Oxfordshire Highways

Cogges Link Road
Fish Survey

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For avoidance of doubt all references in this document to 'Witney-Cogges Link Road' relate to the Cogges Link Road.

Fish population studies in the river Windrush, 2002

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CONTENTS

1. INTRODUCTION 1
2. METHODS 1
3. RESULTS 2
   3.1. Population size distributions 2
   3.2. Population density 3
4. DISCUSSION - FISH HABITAT SURVEY 3
5. ECOLOGICAL MITIGATION 4
   5.1. Fish clearance 4
      5.1.1. Background 4
      5.1.2. Tasks 4
   5.2. Draining down the river 5
6. CONTROL OF ON-SITE POLLUTION TO PROTECT FISHERIES 5
   6.1. Control of pollution 5
   6.2. Fuel handling 6
   6.3. Dewatering 6
   6.4. Operations on or near rivers 6
   6.5. Flood defence 6
   6.6. Overview 7
7. TIMING OF THE WORK 7
8. RESTRUCTURING OF THE CHANNEL 7
   8.1. Creating a salmonid habitat 7
   8.2. Creating a habitat for coarse fish 8

1. INTRODUCTION

This report presents information on fish diversity and density in the River Windrush, north of the A40 near Oxford, in October 2002. The work was commissioned as part of the environmental study for the proposed Witney-Cogges link road. In the study area the river is braided into three channels. The two principal channels, East and West, were quantitatively electric fished. The third channel is a small highly overgrown flowing ditch unsuitable for electric fishing, and was only subjected to visual examination.

2. METHODS

Quantitative electric fishing was undertaken at three sites on both the East and West channels of the River Windrush on October 9th 2002. The positions of the sites are shown in **Figure 1**.

On the East channel three 50 m reaches were fished (see **Table 1**). On the far smaller West channel three 25 m reaches were fished (**Table 2**). The shorter reaches on the West channel reflected the far smaller size of this stream - with fewer habitat types offered, less fishing area was required to get a fair reflection of the fish community. Further, the overgrown banks made access difficult and it is likely that in some areas electric fishing would have been difficult and inefficient. On both the East and West channels the reaches were fished sequentially, working upstream. Each reach was measured out using a tape, or when not possible, by pacing, and isolated using stop nets across the channel. The reach was then systematically electric fished in an upstream direction. All of the fish captured were identified to species, and standard lengths were measured to the nearest millimetre. For abundant species at least 50 individuals were measured. For each reach the systematic electric fishing was repeated until the number of fish captured for all abundant species had declined over 3 successive passes. This was to allow a removal sampling method to be used to estimate population density.

The fished reaches were contiguous so that on completion of one reach the lower stop net was moved upstream to form the upper boundary of the next reach to be fished. The positioning of the reaches was chosen so that they would hold the fullest possible range of the habitats available to the fish in the vicinity.

The efficiency of electric fishing increases with the size of the fish, and the method is unreliable for fish less than 25 mm in length. The East channel of the river held large numbers of fish < 25 mm in length which were not sampled. All of the small individuals examined were minnow, *Phoxinus phoxinus*.

Reach	Width (m)	Depth (cm)	Description
1	5	25	Clean gravel/chalk, shallow and fast flowing, some *Ranunculus* in the river. Willows on the bank.
2	5	40	Slower flowing with deeper holes (75 cm) with water-crowfoot (*Ranunculus*) and undercut banks. Some trees on the bank
3	4	60	S bend - shallow inside of corners, with reeds. Deep hole on outside of bend. Holes to 2 m, undercut tree-lined banks.

Table 1: A brief description of each of the 50 m lengths of the East channel of the River Windrush

Reach	Width (m)	Depth (cm)	Description
1	4	50	Slow-flowing with overgrown banks, silty gravel, large beds of reed sweet-grass and branched bur-reed
2	4	35	Overgrown, tree and bush lined, silty gravel. Over-hanging trees. Shallow margins.
3	3.5	30	Right bank overgrown, the left more open. Silty gravel, no undercuts on the banks.

Table 2: A brief description of each of the 25 m lengths of the West channel of the River Windrush

All the captured fish were subsequently released alive. Population size was estimated using Zippin's method in the computer program *Removal Sampling* (written by Pisces Conservation Ltd.). This method assumes a constant probability of capture and seemed appropriate for the conditions and data collected.

3. RESULTS

The counts of the individuals are given in **Appendix 1**. The sizes of each fish are given in **Appendix 2**. Detailed output from the computer analysis of the data is given in **Appendix 3**. The species found and the estimates of their population densities are given in **Table 3**. A total of 10 species were caught, indicating that the river holds a generally diverse and varied community. The only commonly found species missing from this list that we would have expected to see was the eel, *Anguilla anguilla*. For each channel of the river the population estimates are calculated by combining the results from the reaches. This was necessary because of the small number of individuals of some species captured.

Species Name	**Scientific name**	**East Channel**		**West Channel**	
		Observed	**100 m^{-1}**	**Observed**	**100 m^{-1}**
Minnow	*Phoxinus phoxinus*	465	**487**	34	**51**
Bullhead	*Cottus gobio*	139	**137**	9	**13.5**
Chub	*Leuciscus cephalus*	11	**7.3**	7	**19.6**
Stone loach	*Noemacheilus barbatulus*	2	**1.3**	4	**5.8**
Brown trout	*Salmo trutta*	23	**16**	0	**0**
Stickleback	*Gasterosteus aculeatus*	5	**5.7**	0	**0**
Barbel	*Barbus barbus*	1	**0.7**	0	**0**
Perch	*Perca fluviatilis*	0	**0**	3	**4**
Dace	*Leuciscus leuciscus*	0	**0**	2	**2.6**
Pike	*Esox lucius*	0	**0**	1	**1.3**
Total Density			**655**		**97.8**

Table 3: Fish species recorded in the River Windrush, October 2002. The first number in each column is the total number recorded at each site after three electric fishing passes. The second number in bold is the density of fish per 100 m of stream.

3.1. Population size distributions

Figure 2 shows the size distribution of bullhead, *Cottus gobio,* in the two channels of the river. The population within the brook was dominated by the 1+ age classes with a modal length of about 40 mm SL. It is possible that the 70 mm SL fish belonged to the 2+ age group.

Bullhead were most abundant in the east channel. It is certain that the 0+ fish were under-sampled, as very small fish are difficult to catch by electric fishing.

The size distribution of minnows (*Phoxinus phoxinus*) is shown in **Figure 3**. The modal size of the fish was about 60 mm SL. Many very small minnows were observed but were not sampled effectively by electric fishing.

Figure 4 shows the size distribution of brown trout, *Salmo trutta*, which was only caught in the East channel. The population comprised a number of age classes, young of year dominated with a few older 1 and 2+ individuals present. The fish gave the appearance of being in good condition.

3.2. Population density

The ten species of fish recorded during the survey are listed in **Table 3** together with the total number captured and the estimated population density in numbers per 100 m of river. The two most abundant species were bullhead and minnow. However, in terms of biomass, chub and trout were the dominant fish as the individual weights of these species were far greater than that of the bullhead and minnows. In biomass terms barbel are also more important than their numbers might suggest. While only a single individual was caught, it was a large fish (410 mm SL) and other individuals were seen in the vicinity.

