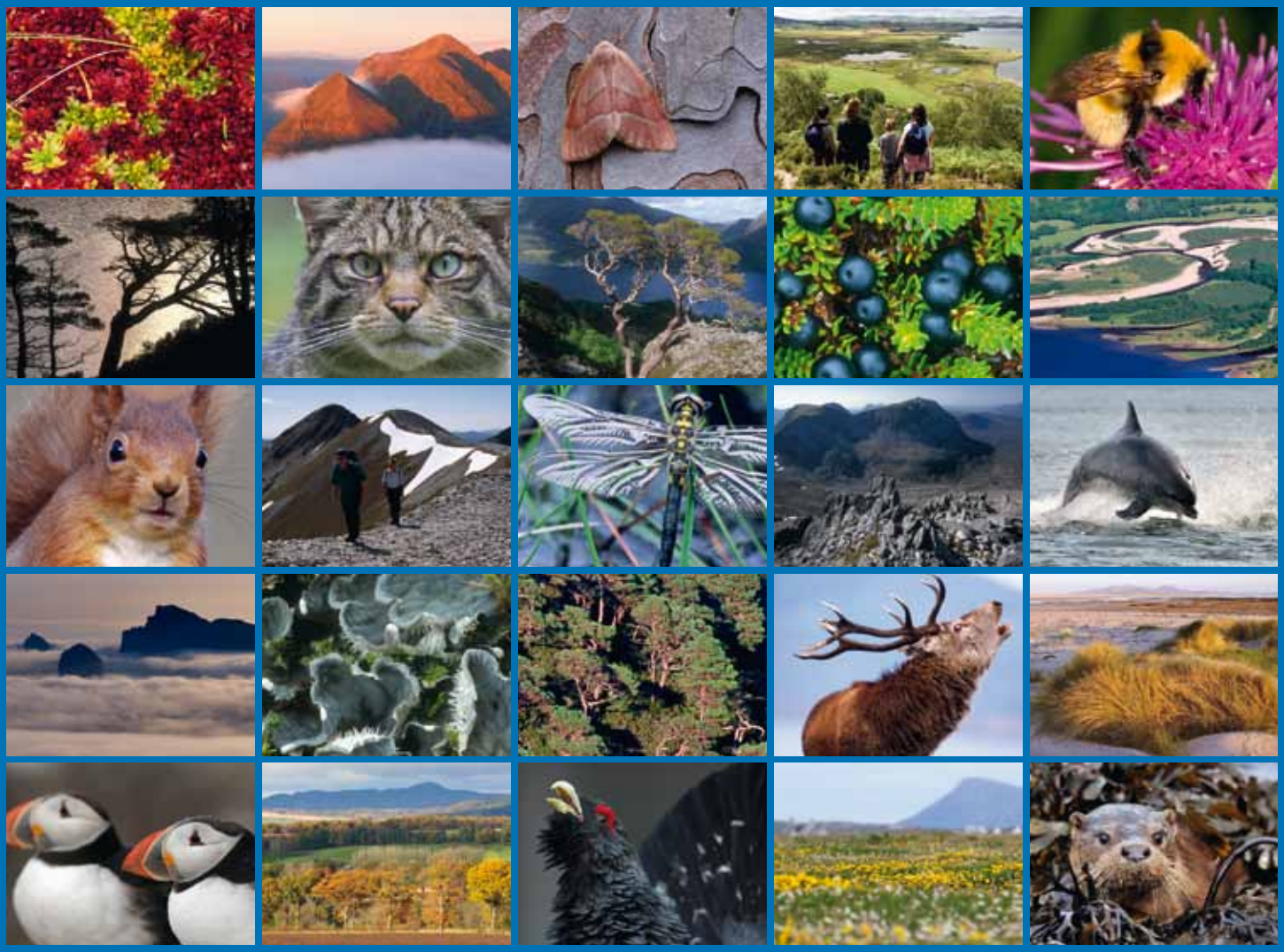
Scottish Natural Heritage
Commissioned Report No. 489

The Scottish Beaver Trial: Collection of fluvial geomorphology and river habitat data 2010



