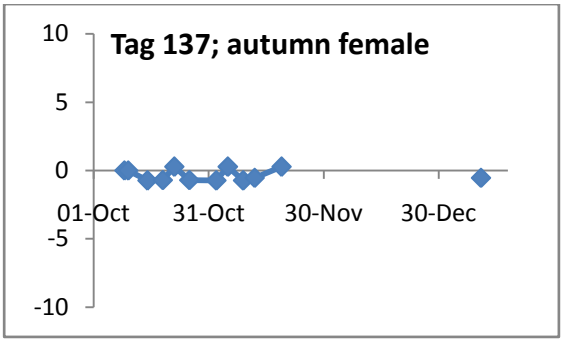
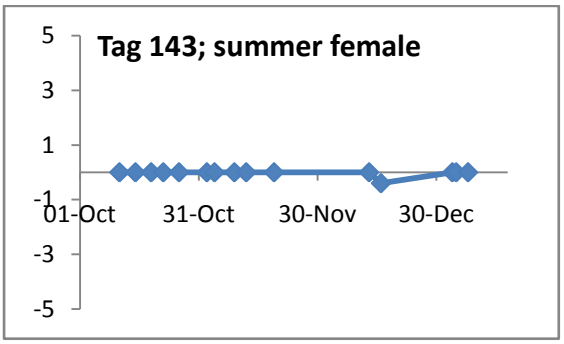
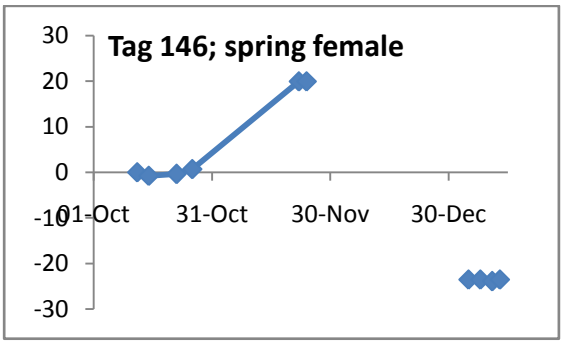


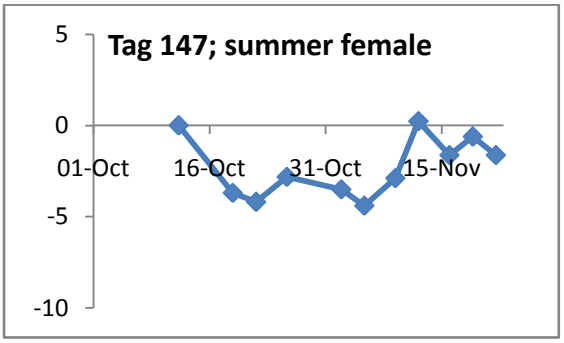
Figure 7d. Plots of migration of female salmon tagged in October 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.











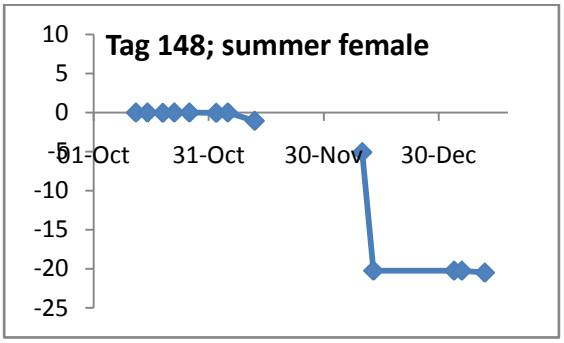


Figure 7d continued. Plots of migration of female salmon tagged in October 2010. Distance moved from tagging site (in km) shown on vertical axis (distances greater than 0 represent upstream migration). Positions of fish as determined by tracking marked ♦. Note different scales on axes for different fish.

Upstream Limits

Six fish (14%) migrated more than 40 km (25 miles) after being tagged and a further five fish migrated between 20 and 40 km. It was not possible to discern whether the fish that migrated downstream did so for spawning, or after they had completed spawning. Excluding fish that migrated downstream only (N = 9), there was no significant difference in the numbers of September- and October-tagged fish that reached the Upper Dee or remained in the Middle Dee for the spawning period (shown statistically; chi square; Fig. 7).

