Lough Melvin Fish Stock Report

- 2001 -

Central Fisheries Board, November 2002

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Acknowledgements

This report was researched and written by Karen Delanty M.Sc. and Martin O'Grady Ph.D. of the Central Fisheries Board at the request of the Northern Regional Fisheries Board, as part of their Lough Melvin Catchment Management Programme. The survey was carried out with the assistance of our collegues in the CFB and staff of the NRFB, in particular Mr. Kevin Crowley, Catchment Manager. Thanks are also due to Dr. Robert Rosell, DARDNI, for his assistance.

1. Introduction

Lough Melvin is situated in the north-west of Ireland and lies between counties Leitrim and Fermanagh. It extends 12km in length with a maximum width of just under 3km and has a water surface area of some 2125 hectares. Most of the lake is about 10 – 20 meters in depth with shallower areas around the islands in the Fermanagh section and at the western end. A deep trench runs east-west from Rossinver Bay towards the outlet into the Drowes River and has a maximum depth of approx. 45 m (150ft) (Ferguson, 1985). The lake has a unique salmonid fish community, which originates from the end of the last Ice Age, some 13,000 years ago. Up to recent times the lake remained relatively unaffected by nutrient enrichment, over-exploitation and the introduction of other fish species especially cyprinids (rudd and roach) and pike (Ferguson, 1985).

The geology of the underlying land around L. Melvin belongs to the Visean Limestones of the Carboniferous group. In particular the area between Sligo and L. Melvin are represented by what is known as the 'Calp' which consists of a mixture of shales, sandstones and limestones (Bundoran shale, Mullaghmore sandstone, Benbulben shale and Glenca limestone (GSNI) (fig. 1)

At the request of the Northern regional Fisheries Board (NRFB) a fish stock survey was carried out July / August 2001 and this report will form part of their Catchment Management Programme. The survey was carried out by the Central Fisheries Board with the assistance of the NRFB. As mentioned previously L. Melvin had remained for a long period unaffected by nutrient enrichment and free from introduced fish species, but recent indicators of eutrophication (ie increased P, algae and zooplankton) and the presence of cyprinids have led to some concerns for the status of the lake.

The aims of this survey were 1) to assess the current status of the major fish species present in the lake and 2) to compare the findings of the current study with that of the 1986 survey and determine what changes have occurred since then.

2. Methodologies

A standardised gill-netting technique was used to sample fish stocks. This gill-netting technique was designed in the late 1970's to assess the status of Irish lake brown trout stocks (O'Grady, 1981 and 1983). It essentially involves the use of standard survey 'gangs ' of gill nets, of a particular range of net sizes. Each gang being composed of seven individual gill nets of 27.5m length each of which had a mesh size in the range 2" to 5" stretched mesh at 0.5" intervals. These nets were set at randomly selected sites and fished overnight. These gangs were originally designed to capture brown trout of 19.8cm and greater in proportion to their presence. The sample will therefore reflect the structure of a lake trout stock for fish >= 19.8cm. This technique can also catch a cross-section of all other fish species present (over a given size).

30 sampling sites were selected from the original selection of 60 sites sampled during the 1986 survey (fig. 2). The decrease in sites sampled will not effect the netting effort results. The original selection of sites was done by dividing the lake into a numbered grid system of squares, using an Ordnance. Survey map (1:52000). Each square being 250m by 250m. Then the sites were chosen by using random number generation. All sites were fished for one overnight period.

Of the 30 sites sampled, 15 were fished from the bottom or bed of the lake upwards into the water column to a height of 2m. These are referred to as bottom-fishing or sinking nets, (using bottom line weights to sink the nets). The other 15 sites were set to fish from the water surface downward into the water column for a depth of 2m and are referred to as floating nets (here a series of floats are attached along the top line of all gill nets and no bottom weights are used). Generally speaking 'sinking nets' were set at sites close to the shore or in shallow waters, while 'floating nets' were fished in deeper waters.