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COMMISSIONED REPORT

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The Scottish Beaver Trial: Collection of fluvial geomorphology and river habitat data 2010

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COMMISSIONED REPORT

Summary

The Scottish Beaver Trial: Collection of fluvial geomorphology and river habitat data 2010

Commissioned Report No. 489 (iBids No. 7062).
Contractor and Partner: Centre for River Ecosystem Science, University of Stirling
Year of publication: 2011

Background

A five year trial reintroduction of the European beaver in Knapdale, Argyll, began in spring 2009. An independent monitoring programme has been established to investigate the effects beavers might have upon particular aspects of the natural heritage were they to be released more widely in Scotland. The aspects being studied include: semi-aquatic and aquatic macrophytes; damselflies and dragonflies; fish; water chemistry; hydrology; and fluvial geomorphology and river habitat. In addition to extensive surveys at the start and end of the trial period, interim monitoring is being undertaken to establish the rate of any changes related to beaver activity. This report describes the collection of interim fluvial geomorphology and river habitat data in 2010, eighteen months after the beavers were released.

Main findings

Field observations made in 2010 suggest that there has been minimal change in the geomorphology and river habitat of the sub-set of sites selected for re-survey. Increased in-stream woody debris and the appearance of stream features associated with the activity of beavers were limited in number and scale and were highly localised. This is consistent with observations that the beavers are predominantly using loch habitat in the trial release area. Consequently there will be an increased focus on changes in standing water habitat from 2011, the methods and results for which will be published in a future report. Conclusions are based on field observations made during the application of River Habitat Survey and a bespoke geomorphic assessment.

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This project is part of the independent monitoring programme for the Scottish Beaver Trial coordinated by SNH in collaboration with a number of independent monitoring partners. For further information go to:
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CONTENTS

Acknowledgements

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1 INTRODUCTION

In spring 2009, a five year trial reintroduction of the European beaver (*Castor fiber*) began in Knapdale, Argyll. Ongoing monitoring of the trial includes the collection of data to illustrate the effects that beaver activity might have on the natural environment, with the aim of providing a comprehensive scientific dataset. This will provide important evidence that can be used to guide and inform future decisions about the reintroduction of beavers to other parts of Scotland.

A successful trial requires independent, objective monitoring, that has been carefully designed to detect any positive or negative habitat changes. For the reintroduction to be considered beneficial, judged criteria will include evidence of a positive contribution to ecosystem functioning and an absence of significant or unsustainable impairment to ecosystem functioning.

The University of Stirling's Centre for River Ecosystem Science is responsible for monitoring the response of fluvial geomorphology and river habitat and this report provides an update on the monitoring of these, specifically the re-survey of 12 stream reaches in 2010. These represent a subset of the 55 reaches surveyed to provide a baseline dataset in 2008.

The data collected are of sufficient quality and resolution to enable the differentiation between the effects of the trial beaver reintroduction and a range of other possible influences on the physical nature of the rivers and streams in the release area. Furthermore, the survey design has been integrated with other monitoring being undertaken, including studies of beaver ecology and fish surveys.

As a result of the beavers predominantly using loch habitat in the trial release area it is intended that future morphology and habitat assessments will also include those standing waters that have been the focus of beaver activity.

The aims of the interim survey of fluvial geomorphology and river habitat are presented in Section 2, below. The methods used are described in Section 3, and a more detailed discussion of the rationale for the study design is presented in Gilvear and Casas-Mulet (2010). An overview of the survey results is given in Section 4. Detailed analysis of the data is planned, and will be undertaken following the final monitoring surveys that will be undertaken at the end of the trial.

2 AIMS AND OBJECTIVES

2.1 Background

This report documents progress on the implementation of a monitoring programme designed to detect any changes in fluvial geomorphology and river habitat that may result from the reintroduction of beavers to Knapdale.