There were large differences in species composition, density and biomass between the two localities (**Table 3**). Both channels of the river contained 7 species, but each held three species not found in the other channel. Trout, barbel and stickleback were only found in the east channel and pike, dace and perch were only found in the west channel. In addition to these differences in species present there were also notable changes in abundance. Overall there were fewer fish present in the West channel of the river. In particular there were an order of magnitude fewer bullhead and minnows, but increased numbers of chub and stone loach. There is a clear difference between the fish communities of the east and west channels of the river. The east channel held the typical elements of an open trout stream, while the west channel could be characterised as a lowland cyprinid/perch dominated water.

4. DISCUSSION - FISH HABITAT SURVEY

The bed of the East channel of the river offered a variety of habitats. The depth varied considerably from riffles, often used by young trout, to deep pools used by adult trout, chub and barbel. The main bed of the river was clean gravel with chalk, well washed by the strong flow, offering good conditions for minnows and trout. The main riverbed was also colonised by water-crowfoot (*Ranunculus* sp.) offering excellent shelter for small fish and their invertebrate food. Along the banks the steady flow of the river had created meanders, with undercut banks on the outer curve and shallows and reed beds on the inner curve. This arrangement gives the widest possible range of habitats for juveniles, adults and shallow and deeper water fish species. The riverbanks also contributed to the diversity, with overhanging trees interspersed with open grassy banks. The open nature of the East channel of the river produces a classic trout stream. Large trout were only found in the faster flowing shallow parts of the river. Young trout were found in stretches 1 and 2. Perhaps rather surprisingly, trout were not observed at all in stretch 3, a reach with deep pools and undercut banks. This section contained the only barbel caught during the study.

In contrast the West channel was a much more homogeneous habitat. The riverbanks were overgrown and there was little plant growth in the stream, presumably due to shading by overhanging trees. Flow was obviously considerably lower than in the larger East channel as the gravel was clogged with silt and there were fewer spots where the stream had undercut the bank. The overgrown, slower-flowing west channel held a larger number of coarse fish. In the first two sections of this river the water was deeper and contained pike, perch, and dace. This channel of the river showed much more evidence of impact from rubbish (there were large amounts of litter in the water) and sediment run-off. It is also possible that this stream is impacted by run-off from nearby roads and car parks.

The third, minor, channel of the river was only subjected to a visual inspection. For much of its length it runs through woodland/scrub and beneath thick undergrowth, which would have made electric fishing extremely difficult. It is generally narrow, only 1 – 2m in width, shallow, and quite heavily silted. In unshaded sections, it supported marginal vegetation including Branched Bur-reed, *Sparganium erectum*, Water-mint, *Mentha aquatica*, Lesser Water-parsnip, *Berula erecta*, and Bittersweet, *Solanum dulcamara*. It is probable that it is polluted by run-off from the nearby road, and as such is unlikely to support a large and diverse fish population.

The fish caught on both main channels of the river were generally in good condition. One chub caught in stretch 2 of the East channel was observed to have significant scale damage on its flanks, although its condition did not appear poorer as a result.

5. ECOLOGICAL MITIGATION

5.1. Fish clearance

5.1.1. Background

There is a requirement to relocate fish from a short section of river due to be diverted. As many as possible of the fish living within the section should be removed alive and placed in another section of river. Care must be taken to ensure that the displaced fish survive capture and transportation and are subsequently able to survive in their new location.

5.1.2. Tasks

Electric fishing should be used to clear the area of fish. This must be undertaken following the Environment Agency code of practice for safety in electric fishing operations. This requires the use of approved electric fishing equipment with a current test certificate and staff that have undertaken training and been certified competent. The clearance team should consist of at least four people, two electric fishers and two workers to care for the captured fish and transport them to the new site. The stretch of river to be cleared should be divided into sections by stop nets and each section cleared systematically. A removal sampling approach should be taken, with the number and species of fish caught on each sweep recorded. Each section must be electric fished several times until a sweep occurs in which no fish larger than 10 cm is caught. Electric fishing is inefficient for small species such as minnows and sticklebacks so it is inappropriate to specify that sweeps should be undertaken until no further fish are caught. Only two members of the team may be in the water at any one time and a third member of the team must be by the control box on the bank to activate the emergency stop button. The work area must be checked to ensure that non-involved people are kept clear. Fishing must stop immediately if any animals or unauthorised people come within 5 m of the electrodes.

Ideally, an in-stream holding facility should be used, in an area where the captured fish will not be affected by the electric fishing. Aeration should be provided if the fish are to be stored out of the stream for more than 10 minutes. Fish removed from the stream must be reintroduced downstream as soon as possible. They should be released as carefully as possible to reduce damage and care should be taken to choose a spot where they can be released without suffering high predation losses while recovering.

5.2. Draining down the river

If the channel can be drained this should be done gradually by closing off the upstream end of the section. The pools left should be checked for fish, which, if found, should be removed using the methods outlined above. If the pools are small a simple netting and removal will probably suffice.

6. CONTROL OF ON-SITE POLLUTION TO PROTECT FISHERIES

As little 'grey' drainage water as feasible should be released from the site. The practice must fully comply with BS6031 (Code of Practice for Earthworks - concerning the general control of site drainage):

Where public sewer systems are available and an arrangement has been made with the local water company, drainage water should be discharged to the sewer system.

Hardstanding areas should be used for all plant maintenance and washing off. Wastewater from these areas should pass through an oil interceptor and settling tank system. These hardstanding areas should be remote from any drain or watercourse. Disposal of effluent from vehicle washing containing detergent should be via a foul sewer or sealed tank. Water released from this area should be of sufficient quality to meet any of the relevant Discharge Consents.

All practicable measures to prevent the mobilisation or migration of contaminants to groundwater should be taken.

Run-off from sites should, where appropriate, pass through settlement tanks or pools before discharge. Sampling to ensure water quality prior to discharge should be carried out when appropriate.

Particular attention should be paid to any on-site concrete batching plants to ensure that no cementitious materials enter the drainage system.

The site should be kept clean and tidy. There should be as little broken ground left exposed to the elements as possible. If areas are to be left open for long periods of time, erosion control methods such as geotextiles, cover crops or contour drainage should be implemented.

Effluent water from concrete batching plants, bentonite plants, grout mixing plants and concrete washing should be recycled within the process or passed via a settlement tank to a foul sewer, soak-away or sealed tank.

6.1. Control of pollution

The layout of the site and facilities should be designed to minimise the risk of pollution reaching the groundwater or watercourses. Any potentially polluting activities should be at least 10 metres from any watercourse. Potentially polluting substances, where stored on site, must be kept to the minimum level required to complete the work in progress. On-site storage of chemicals, fuels, etc. should be checked regularly and any container found to be leaking

removed to a suitable handling facility. Bunding capable of containing 110% of the maximum volume of stored liquid should be constructed around storage areas wherever possible.

6.2. Fuel handling

Refuelling is a potentially polluting activity. It must be carried out as far away as feasible from any watercourse or drain. Best Practice Means, for both fixed pump sites and mobile refuelling, will be adopted. These include:

- the positioning of sites for refuelling away from sensitive receptors and areas,
- the construction of containment and bunding (capable of containing 110% of maximum volume of stored liquid),
- a regular inspection routine, with maintenance and repair as appropriate,
- dispensing nozzles with automatic shut-off and lockable flow controls which lock when not in use
- provision of spillage kits, locks and other suitable security devices,
- refuelling area should be paved with an impervious surface and drained. Drainage from the area should pass through an oil interceptor and settling tank system prior to discharge,
- fuel bowsers and stores should be as far as possible vandal-proof

6.3. Dewatering

The area of influence of dewatering activities and longer-term effects on groundwater flow and quality should be kept to a minimum.