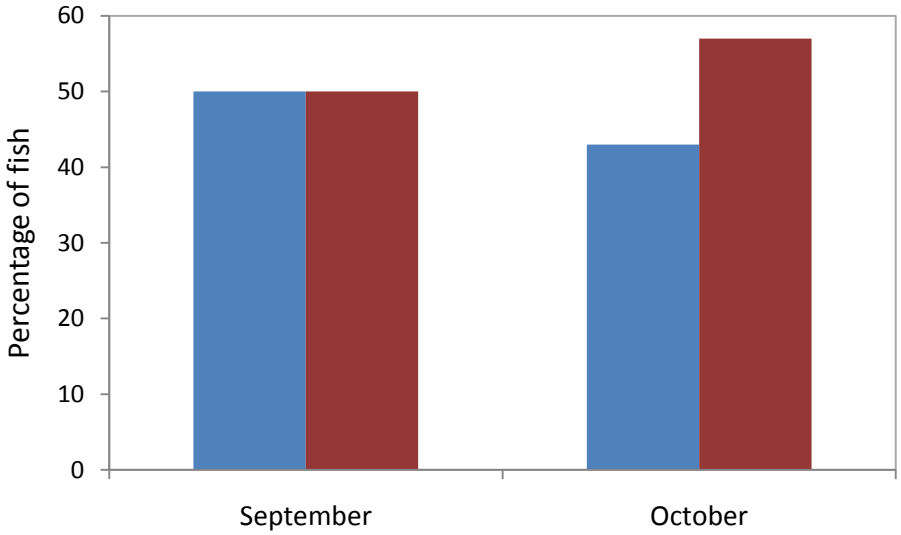


Figure 7. Percentages of September- (■) and October-tagged (■) fish that stayed in the Middle Dee and migrated into the Upper Dee during the spawning period.

Fish tagged in September and October migrated similar distances upstream, on average (13.9 and 12.8 km, respectively). The distances migrated were not significantly different between male (average 15.2 km upstream) and female (average 10.9 km) fish (shown statistically; t-test).

The (spawning) distribution of the tagged salmon at their furthest location upstream did not appear to depend on the entry time of salmon into the river (spring, spring/early summer, summer or autumn; Figs 9 and 10). Summer and autumn salmon were most widespread throughout the catchment, whereas spring and spring/early summer salmon were distributed more closely between Aboyne and Potarch; however, the wider distribution of summer salmon is likely to be influenced by the much greater number of these fish that were tagged. Therefore, while there was a trend for summer and autumn salmon to migrate further distances (16.6 and 16.7 km, respectively) compared to spring (9.4 km) and spring/early summer (7.3 km) fish, this was not statistically different (shown statistically; ANOVA).