This survey follows a baseline survey, undertaken during the first year of the project (2008). The overall aims of the fluvial geomorphology and river habitat project are to:

i develop an appropriate method for collecting fluvial geomorphology and river habitat data against which any future changes, due to the trial release of beavers in Knapdale, can be measured; and

ii use the method developed to undertake a baseline survey of the fluvial geomorphology and river habitat of streams within the area of Knapdale identified as suitable for the trial release of the European beaver.

In the baseline survey report (Gilvear and Casas-Mulet, 2010) it was recommended that:

In reaches where beaver activity is identified by the field officer 14 months after the reintroduction of beavers, RHS surveys and modified geomorphic assessments will be repeated by University of Stirling specialists to provide an understanding of the development of in-stream and riparian habitat such as the re-growth of felled willow (see Jones et al., 2009). A comprehensive RHS and modified geomorphic assessment will take place for the whole area at the end of the trial period.

As a result, the sites identified for the interim survey included a number where beaver activity had been observed by Scottish Beaver Trial field officers. However, the field officers also reported that the beavers had not explored or utilised the stream system intensively.

2.2 The interim survey

The aim of this interim survey was to:

survey a subset of reaches using the protocols developed by Gilvear and Casas-Mulet (2010) for assessing changes in fluvial geomorphology and river habitat.

The collection of interim data will allow a more detailed assessment of changes than would be gained through simply comparing baseline data to data collected at the end of the trial period. The approach taken should provide an insight of the dynamics of any changes detected. The collection of interim data is also prudent as it enables evidence of the onset of large-scale changes to be reported early, were they to have occurred.

The specific objectives of the 2010 survey were to:

i repeat RHS surveys on 12 reaches within the survey area; and

ii repeat fluvial geomorphology surveys on 12 reaches within the survey area to include:

- in-channel fluvial features and substrate types;
- bank side vegetation presence and structure;

- wider riparian woodland and wetland habitat features;
- hydraulic meso-habitats;
- bank morphology and stability; and
- the extent and significance of woody debris.

The surveys incorporated habitat attributes that may be influenced by beaver activity. Knowledge of the general location of the released beavers enabled the interim survey to be targeted at areas of beaver activity. This will allow an assessment of the changes at various disturbance levels.

The data collected during the 2010 survey will be analysed following the end of the trial reintroduction period.

3 METHODS

3.1 Overview

The 2010 re-survey sites comprised 12 of the 55 baseline reaches. Both the River Habitat Survey (RHS) and fluvial audit protocols developed for the collection of baseline data in 2008 were followed. Gilvear and Casas-Mulet (2010) provide a detailed description and rationale for these methods, a summary of which is provided in Table 3.1.

As in previous surveys, collected ecological data were complemented with both GPS mapping (a hand-held SATMAP Active10 GPS) and photographs taken at cross-sections and of significant features. Where poor satellite reception prevented the collection of GPS data, locations were marked directly on to Ordnance Survey (OS) maps.

The reaches resurveyed are listed in Table 3.2 and shown on the map in Figure 3.1.

3.2 River Habitat Survey

River Habitat Survey is a reliable method for surveying stream and river habitats over 500 m reaches (Fox *et al.*, 1998; Raven *et al.*, 1998). For the purposes of the Scottish Beaver Trial, RHS surveys are undertaken during the winter months as the absence of dense riparian vegetation enables more accurate recording of habitat structure.

3.3 Modified geomorphic assessment

As in 2008, additional data not recorded by RHS were collected:

- Data associated with channel dimensions, bank side vegetation, fallen trees and hydraulic meso-habitats were collected at each RHS spot-check.

- Woody debris, erosion and deposition, and wetland and pond feature data were collected independently of spot-check data and were noted wherever they occurred along the length of the reach being surveyed.

3.4 Data processing

The data collected will be analysed and the findings given to SNH at the end of the trial.

Both hard and electronic (PDF) copies of completed RHS forms will be given to SNH. Other data will be added to *Microsoft Excel* databases and spatially linked using geographical information software (*ArcGIS 9.2)* as per the baseline dataset. A complete photographic library will be supplied in electronic format.