6.4. Operations on or near rivers

Fording or work in rivers by vehicles should not be allowed without the prior agreement of the Project Manager and the Environment Agency.

Only essential activities should be carried out in relation to the construction of culverts, bridges and associated works. Any work in or around watercourses should be carried out in a manner that reduces the impact of the work on the watercourse. Special attention should be paid to the environments that depend on water to survive, including marshes, ditches, streams and fisheries.

Culverts should be constructed without water flowing though them. They should then be brought into use before the closure of the existing culvert. Submersible electric pumps should be used for moving water where appropriate.

Operations should take place so that they do not limit, reduce or restrict flow at the highest flow periods (September to March). Care should be taken to reduce (1) the erosion of the channels, their banks or margins and (2) changes in sedimentation levels.

6.5. Flood defence

Care should be taken when working in areas close to the floodplain, watercourse or river to ensure that the flow of floodwater is not impeded. The operation of field and land drains should not be impeded. Where flood defences have to be altered or have been damaged, they should be made good as soon as it is feasible.

The work on site should be performed in such a way as to minimise the effect on the flow of the watercourse at high flows.

Any rubbish or materials that are likely to float should be stored in areas that are unlikely to flood.

6.6. Overview

There are many activities that can potentially impact surface and ground waters on the site. Listed below are those activities most likely to impact the aquatic environment. These procedures can occur at any time during the onsite work:

fuelling, delivery and storage
surface drainage from site
on-site facilities (sanitary/welfare)
on-site storage of chemicals
culvert and pipe construction
work on river bank and in watercourse
wheel washing
dewatering
pumping
concrete truck washout
concrete plant

7. TIMING OF THE WORK

To avoid impact on the fish in the river, work must be carried out when the fish are least sensitive to silt and disturbance. There are two discrete breeding seasons for the various fish species in the Windrush. The trout will breed in November or December, depending on the local stock of fish. The presence of large O-group fish in October suggests that this stock does breed in late autumn. The young fish are then sensitive to silt for several months.

The coarse fish will breed mainly between February and June. Most coarse fish have sticky eggs that they attach to the surface of stones or weed. At this stage of their life cycle these fish are very vulnerable to blanketing by silt. Within a few weeks of hatching the fish are more able to cope with moderate silt levels.

To minimise the effect of the construction on fish, their breeding seasons would suggest that in-river and bank-side work should be performed between July and September.

8. RESTRUCTURING OF THE CHANNEL

The two channels of the Windrush are quite different. The east channel could be classified as suitable for salmonids, the west channel suited to coarse fish. The decision of whether to create a stream suitable for salmonids or coarse fish will be up to the Environment Agency.

8.1. Creating a salmonid habitat

To make a stream suitable for trout the following are desirable:

1. A steady constant flow of cool low-sediment water must be maintained throughout as much of the year as possible.
2. Pool and riffle sequences. The variation in depth is important as it allows the trout to use the clean gravels in the riffles for breeding and feeding and the deeper water for resting.
3. Bank-side and marginal vegetation. The cover provided by vegetation is important to allow trout to rest in safety.
4. Bends in the river. The bends create differential water currents, leading to deep undercut banks on the outside of the bend and shallow gravel banks on the inside.

Undercut banks give protection for the fish, niches for older solitary fish, and add heterogeneity to the environment; shallow areas provide shelter from predation for smaller and juvenile fish.

5. Clean gravel with little silt is essential for the breeding of trout. The clean gravel also provides good feeding grounds for the trout.
6. In-stream macrophyte growth (for instance water-crowfoot, *Ranunculus* sp., and water-starwort, *Callitriche* sp.) provides both food and protection in the river. Healthy development of these species requires that the river is not heavily shaded by overhanging trees.

8.2. Creating a habitat for coarse fish

To make a stream suitable for coarse fish requires fewer, and easier to create, features than a trout stream.

1. Deeper and slower-flowing than the salmonid stream.
2. Bank-side and marginal vegetation. Plenty of reedbeds and trees, allowing fish shelter in the stream margins.
3. Bends in the river. The bends create differential water currents, leading to deep undercut banks on the outside of the bend and shallow gravel banks on the inside. Undercut banks give protection for the fish, niches for older solitary fish, and add heterogeneity to the environment; shallow areas provide shelter from predation for smaller and juvenile fish.
4. The riverbed is usually consolidated gravel and/or silt; due to the lower current velocities, it will tend to have a considerably greater accumulation of silt than the stream suitable for salmonid fish.

Figure 1 - Map showing the positions of the electric fishing sites on the River Windrush

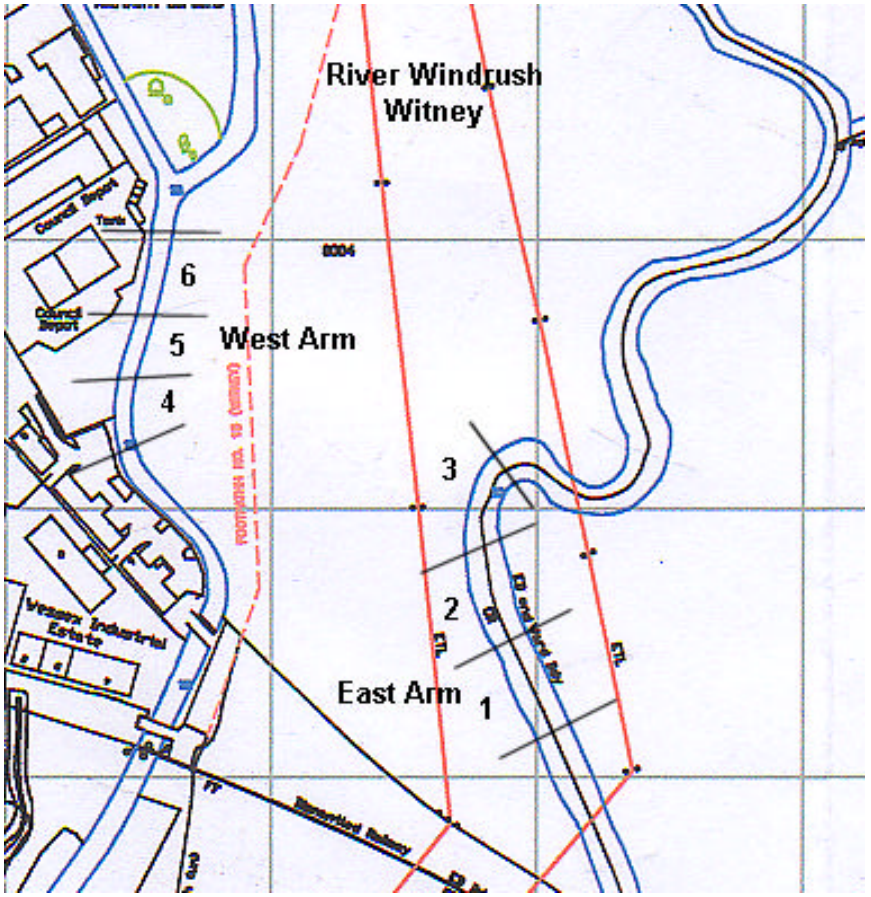
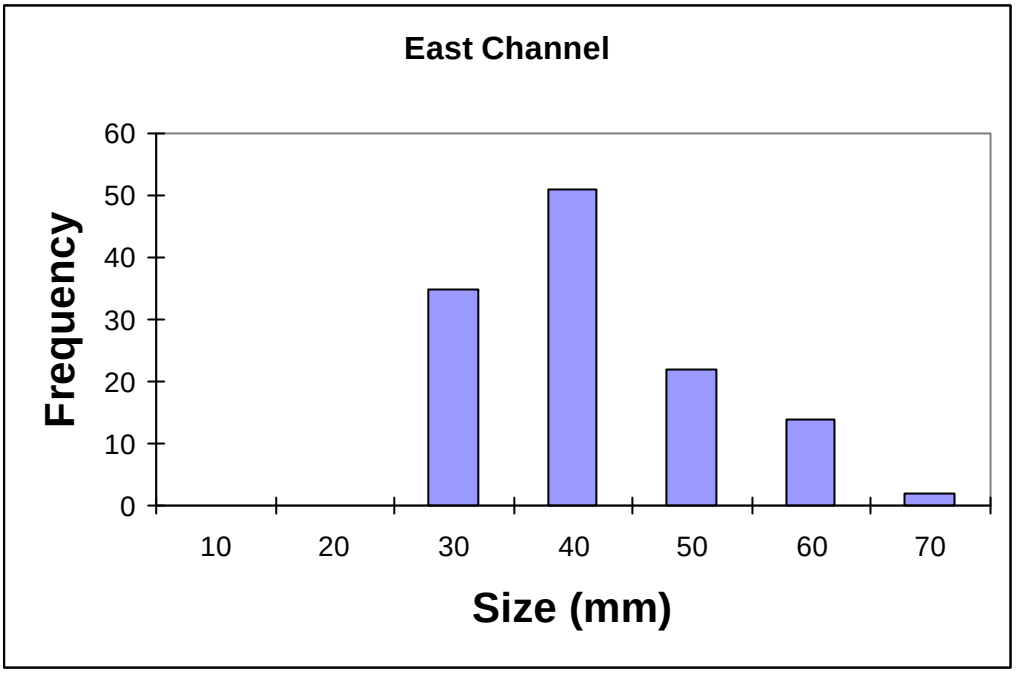