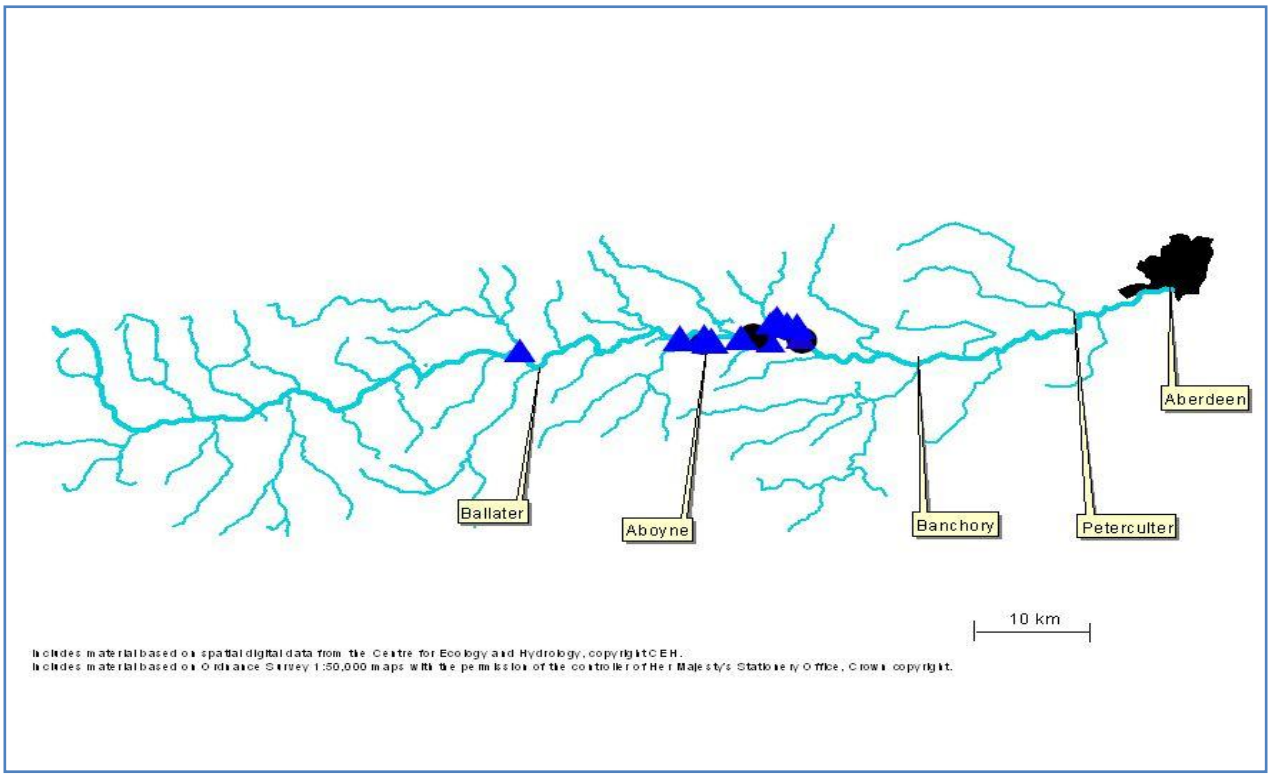


Figure 9. Maximum upstream locations of fish tagged in September and October 2010 that had entered the river in spring (●) or spring/early summer (▲); determined by scale readings.

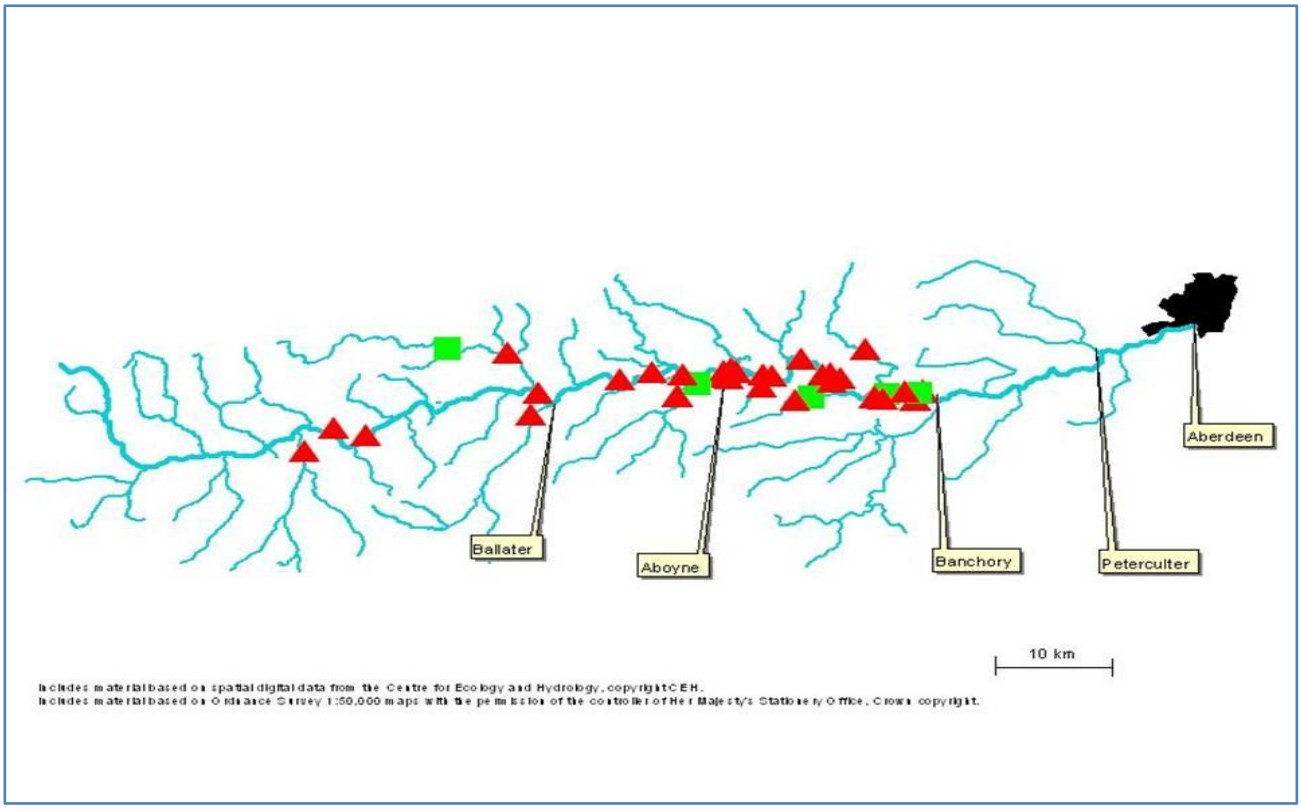


Figure 10. Maximum upstream locations of fish tagged in September and October 2010 that had entered the river in summer (▲) or autumn (■); determined by scale readings.