Table 3.1 *A summary of the data collected during the modified geomorphic assessment of stream reaches in the Knapdale area*

Reference information	
spot-check code	unique identifier for each individual spot-check
RHS reach	number identifying the reach being surveyed
photo reference	unique identifier for each photo taken
easting	OS grid reference easting (OSGB36)
northing	OS grid reference northing (OSGB36)
watercourse	name of watercourse (if named)
tributary to	loch that a stream flows into
date	data collection date
Channel dimensions and characteristics	
The standard RHS method records channel dimensions at one location for each 500 m reach. The modified survey records the following information every 50 m:	
bankfull width, left bank top height, right banktop height	bankfull as delimited by the first major break in slope or occasionally by the limit of terrestrial vegetation
bankfull depth 1, 2 & 3	bankfull channel depths recorded at ~0.4 m intervals across the wetted channel width
bed material type	bed material classified as 'consolidated' or 'unconsolidated'
Bankside vegetation	
The standard RHS records vegetation structure at 10 spot-checks within each 500 m reach but only notes the presence of alder species. Furthermore, information on vegetation structure is not linked to vegetation communities or key species relevant to beaver foraging activity. To rectify this, the following information was collected along a 25 m transect across the river corridor perpendicular to the stream:	
left bank and right bank vegetation width	width of left bank and right bank riparian broadleaf woodland (0–1 m, 1–5 m, 5–10 m, 10–15 m, >15 m)
left bank and right bank vegetation distribution	distribution of left bank and right bank broadleaf trees (none, none-CP (indicating the presence of coniferous plantation immediately next to the stream), isolated, scattered, semi-continuous, continuous)
left bank and right bank *Alnus* structure / cover left bank and right bank *Betula* structure / cover left bank and right bank *Salix* structure / cover	at each spot-check right bank and left bank structure (tree/shrub) and percentage cover of three key broadleaf tree genera (*Alnus, Betula* and *Salix*)
left bank and right bank other broadleaf structure / cover	structure (tree/shrub) and percentage cover of *Corylus* sp. and *Acer* sp. recorded for each bank
number of fallen branches	number of fallen branches tallied for three size classes (small, <1 m; medium, 1–5 m; large, >5 m)
number of fallen trees	number of fallen trees tallied for three size classes (small, <1 m; medium, 1–5 m; large, >5m)
dominant fallen tree species	dominant species recorded where a number of fallen trees observed