Figure 2 - Size distribution of the Bullhead (*Cottus gobio*) in the Windrush



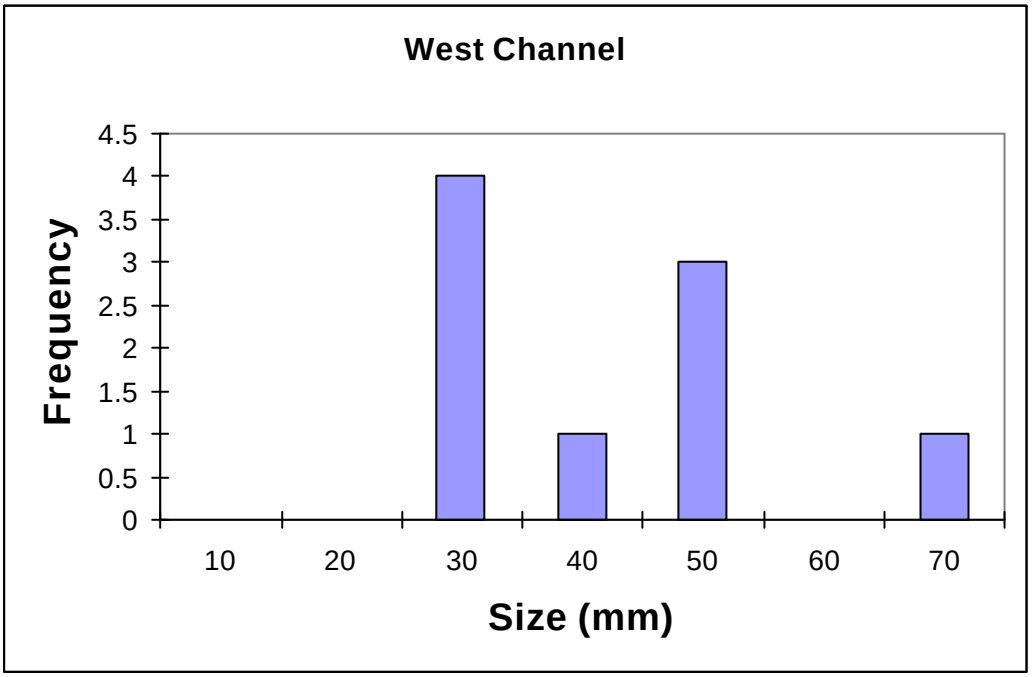
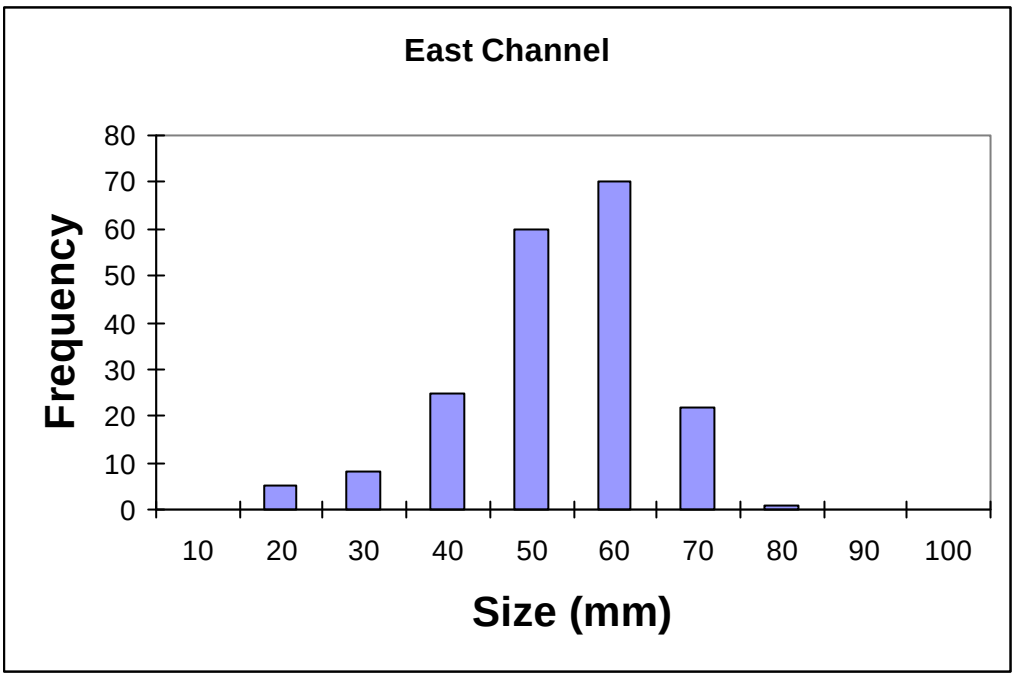