Timing of Fish Movements

Upstream migrants reached their furthest location upstream between 4 Oct and 14 Dec, with the majority of fish reaching their final position around the second week of November (also found in 2009). The dates at which September-tagged fish that migrated upstream reached their final destination was not significantly different to the dates at which October-tagged fish reached their final destination (shown statistically; t-test), and averaged 10 Nov and 11 Nov for the two tagging groups, respectively. Although there were fewer fish for which their subsequent downstream migration date could be ascertained (N = 19), there was also no statistical difference in this date between September- and October-tagged fish (averaging 20 Nov and 16 Nov, respectively).

The time at which the fish entered the river (spring or early summer, summer, autumn) did not significantly affect the time that upstream migrants reached their final (spawning) destination (shown statistically; ANOVA). There was no relationship between the final (spawning) position of the radio tagged fish (distance from the harbour) and the time that they reached this final location (shown statistically; Pearson correlation).

Diurnal Movements

The fixed position data loggers registered the time that tagged fish moved into range and it could be determined from subsequent movements whether these fish were migrating upstream, downstream, or simply 'milling around'. The data loggers recorded 22 movements from 17 fish that were migrating upstream. There was weak evidence that upstream migration occurred more during periods of darkness (14 of the recorded movements) than during daylight (6 of the recorded movements) or twilight (the periods 0.5 hr before sunrise and 0.5 hr after sunset; two of the recorded movements).

There were also 20 movements recorded from 17 fish that were migrating downstream. Movements occurred throughout the 24 hour period, with eight records occurring during daylight and 11 occurring during darkness (one occurred during twilight).

Discussion

Similar proportions of the fish that were tagged in the Middle Dee in autumn 2010 remained in the Middle Dee for spawning (47%) and migrated upstream into the Upper Dee (53%). This spawning distribution was similar (i.e. not significantly different) for the fish captured and tagged in September and October, suggesting that both the September and October fisheries on the Middle Dee target Middle and Upper Dee stocks.

There was no evidence that salmon captured, handled and tagged in October were differently impacted than salmon tagged in September, as both groups of fish showed the same propensity to continue upstream migration (this was also found in the Lower Dee in 2009). Some tagged fish (18% in 2010, 12% in 2009) did show downstream migration after tagging but this was unrelated to whether the fish were captured in September or October. Of the nine fish that showed only

downstream movements in 2010, five were tracked into January. Additionally, three fish migrated downstream before entering into a tributary. Therefore it is considered that some downstream movement may be 'normal' behaviour for some fish at this time of year.

The majority of salmon that were radio tagged in September/October in the Middle Dee were summer fish (i.e. had entered the Dee in the summer; 60%). The majority of these summer fish (59%) entered the Upper Dee during the spawning period. Traditionally it was understood that spring salmon predominated in the Upper Dee catchment (e.g. Girnock and Baddoch burn studies by Marine Scotland). However, in 2009, one third of the fish caught and tagged in the Lower Dee in the autumn were spring or early summer entrants; the majority of these remained in the Middle (40%) and Lower (40%) Dee during the spawning period. Although fewer spring salmon were tagged in 2010 (5% of tagged fish were spring salmon and 27% were spring or early summer salmon), these fish were split between the Upper (46%) and Middle Dee (54%) at spawning time. In short, we have found no evidence that spring salmon captured in the autumn fishery are heading predominantly to the Upper Dee, or evidence that later-running stock components (summer and autumn) are predominantly in the lower reaches of the Dee.