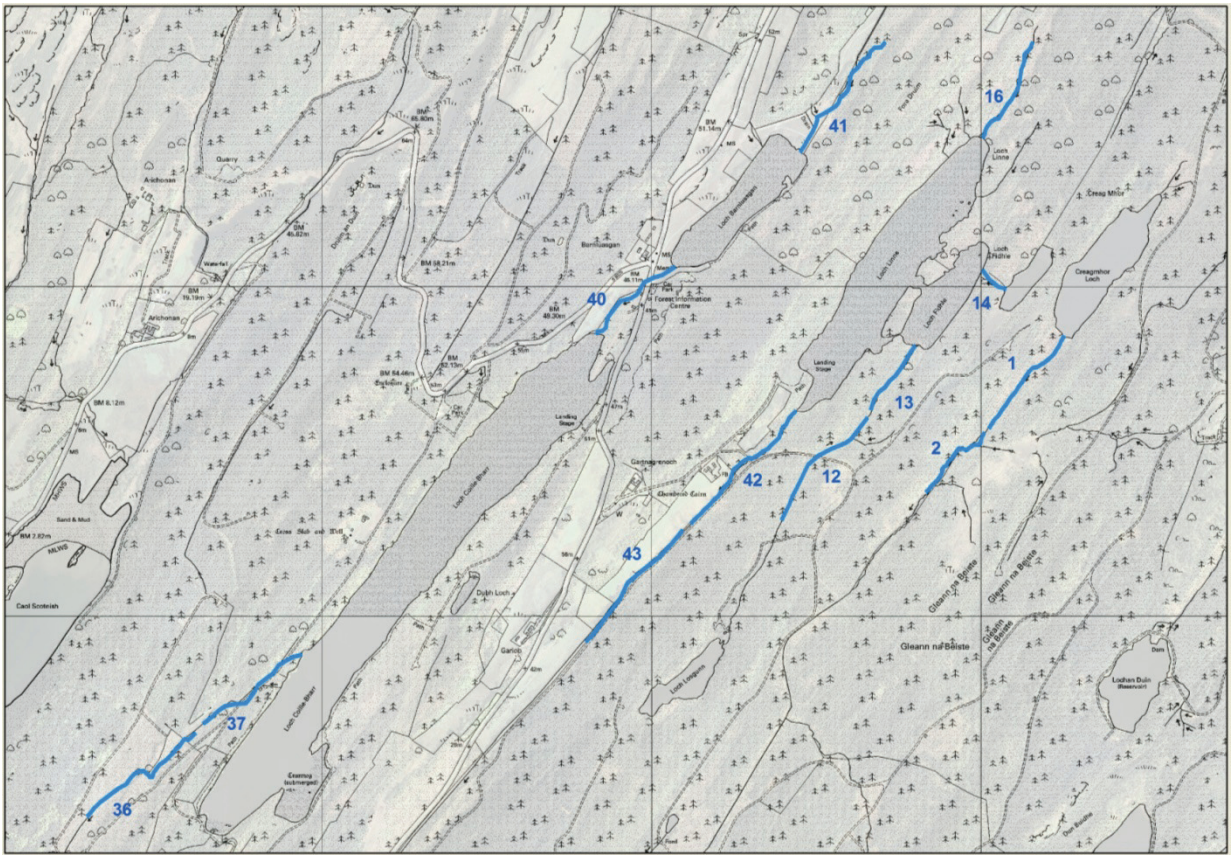
In-stream habitat	
A change in the hydraulic features of meso-scale habitat will occur in, and adjacent to, any reaches affected by beaver dam building activity. River Habitat Survey provides information on the presence and extent of flow types and channel features, but it does not map the location of meso-habitats. To address this, the following information was recorded:	
flow type (salmonid habitat)	hydraulic habitat assessment using six habitat types (riffle, riffle-run, glide, deep glide, pool and bedrock/cascade)
bed material	Two armour layer pebble counts (100 particles) were undertaken in every 500 m reach, using a standard pebble plate. Pebble counts were located at spot-checks 1 and 6 except where conditions did not allow, e.g. in bedrock reaches or those with heavily silted substrates
Woody debris features	
The standard RHS only reflects the presence/absence of woody debris features. As woody debris is expected to be influenced by beaver activity the following data were recorded:	
woody debris feature code	unique identifier for woody debris feature
woody debris feature composition	woody debris features classified by type (leaf, L; twig, Tw; branch, Br; trunk, Tk)
woody debris channel coverage	proportion of channel covered by woody debris recorded as full-width (FW), half-width (HW) or marginal (M)
woody debris feature length and width	length (m) and width (m) woody debris dimensions (length and width in m)
woody debris feature photo reference	photo of woody debris feature
River corridor features	
river corridor feature code	river corridor feature unique identifier
river corridor feature type	pond, wetland, fallen tree, felled tree
river corridor feature length, feature width	river corridor feature length (m) and width (m)
river corridor feature location	feature location OS grid reference
river corridor feature photo reference	photo of river corridor feature
Erosion/Deposition features	
As part of the modified geomorphic assessment the location of areas of major bank erosion and sediment deposition were recorded, characterised, photographed and geo-referenced.	
erosion/deposition feature code	erosion/deposition feature unique identifier
erosion/deposition feature type	geomorphological term for feature
erosion/deposition feature substrate	cobble, pebble, sand, earth
erosion/deposition feature location	position in channel of erosion/deposition feature (left bank, LB; right bank, RB; in-channel, Ch)
erosion/deposition feature length, feature width	erosion/deposition feature length (m) and width (m)
erosion/deposition feature location	erosion/deposition feature grid reference

Table 3.2 *Ordnance Survey grid references and survey dates for the reaches re-surveyed October 2010*