Figure 3 - Size distribution of the Minnow (*Phoxinus phoxinus*) in the Windrush



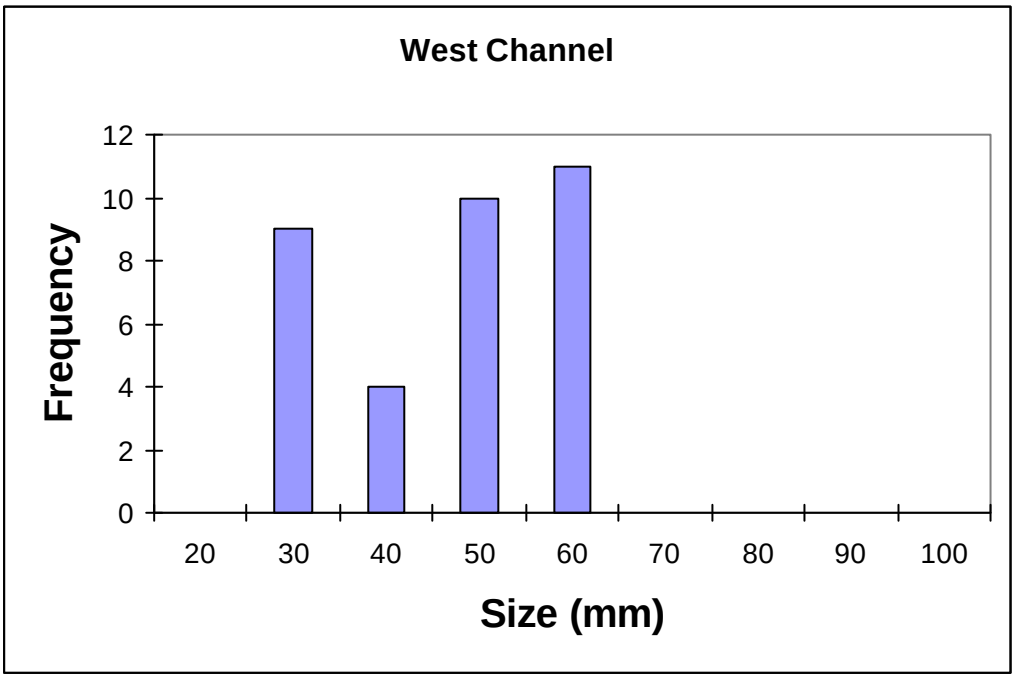
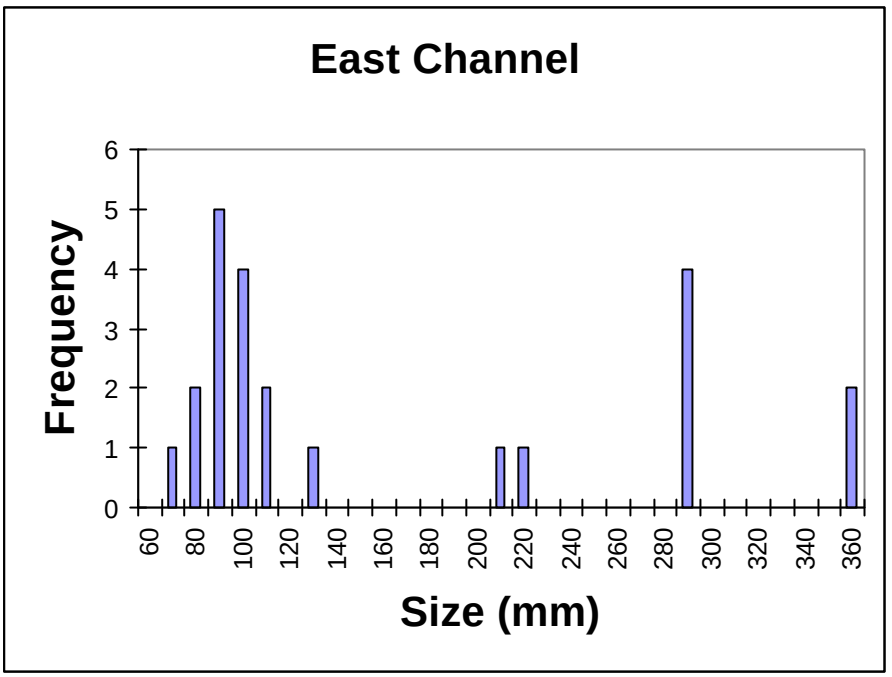


Figure 4 - Size distribution of the Trout (*Salmo trutta*) in the Windrush



Appendix 1

The number of fish caught - for all three sweeps of each section combined and from each section.

	Trout	Minnow	Bullhead	Stone Loach	3 Spined Stickleback	Chub	Barbel
Sample 1	14	180	72	2	3	4	0
Sample 2	8	204	29	0	0	2	0
Sample 3	1	81	38	0	2	5	1

Table 1 - East arm - From the three sections sampled.

		Trout	Minnow	Bullhead	Stickleback	Loach	Chub	Barbel
1	**Sample 1**	6	55	37	0	1	0	0
	Sample 2	3	148	16	0	0	0	0
	Sample 3	0	55	21	1	0	0	0
2	**Sample 1**	8	114	32	2	0	2	0
	Sample 2	5	50	11	0	0	2	0
	Sample 3	1	8	13	1	0	1	0
3	**Sample 1**	0	11	3	1	1	2	0
	Sample 2	0	6	2	0	0	0	0
	Sample 3	0	18	4	0	0	4	1
	Sample 4	0	9	1	0	0	0	0

Table 2 - Catches at each section in the east arm of the Windrush

	Pike	Perch	Minnow	Dace	Bullhead	Chub	Loach
Sample 1	1	1	22	1	5	3	3
Sample 2	0	1	5	0	3	2	0
Sample 3	0	1	7	1	1	2	1

Table 3 - West arm - From three sections sampled

		Pike	Perch	Minnow	Dace	Bullhead	Chub	Loach
4	**Sample 1**	1	1	7	1	2	0	0
	Sample 2	0	1	1	0	0	1	0
	Sample 3	0	1	2	1	0	1	0
5	**Sample 1**	0	0	14	0	2	3	2
	Sample 2	0	0	2	0	0	1	0
	Sample 3	0	0	5	0	1	1	1
6	**Sample 1**	0	0	1	0	1	0	1
	Sample 2	0	0	2	0	3	0	0
	Sample 3	0	0	0	0	0	0	0

Table 4 - Catches at each section in the west arm of the Windrush

Appendix 2 - The size of the fish caught in each section.