Although spawning occurs earlier in the Upper Dee (see following section), there was no relationship between the location of a fish's final (spawning) site and the time that the fish reached this location. Thus, fish that were destined for the Upper Dee reached their spawning grounds no earlier than fish that had spawning sites in the Middle Dee. One fish reached its final destination in the Upper Dee on 4 October (and remained there until January) and two other fish reached their final position in the Upper Dee on 31 October. All other fish reached their destination in the Upper Dee in November (and one fish in December). It therefore appears that the Upper Dee fish that are caught in the Middle Dee autumn fishery are not the earliest spawners (i.e. October spawners) in the upper catchment. It may also suggest that (for the Middle Dee spawners at least), arrival at spawning grounds does not reflect readiness to spawn.

The time of arrival at the spawning location was not influenced by the initial entry time of fish into the river (spring, summer, autumn), suggesting that river entry time does not influence time of spawning or that arrival at the spawning site does not necessarily mean imminent spawning.

Radio tracking does not allow confirmation of a spawning event, as fish are not (or rarely) observed. This year, a single fish (tag 103) was recaptured (at Park in February 2011) and was identified as a kelt (i.e. it had spawned). It is interesting to note that fish 103 was a female grilse which did not migrate upstream, rather staying within 2 km of her tagging site. No carcasses were retrieved following this year's study, possibly owing to weather conditions and flow levels.

Redd Count Surveys

Introduction

Repeated redd count surveys can demonstrate when spawning starts and when spawning peaks at a given location. Previous surveys (for salmon and sea trout) show that spawning occurs earlier in the Western catchment of the Dee. Downstream of Aboyne, salmon redds have not been found before the first week of November, suggesting little spawning takes place in the Lower and Middle Dee in October.

The trial of the season extension has been limited to downstream of Aboyne Bridge, to avoid targeting early-spawning fish and spring salmon. However, it is unclear whether fishing in the Middle Dee (particular the higher section, towards Aboyne) could target fish close to, or even in, their spawning period, as it is possible that October-spawning fish may be occurring in or above this region. In 2010 the redd count surveys were used to focus around the Middle – Upper Dee boundary (i.e. Aboyne area) to determine the start of the spawning period in this part of the catchment.

Methods

Repeat redd counts were carried out during the spawning season on seven tributaries and at three sites on the main stem. These sites were spread throughout the catchment but focused on the Middle/Upper river area (1. River Clunie, 2. Feadar burn, 3. Invercauld main stem, 4. Cambus O' May main stem, 5. River Tanar, 6. Tarland burn, 7. Birse main stem, 8. Cattie burn, 9. Beltie burn, 10. Sheeoch burn). In addition, information from 2009 surveys on the main stem at Dinnet and Drum is presented here.

Redd count surveys were carried out once per week at each site from the first week of October. However, because of high flow conditions in November, surveys were not always possible at each site during November. No redd counts were undertaken after the fourth week of November because snow made accessing the sites impossible. Therefore between three and six successful surveys were made at each site. This meant that it was not always possible to confirm in which week spawning had started at a given site. For each count, only fresh redds (i.e. redds that were not present at the previous survey) were recorded. The results presented below include 2009 and 2010 survey data.

Results

In the Upper Dee, salmon spawning was recorded in October in three of the five sites (River Clunie, Feardar burn, Dinnet main stem; Fig. 11). In the River Clunie and Feardar burn (the most westerly sites), starts and peaks in the fourth week of October (21 – 24 Oct).

In the Middle and Lower Dee, spawning at both main stem and tributary sites started in the first or second week of November in 2009/10 (Fig. 11).