RHS reach	Associated Loch	Start point	End point	2008 date	2010 date
1	Creagmhor Loch (upstream)	180237 690828	179968 690515	06/11	21/10
2	Creagmhor Loch (upstream)	179968 690515	179692 690196	06/11	21/10
12	Loch Fidhle (downstream)	179383 690269	179632 690574	07/11	21/10
13	Loch Fidhle (downstream)	179634 690572	179798 690818	07/11	21/10
14	Loch Fidhle (upstream)	180002 691042	180069 690990	09/12	20/10
16	Loch Linne (downstream)	180005 691450	180087 691555	09/12	22/10
36	Loch Coile-Bharr (upstream)	177628 689682	177313 689425	05/11	21/10
37	Loch Coile-Bharr (upstream)	177902 689862	177636 689673	05/11	21/10
40	Loch Coile-Bharr (downstream)	179066 691053	178834 690863	02/12	20/10
41	Loch Barnluasgan (downstream)	179456 691422	179709 691741	13/01*	21/10
42	Loch Linne (downstream)	179425 690590	179103 690269	02/12	20/10
43	Loch Linne (downstream)	179103 690266	178774 689886	02/12	20/10

*2009

Figure 3.1 *Stream reaches re-surveyed in October 2010*



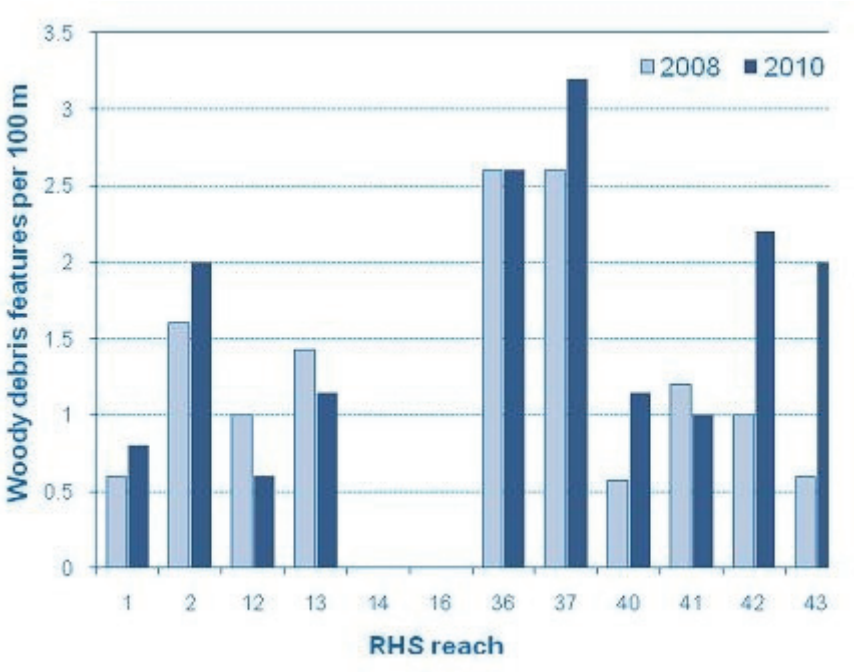
4 RESULTS

The collection of monitoring data from 12 reaches within the trial area was successfully achieved through the use of the methods described above. Of these, eight were complete RHS reaches of 500 m in length, two were 350 m long, and two were 200 m long (as a result of stream length or their proximity to lochs). Where appropriate, reaches were selected to coincide with areas of reported beaver activity. The surveys will allow detailed comparisons to be made between survey years and baseline datasets (including data collected in 2002). This analysis will be undertaken after the surveys at the end of the trial period.

No major geomorphic changes were observed across the reaches surveyed during the 2010 survey, when compared with the morphology observed during baseline surveys.

No significant changes in the amount or extent of woody debris were observed during the survey. Two notable exceptions to this were reaches 42 and 43. Inspection of the woody debris in reach 42 revealed four of the 11 woody debris features to contain beaver cut branches and twigs, three of which appeared to be the remains of dismantled beaver dams. Inspection of woody debris in reach 43 revealed no evidence of beaver cut material. However, the increase appears to be above the level of natural variability observed across the reaches surveyed. It is possible that the increase may be attributable to its proximity to a track where extensive cutting back of vegetation was observed in autumn 2009.