Not all animals were measured. Approximately 50 individuals were measured for common animals

Sizes of fish caught in the east arm of the Windrush. Not all common species were measured. A Minimum of three sweeps in each section

Section 1			
Trout	Minnow	Bullhead	Stickleback
360	48	51	85
290	49	47	
90	54	44	
85	60	49	
80	56	35	
360	44	32	
	50	30	
	61	40	
	62	38	
	57	30	
	50	34	
	61	34	
	38	30	
	65	31	
	58	34	
	48	32	
	30	48	
	27	29	
	50	28	
	57	34	
	45	34	
	40	54	
	65	52	
	38	40	
	25	40	
	46	50	
	75	31	
	38	27	
	56	40	
	54	44	
	45	33	
	45	40	
	44	34	
	50	27	
	46	32	
	57	28	
	45	28	
	50		
	58		
	55		
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	60		
	60		
	51		
	50		
	57		
	41		
	50		
	38		
	50		
	55		
	40		
	55		
	44		
82	50		
130	57		
70	54		
	30		
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	52	40	
	50	29	
	60	35	
	46	32	
	60	40	
	55	27	
	58	28	
	50	38	
	52	29	
	66	30	
	46	60	
	56	55	
	49	57	
	36	45	
	60	40	
	42	40	
	60	29	
	66	47	
	38	27	
	50	27	
	52	29	
	60		
	52		
	20		

Section 2				
Trout	Minnow	Bullhead	Stickleback	Chub
285	12	43	32	290
285	47	45	38	270
215	50	45		
110	53	44		
95	51	50		
72	56	50		
92	60	32		
285	66	42		
	59	38		
	65	40		
	60	38		
	52	62		
	40	51		
	41	45		
	45	30		
	54	27		
	58	27		
	48	40		
	53	37		
	40	27		
	52	47		
	36	68		
	56	60		
	28	32		
	20	22		
	25	32		
	67	30		
	70	35		
	68	32		
	57	40		
	60	25		
	60	32		
	57			
	45			
	50			
	50			
	45			
	51			
	41			
	60			
	45			
	20			
	12			
	65			
	60			
	65			
	41			
	55			
	45			
	55			
	40			
	41			
	45			
90		54		390
110		40		280
95		25		
85		35		
96		24		
		50		
		30		
		31		
		32		
		50		
		22		
210		40	35	340
		45		
		56		
		35		
		42		
		22		
		30		
		31		
		30		
		50		
		30		
		25		
		32		

Section 3					
Minnow	Bullhead	Stone Loach	Stickleback	Chub	Barbel
44	55	70	35	430	
59	40			250	
40	38				
44					
62					
47					
52					
60					
38					
51					
50					
40	55				
63	32				
44					
55					
39					
44					
51	30			260	410
60	35			240	
62	52			280	
60	55			245	
59					
65					
62					
55					
55					
50					
54					
47					
53					
43					
26					
69					
38					
39					
63	40				
60					
43					
66					
45					
47					
50					
60					
57					

Sizes of fish caught in the west arm of the Windrush. Not all common species were measured. Three sweeps in each section

Section 4						
Pike	Pearch	Minnow	Dace	Bullhead	Chub	Loach
380	240	57	135	65		
		50		35		
		51				
		48				
		53				
		42				
		49				
	260	56			200	
	198	59	93		220	
		54				

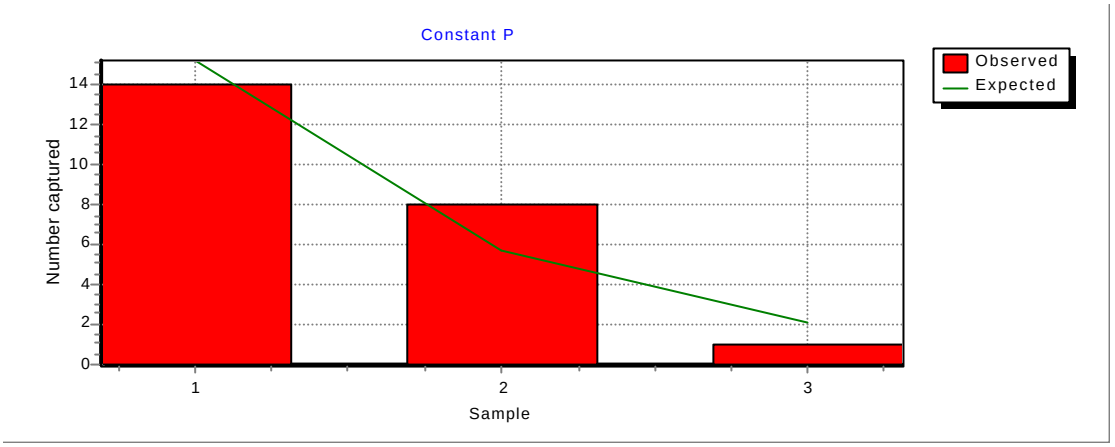
Section 5						
Pike	Perch	Minnow	Dace	Bullhead	Chub	Loach
		56		47	323	27
		43		43	282	35
		49			310	
		39				
		32				
		27				
		29				
		24				
		27				
		30				
		26				
		22				
		24				
		27				
		41			231	
		49				
		52		21	260	96
		41				
		52				
		58				
		47				

Section 6						
Pike	Perch	Minnow	Dace	Bullhead	Chub	Loach
		38		42		34
		58		27		
		31		26		
				26		

Appendix 3 - The results of the Removal Sampling Calculations.

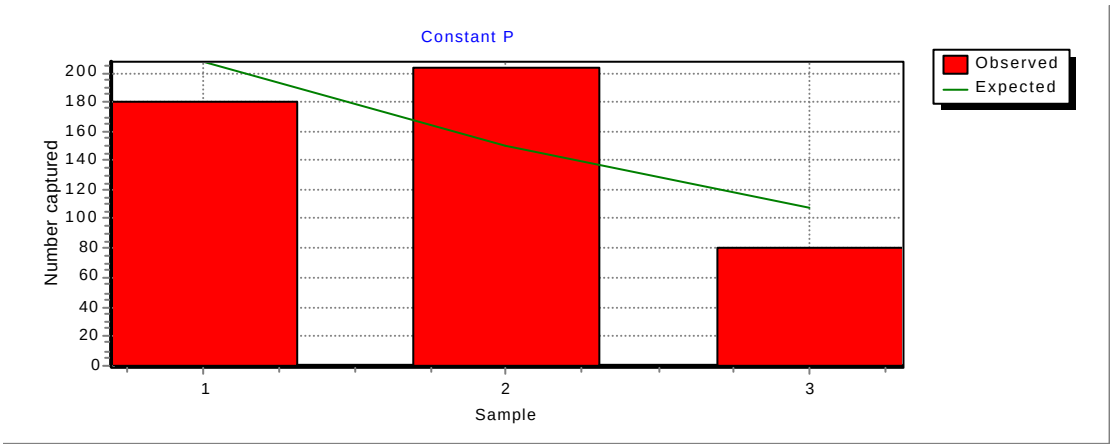
East channel of the Windrush - Population estimates for 150 m stretch

Trout



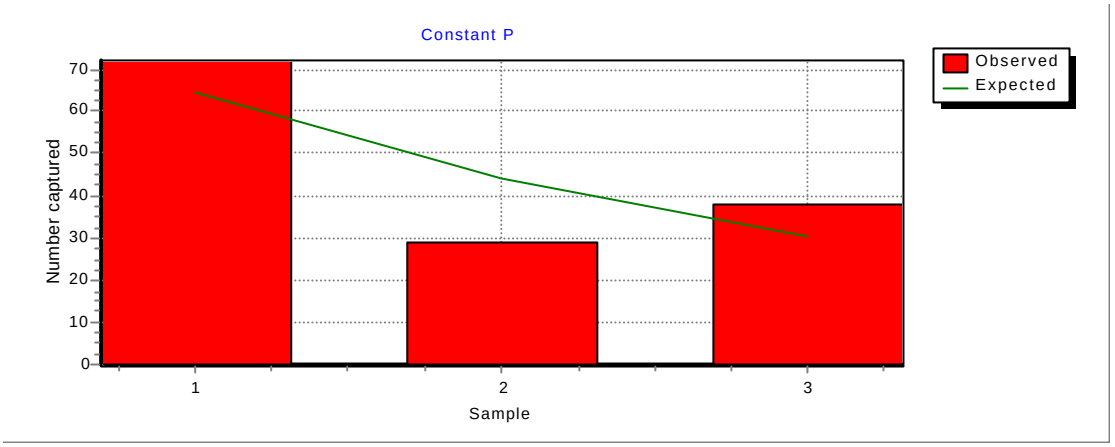
Estimated population = 24.2974
Chi-squared = 1.62
Standard error = 1.752
Degrees of freedom = 1
Probability = 0.2025 Accept model (P>=0.2)
Number Observed = 23
Lower 95% confidence interval = 23
Upper 95% confidence interval = 27.7315