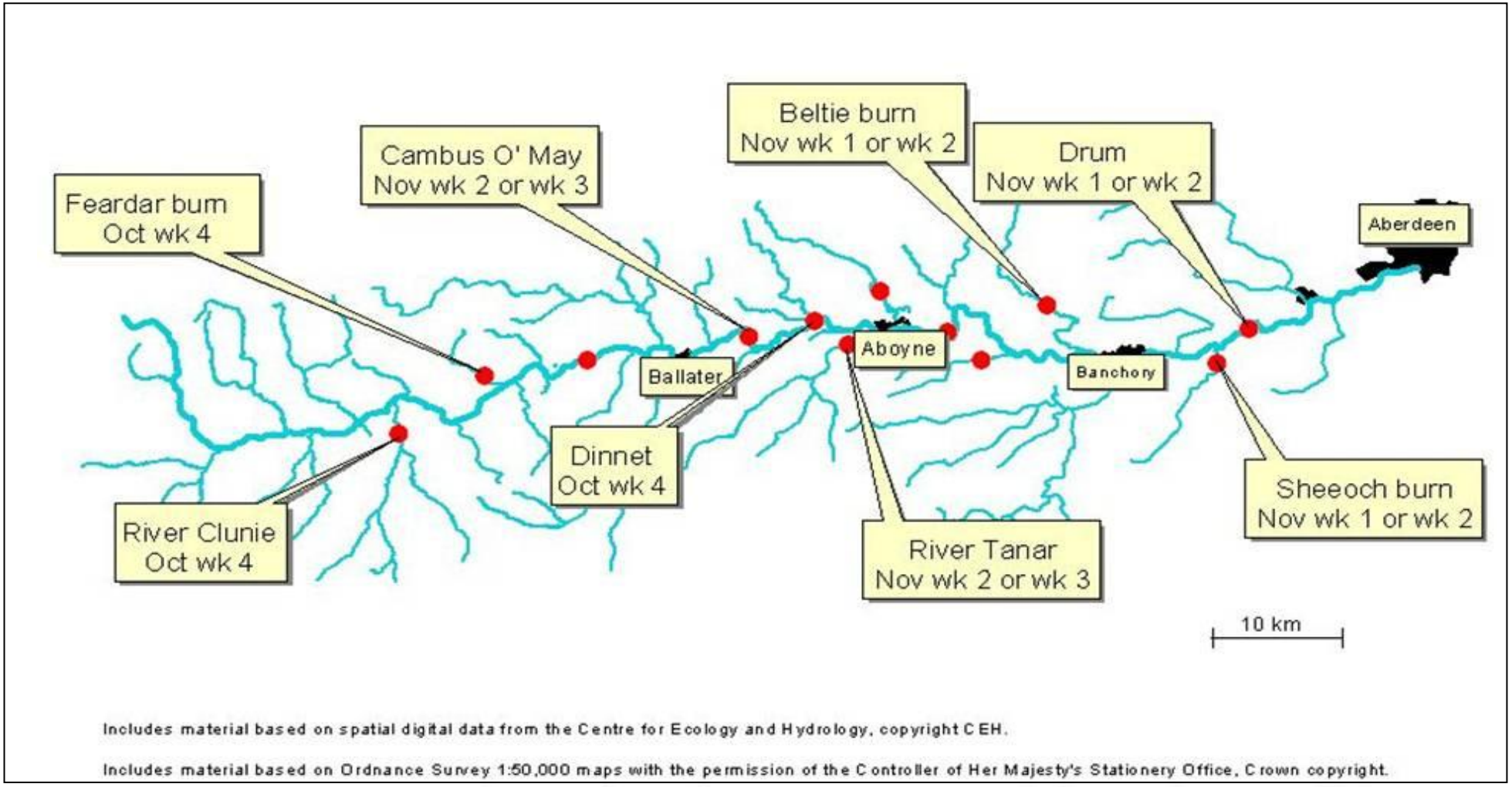


Figure 11. Start of salmon spawning in the Dee catchment, based on repeat redd count surveys in 2009 and 2010. Red dots represent survey sites.

Conclusions

The redd count surveys show that spawning occurs in late October in the Upper Dee, with no October spawning of salmon detected downstream of Aboyne. Further differentiation in the start of spawning along the length of the catchment was not identified, hence it appears that the upper half of the catchment (upstream of Aboyne) could be seen as 'earlier' spawning and the lower catchment (downstream of Aboyne) as 'later' spawning.

Although no cline was detectable for the start time of spawning through the catchment, surveys in 2009 found that the peak and duration of spawning show more of a cline within the catchment; with peak spawning occurring later and spawning duration being greater in the lower catchment.

There is some annual variability in the onset and peak of spawning (e.g. noted between 2009 and 2010), due to conditions such as weather, flows and temperatures. This is particularly likely to influence spawning in tributaries, as flows can affect access into tributaries and smaller water bodies are more rapidly influenced by changing temperatures. However, the earlier spawning found consistently in the Upper Dee may be in response to the lower water temperatures, which affects the development rate of spawned eggs and newly-hatched fish (Taranger et al 2003, Taranger & Hansen 2008).

Conclusions

The monitoring of the fishing season extension period was carried out in 2010 with a focus on the Middle Dee fishery (Between Aboyne Bridge and Banchory Bridge). Three objectives for monitoring were outlined and these are addressed below.

Objective 1. To assess whether fish caught by rod and line and released in the first two weeks of October have the same chance of successfully surviving to spawn as those caught in the last two weeks of September.