Figure 4.1 *Comparison of the number of woody debris features recorded per 100 m of channel for the subset of reaches surveyed in 2010 with baseline data collected in 2008*



The 2010 survey will provide additional detail on the nature and rate of any changes that are identified during the complete survey of all reaches, to be undertaken at the end of the trial.

5 CONCLUSIONS

The methods were successfully re-applied to a subset of 12 survey reaches in the Knapdale area, allowing the collection of standard RHS data and additional physical habitat data.

At this stage, a limited number of notable findings can be reported about the current status of the streams in Knapdale. No large scale changes were evident in the 12 reaches surveyed during 2010 fieldwork. These reaches were chosen to coincide with the reported locations of beaver activity. It is therefore possible to conclude that, up to 2010, beaver activity has had only a minimal effect on the fluvial geomorphology and river habitat of the streams in the Knapdale area. Small scale alterations to the fluvial geomorphology and river habitat were observed at a few locations and were associated primarily with the construction of small dams. These were, without exception, in close proximity to lochs.

In light of the results from the other Scottish Beaver Trial surveys, those presented here were to be expected. They indicate that the beavers have predominantly remained in the lochs and have not extensively occupied the stream systems in the area.

River Habitat Survey and fluvial geomorphology data, collected for this part of the project, will be used in future comparisons with baseline survey data and data collected at the end of the trial period. All datasets will have been collected from the same reaches using standardised protocols. A detailed analysis and interpretation of all data collected will be undertaken at the end of the trial.

As result of the beavers predominantly using loch habitat in the trial release area it is intended that future morphology and habitat assessments will also include those standing waters that have been the focus of beaver activity.

6 REFERENCES

Fox, P.J.A., Naura, M. & Scarlett, P. (1998). An account of the derivation and testing of a standard field method, River Habitat Survey. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **8**, 450-476.

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Appendix 1 Modified geomorphic assessment fieldwork form

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Modified geomorphic form (I) . vers2

RESS

Surveyor(s):	Date:	Water course:	RHS ref:

CHANNEL DIMENSIONS (linked to L in RHS)

Spot Check GPS	Meso Habitat type		Bed material (c / u)		LEFT BANK	CHANNEL						RIGHT BANK	Photo references
					Banktop height (m)	Bnkfull width (m)	Bankfull depth (m)					Banktop height (m)	
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													

BANKSIDE VEGETATION (linked to F & Q in RHS)

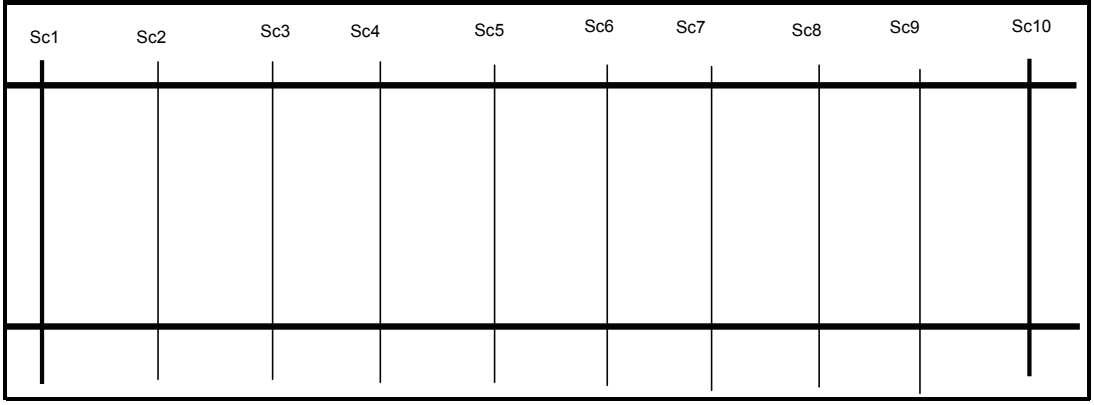
Spot Check GPS	LEFT BANK										RIGHT BANK									
	Buffer width (m)	Buffer structure	Birch (*Betula sp.*)		Alder (*Alnus sp.*)		Willow (*Salix sp.*)		Aspen (*Populus tremula*)		Buffer width (m)	Buffer structure	Birch (*Betula sp.*)		Alder (*Alnus sp.*)		Willow (*Salix sp.*)		Aspen (*Populus tremula*)	
			Structure	Coverage	Structure	Coverage	Structure	Coverage	Structure	Coverage			Structure	Coverage	Structure	Coverage	Structure	Coverage	Structure	Coverage
1.																				
2.																				
3.																				
4.																				
5.																				
6.																				
7.																				
8.																				
9.																				
10.																				