Minnow



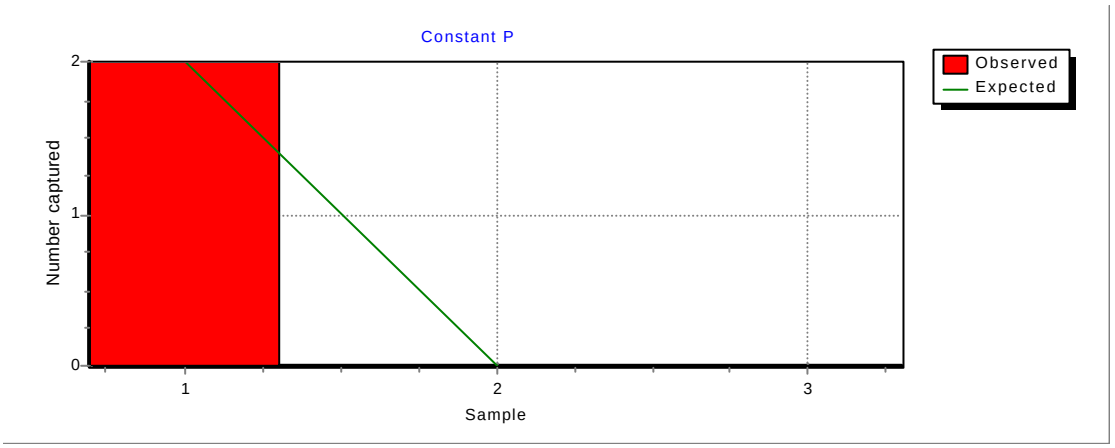
Estimated population = 746.693
Chi-squared = 30.09
Standard error = 81.920
Degrees of freedom = 1
Probability = 0.0000 Reject model (P<0.2)
Number Observed = 465
Lower 95% confidence interval = 586.13
Upper 95% confidence interval = 907.256

Bullhead



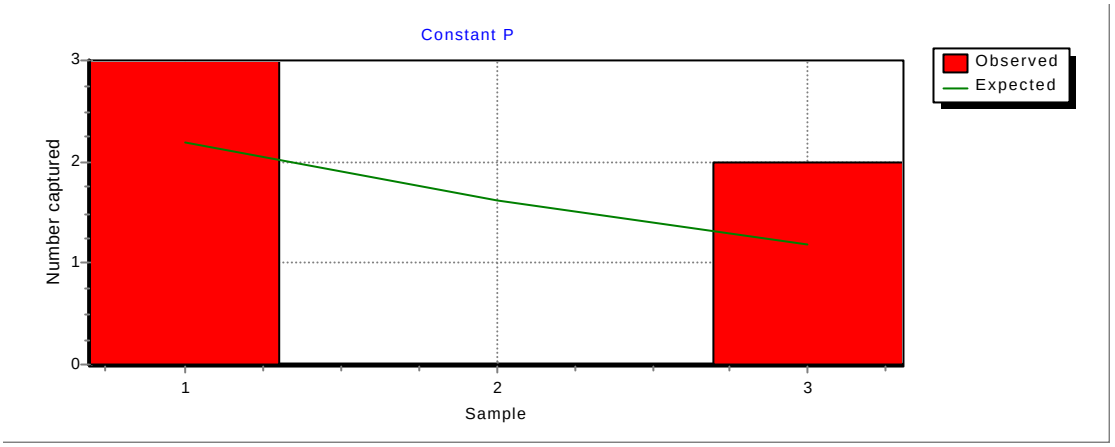
Estimated population = 205.681
Chi-squared = 8.05
Standard error = 33.350
Degrees of freedom = 1
Probability = 0.0045 Reject model (P<0.2)
Number Observed = 139
Lower 95% confidence interval = 140.316
Upper 95% confidence interval = 271.047

Stone Loach



Estimated population = 2
Chi-squared = 0.00
Standard error = 0.000
Degrees of freedom = 1
Probability = 0.9643 Accept model (P>=0.2)
Number Observed = 2
Lower 95% confidence interval = 2
Upper 95% confidence interval = 2

3 Spined Stickleback



Estimated population = 8.3469
Chi-squared = 2.46
Standard error = 9.687
Degrees of freedom = 1
Probability = 0.1166 Reject model (P<0.2)
Number Observed = 5
Lower 95% confidence interval = 5
Upper 95% confidence interval = 27.3332

Chub

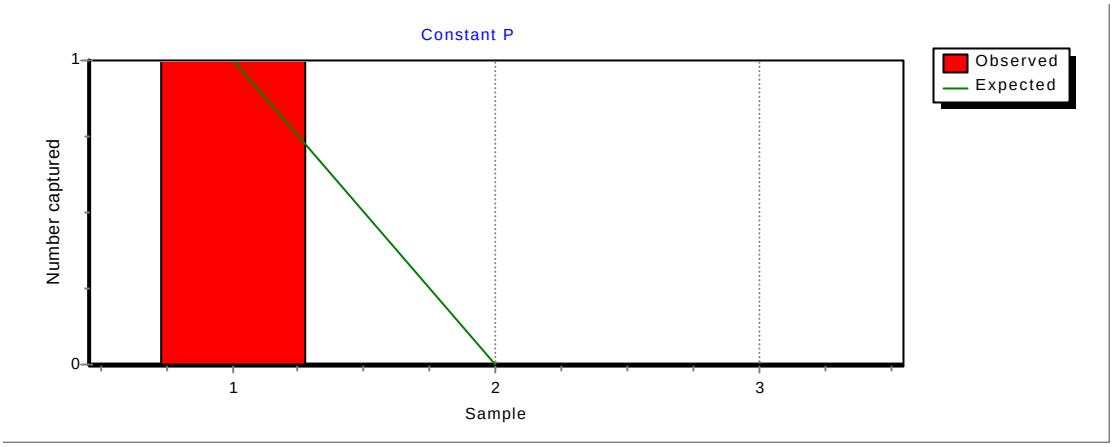
No analysis possible - 11 caught.