The radio tracking project found no significant difference in the movements and final destinations of salmon caught and tagged in the Middle Dee in the last two weeks of September compared to the first two weeks of October. There was also no significant difference between fish caught and tagged in the last two weeks of September and in the first two weeks of October in the time that they reached their final (spawning) destination, providing no evidence that these two groups of fish had different spawning periods. This provides strong indication that, for the Middle Dee, extending the fishing season to 15 October will have no additional impact on the survival of salmon after capture and handling - and therefore on the sustainability of the salmon stock - than closing the fishing season after 30 September. In support of this conclusion, a study by Booth et al (1995) looked at the impact of catch and release of Atlantic salmon just prior to spawning. The study found that, after salmon were fly fished and played to exhaustion, physiological recovery occurred within 12 hours and the stress response was minimal (which may have been due to low water temperatures in the autumn). They also found that egg survival from females was not affected by capture and handling close to spawning time.

Objective 2. To determine if Aboyne Bridge is the correct upstream limit of the season extension.

Redd count surveys indicate that commencement of salmon spawning in the Middle Dee is no earlier than November. However, nearly half of the fish captured in the Middle Dee in the autumn (September and October) migrated into the Upper Dee. Several of the sites surveyed in the Upper Dee recorded salmon spawning in the fourth week of October. However, the fish captured in the Middle Dee autumn fishery that were radio tagged and destined for the Upper Dee reached their final (spawning) destination in the second week of November, on average, and only a single fish may have been at spawning grounds and ready to spawn in October. This suggests that the Upper Dee fish captured in the Middle Dee fishery are not early (October) spawners.

As there was no evidence of a difference in the movements and behaviours of fish destined for the Upper Dee, compared to fish that remained in the Middle Dee, it appears that the Middle Dee fishery (between Aboyne Bridge and Banchory Bridge) does not impact on either the Middle or Upper Dee fish stocks it is comprised of. In addition, the radio tracking conducted in 2009 provides evidence that fishing until 15 October below Banchory does not impact on any of the stocks it is comprised of.

Objective 3. To determine what stocks of salmon are being caught in the first two weeks of October and whether there is an impact on the more vulnerable stocks of Spring-running salmon.

The radio tracking suggested that the October fishery in the Middle Dee targets both Middle and Upper Dee stock. Scale samples showed that the majority of salmon caught in the Middle Dee in the autumn (September and October) were Multi Sea Winter (MSW) salmon, with the remainder being grilse. Scales also showed that three quarters of the sampled October rod catch in the Middle Dee comprised summer/autumn salmon. The remainder of the rod catch was classed as either spring salmon or 'spring or early summer' salmon (a proportion of scale readings were inconclusive due to scale erosion). There was a slightly greater proportion of summer/autumn salmon in Middle Dee's September fishery (90%) but the difference was not statistically significant.

The radio tagged spring salmon and 'spring or early summer' salmon showed final (spawning) locations in the Upper and Middle River. These fish showed (statistically) similar movements (upstream/downstream/non-directional), migration distances and timing of migration to summer/autumn fish. There was no evidence of any impact from capture and tagging. It is therefore concluded that the October fishing extension in the Middle Dee has negligible impact on the sustainability of the spring salmon stock.

This report, along with a summary report for the three year monitoring trial, will be sent to the Dee DSFB in March 2011. The Dee DSFB will then make a decision on whether to apply for a permanent licence to extend the season based on the findings of the monitoring programme over all three years.

Acknowledgements

We are grateful to the following ghillies and angling club representatives for scale sampling throughout the year, for help with the radio tracking programme and collecting rod catch information:

Willie Banks (Tilbouries)
Shane Christie (Middle Drum)
Alex Coutts (Aboyne Castle)
Cleve Cowie (Crathes Castle)
Jim Cowper (Aboyne)
Keith Cromar (Park)
Colin Espie (Deecastle)
Robert Fettes (Lower Crathes & West Durris)
Kevin Fleming (Altries & Lower Drum)
Stuart Fleming (Aberdeen & District Angling Association)
Ian Fraser (Commonty)
David Gibbon (Middle Blackhall)
Robert Harper (Lower Crathes & West Durris)
Archie Hay (Crathie)
Martin Hayward (Little Blackhall & Inchmarlo)
Martin Holroyd (Ballater Angling Association)
Mike Maughan (Feugh)
John McGinley (Kincardine)
Ian Murray (Monaltrie & Lower Invercauld)
David Murray (Monaltrie & Lower Invercauld)
Bill Palmer (Borrowstone)
Jim Paton (Upper Drum & Lower Durris)
Terry Paton (Little Blackhall & Inchmarlo)
Karl Revel (Invery)
Brian Sim (Crathes Castle)
Colin Simpson (Lower Blackhall & Kinneskie)
Eoin Smith (Upper & Lower Dess)
Sean Stanton (Ballogie & Carlogie)
Jim Turnbull (Invery)
Bert Webster (Park)
Charlie Yates (Park)