RIVER CORRIDOR (I) - Fallen trees (linked to H in RHS)

Spot Check GPS																				
	Type	Dimension	Specie	Number	Type	Dimensio	Specie	Number	Type	Dimensio	Specie	Number	Type	Dimensio	Specie	Number	Type	Dimensio	Specie	Number
1.																				
2.																				
3.																				
4.																				
5.																				
6.																				
7.																				
8.																				
9.																				
10.																				

SALMONID HABITAT ASSESSMENT (linked to K in RHS)

Type		Characteristics	Colour / code	Habitat quality score					
				5	4	3	2	1	0
Riffle (shallow)	*Fry habitat*	gravel, pebble							
Riffle - Run (unbroken standing waves)	*Mixed juvenile*	cobble, pebble, boulders		x	x	x	x	x	x
Glide (< 0.5m)	*Deep juvenile*	boulder, cobble (>40cm deep but suitable substrate)							
Deeper glide (> 0.5m)	*Glides*	small substrate, smooth surface		x	x	x	x	x	x
Pool	*Holding habitat-pools*	generally >1m depth		x	x	x	x	x	x
Bedrock / Cascade	*Bedrock*	bedrock pools		x	x	x	x	x	x
Spawning habitat			**Sp**	x	x	x	x	x	x
Obstacles			**Obs**	x	x	x	x	x	x



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Modified geomorphic form (II). vers2

RESS

	Date:	Water course:	RHS ref:

WOODY DEBRIS FEATURES

Feature no	Location / GPS code	Channel coverage			Length x Width (mxm)	Type	Photo reference	Feature no	Location / GPS code	Channel coverage			Length x Width (mxm)	Type	Photo reference
		total width	half width	marginal						total width	half width	marginal			

Type: leaf (L) branch (B) twig (T) trunk (TK)

Type: leaf (L) branch (B) twig (T) trunk (TK)

RIVER CORRIDOR (II) - Wetlands and ponds (linked to H in RHS)

GPS ref:	Type	Dimensions (m x m)		Characteristics		GPS ref:	Type	Dimensions (m x m)		Characteristics	
		RB	LB					RB	LB		

wetland (W) pond (P)

wetland (W) pond (P)

BANK STABILITY

Natural Erosion features / processes

Feature name	GPS location	Dimensions (m x m)			Substrate + c/u
		RB	Channel	LB	

Slump (Sp) Creep (C) Freeze-thaw (Ft) Toe scour (Ts)
Slide (Sl) Wash (W) Eroding bank (Eb) Bed scour (Bs)

DEPOSITON

Natural Deposition features / processes

Feature name	GPS location	Dimensions (m x m)			Substrate + c/u
		RB	Channel	LB	

Point bar (Pb) Mid-channel bar (Mb) Berm deposit (Bd)
Side bar (Sb) Discrete deposit (Dd) Floodplain dep. (Fd)

BED MATERIAL CHARACTERISATION (linked to E in RHS)

Wolman 1	Spot Check / GPS ref:	**Wolman 2**	Spot Check / GPS ref:
3		3	
4		4	
5.6		5.6	
8		8	
11.2		11.2	
16		16	
21.4		21.4	
31.5		31.5	
45		45	
63		63	
90		90	
128		128	
180		180	
256		256	
>256		>256	
Bedrock		Bedrock	

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