Barbel

No analysis possible - 1 caught

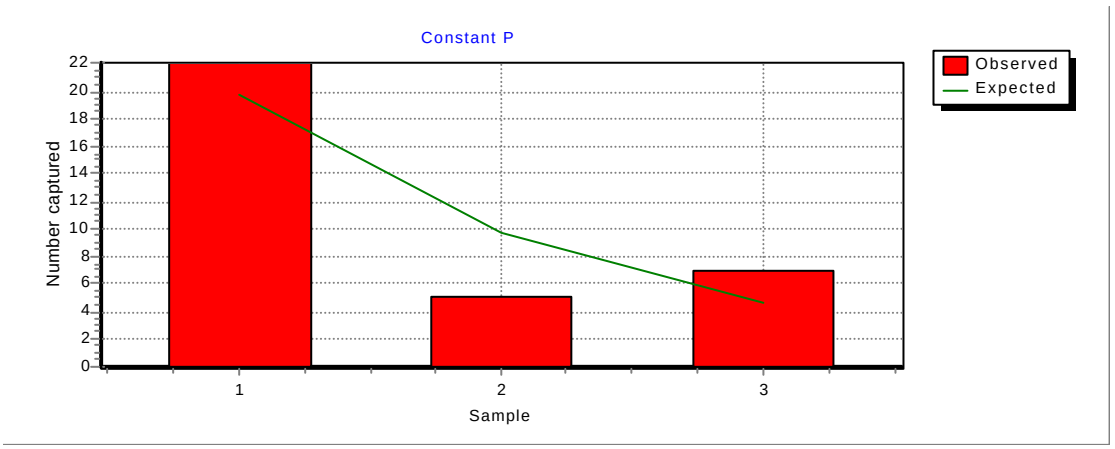
West channel of the Windrush - Population estimates for 75 m stretch

Pike



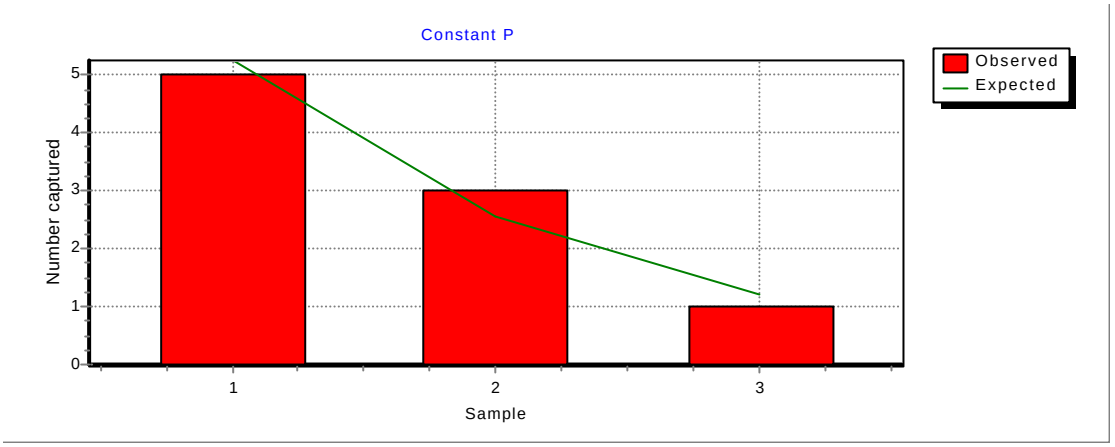
Estimated population = 1
Chi-squared = 0.00
Standard error = 0.000
Degrees of freedom = 1
Probability = 0.9748 Accept model (P>=0.2)
Number Observed = 1
Lower 95% confidence interval = 1
Upper 95% confidence interval = 1

Minnow



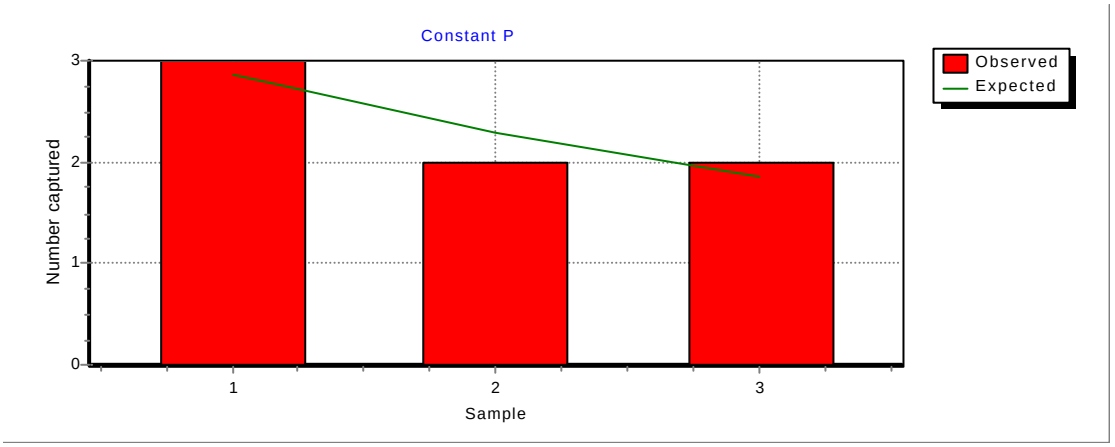
Estimated population = 38.4763
Chi-squared = 3.62
Standard error = 4.250
Degrees of freedom = 1
Probability = 0.0571 Reject model (P<0.2)
Number Observed = 34
Lower 95% confidence interval = 34
Upper 95% confidence interval = 46.8064

Bullhead



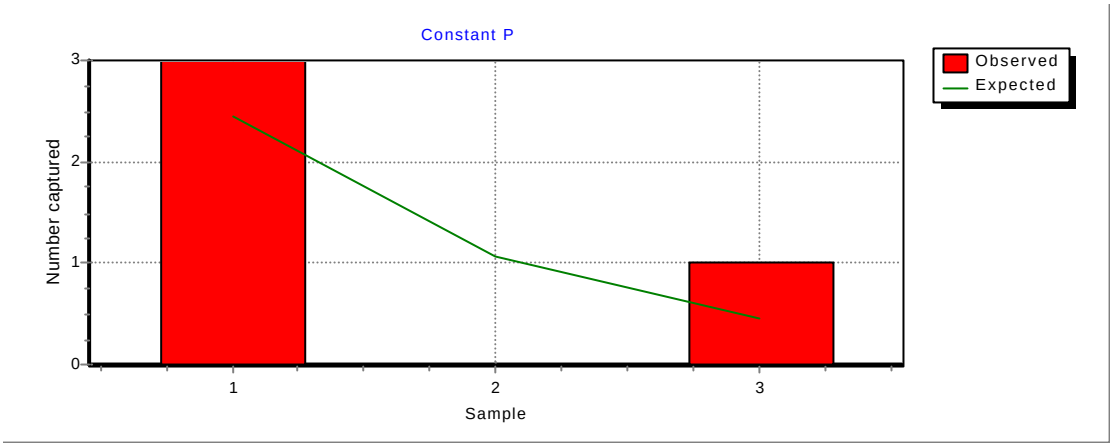
Estimated population = 10.16
Chi-squared = 0.14
Standard error = 2.146
Degrees of freedom = 1
Probability = 0.7105 Accept model (P>=0.2)
Number Observed = 9
Lower 95% confidence interval = 9
Upper 95% confidence interval = 14.3656

Chub



Estimated population = 14.6804
Chi-squared = 0.06
Standard error = 22.983
Degrees of freedom = 1
Probability = 0.8093 Accept model (P>=0.2)
Number Observed = 7
Lower 95% confidence interval = 7
Upper 95% confidence interval = 59.7266

Stone Loach



Estimated population = 4.35679
Chi-squared = 1.80
Standard error = 1.045
Degrees of freedom = 1
Probability = 0.1794 Reject model (P<0.2)
Number Observed = 4
Lower 95% confidence interval = 4
Upper 95% confidence interval = 6.40589

Perch

No analysis possible - 3 caught

Dace

No analysis possible - 2 caught