We are also grateful to the anglers who provided us with the fish for radio tagging (see Appendix) and for the River Dee proprietors for allowing us access to their land throughout the radio tracking period. We are also grateful to Bryce Whyte (Marine Scotland, Montrose) for providing help in reading difficult scale samples.

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Appendix

Table 4. Radio tagged fish

Tag no.	Date of tagging	Tagging location	Angler	Tag no.	Date of tagging	Tagging location	Angler
90	17 Sep	M Blackhall	Mr T Bone	120	4 Oct	Borrowstone	Mr B Palmer
91	17 Sep	Inchmarlo	Mr I Vaananen	121	4 Oct	Commonty	Mr I Fraser
92	17 Sep	Carlogie	Mr D West	122	4 Oct	Ballogie	Mr G M Johnsen
93	17 Sep	Carlogie	Mr D West	123	4 Oct	Borrowstone	Mr B Palmer
94	20 Sep	Inchmarlo	Mr T Paton	124	4 Oct	Carlogie	Mr D Hoenes
95	20 Sep	Inchmarlo	Mr T Paton	125	4 Oct	Borrowstone	Mr B Palmer
96	20 Sep	Ballogie	Mr D McDonald	126	6 Oct	Carlogie	Mr D Hoenes
97	20 Sep	Inchmarlo	Mr T Paton	127	6 Oct	Carlogie	Mr D Halverson
98	21 Sep	Carlogie	Mr P Lindberg	128	6 Oct	Little Blackhall	Mr D Trembath
99	21 Sep	Carlogie	Mr P Lindberg	129	6 Oct	Carlogie	Mr D Halverson
100	21 Sep	Carlogie	Mr D Dunstan	130	6 Oct	Carlogie	Mr W Napier-Gibbens
101	21 Sep	Carlogie	Mr D Dunstan	131	7 Oct	Little Blackhall	Mr P Rimmer
102	24 Sep	Ballogie	Mr C McDonald	132	7 Oct	Commonty	Mr I Fraser
103	25 Sep	Commonty	Mr I Fraser	133	7 Oct	Inchmarlo	Mr T Paton
104	25 Sep	Borrowstone	Mr B Palmer	134	7 Oct	Ballogie, Bulwarks	Mr R Bull
105	25 Sep	Inchmarlo	Mr T Paton	135	8 Oct	Kincardine	Mr & Miss Habershon
106	27 Sep	Borrowstone	Mr B Palmer	136	9 Oct	Little Blackhall	Mr D Trembath
107	27 Sep	Borrowstone	Mr B Palmer	137	9 Oct	Inchmarlo	Mr T Paton
108	27 Sep	Borrowstone	Mr B Palmer	138	9 Oct	Carlogie	Mr D Craik
109	27 Sep	Ballogie	Mr M Dunn	139	11 Oct	Carlogie	Mr D Christensen
110	27 Sep	Carlogie	Mr G Currie	140	11 Oct	Borrowstone	Mr B Palmer
111	27 Sep	Borrowstone	Mr B Palmer	141	11 Oct	Commonty	Mr K Veyhle
112	27 Sep	Aboyne	Mr C Harris	142	11 Oct	Commonty	Mr L Terkildsen
113	27 Sep	Borrowstone	Mr B Palmer	143	11 Oct	Borrowstone	Mr B Palmer
114	27 Sep	Inchmarlo	Mr L Hickman	144	11 Oct	Borrowstone	Mr B Palmer
115	27 Sep	Carlogie	Mr P Longsdale	145	12 Oct	Carlogie	Mr K Veyhle
116	27 Sep	Borrowstone	Mr B Palmer	146	12 Oct	Commonty	Mr D Christensen
117	28 Sep	Ballogie	Mr M Dunn	147	12 Oct	Commonty	Mr H Westergaard
118	28 Sep	Lower Dess	Mr E Smith	148	12 Oct	Carlogie	Mr M Ludenbach
119	28 Sep	Inchmarlo	Mr R Merrin	149	12 Oct	Borrowstone	Mr B Palmer