The survey was carried out over a 3 day period, using 3 boats each setting 5 gangs of nets on each occasion. All boats were supplied with depth readers and where possible depth of water in which nets were set was recorded (instrument permitting). Also provided were measuring boards and scale envelopes to allow live fish (namely trout or adult salmon) captured in the nets to be recorded and released back into the lake.

All other fish captured in the nets were retained and placed in numbered bags corresponding to the number of the square they were taken from. On shore fish captured were identified and measured from tip of the snout to the median rays of the tail (fork length) to the nearest cm below. Fish were weighed to the nearest gram on a top pan balance, while a subsample were examined for weight, sex, degree of maturation, stomach contents and scales for ageing (though in the case of perch operculii (bony material) were removed and otoliths were taken from the charr sample).
Initial identification of the cyprinid population proved somewhat inaccurate and thus a subsample were retained and returned to the lab for further identification.

In conjunction with this netting survey a hydro-acoustic survey was also carried out on Lough Melvin, over the same week. This survey was led by Dr. Robert Rosell (DARNI) in association with the CFB in an effort to test an alternative way of surveying a lake in terms of a fish stock assessment, and thus eliminate the need for such intensive gill netting. Results of this survey will be presented in a separated report (Rosell, 2002) and figure 3 was produced from the data obtained.

Lab-work

Of the rudd and rudd/roach hybrids samples brought back to Dublin, all were measured for forklength and weighed, while a sub-sample were used to take scales, stomach samples, genetic samples and sexed. Identification of the rudd and hybrids was made using phyrangeal teeth. Phyarangeal teeth were removed from all samples, were placed in a water bath and boiled until it was possible to remove any remaining tissue around the bony material, thus allowing for proper identification of the sample along with other identifying features such as position of the dorsal fin, the mouth type etc.

The majority of the samples were identified as rudd with a small number of rudd/roach hybrids. No roach specimens were recorded.

3. Results

A summary of the survey findings in relation to all fish species is presented below (table 1). Numerically the principal fish species were trout, rudd, cyprinid hybrids, perch, charr, salmon and eels. The number of fish captured (for any species) for a particular netting effort (catch per unit effort - CPUE) reflects the relative density of that species present in the lake. CPUE values for any species is obtained by dividing the total number of fish (for that species) captured by the number of sites netted. This technique has been used as a stock monitoring tool on all of Irelands quality brown trout loughs since the late 1970's and thus an extensive survey database has been built up over the years. It has proved to be a very effective management tool in illustrating the fluctuations in fish stocks over time (O'Grady), as it is a way of comparing returns from different lake surveys within one waterbody over time or between different waterbodies.

Of the 30 gangs of nets fished, over the 3 day period, information is only available from 29 sets. Nets set at square 22 were sinking nets and set at the edge of the deepest part of the lake. Recovery of these nets was very difficult due to movement of the nets while in the lake and upon retrieval the nets were found to have 'rolled' up and no fish were present. Therefore it was decided to exclude this site from the overall sample.

Trout

Three species of trout occur in Lough Melvin and these are Sonaghan, Gillaroo and Ferox. Each species can be identified usually on morphological characteristics (external colours, spotting patterns and shape)(plates 1 – 3). Their separation can be attributed to their different feeding preferences, with the Sonaghan feeding primarily in mid-water on cladocera (water fleas), chironomid pupae (non biting midge) and chaoborus larvae (phantom midge). By contrast with the exception of the late summer period, gillaroo feed almost exclusively on bottom living animals including snails, trichoptera larvae (caddis/sedge) and gammarus (freshwater shrimp). While Ferox trout from age three (or circa 30cm) take a considerable proportion of fish in their diet with perch, arctic charr and trout being the principal prey items (Ferguson, 1986).

A total of 374 trout were taken during the survey. Their distribution is well scattered throughout the lake, in both the shallow waters and the deeper areas. Highest densities of trout were recorded in the more deeper waters of the lake (15 – 20m), see fig. 4.
Of these fish 281 were identified as sonaghan, 37 as gillaroo and 29 as ferox based on physical features and stomach contents. The remaining 110 samples were classed as 'trout'.

Length frequency distributions for all the trout combined showed the majority of the fish were in the length range 25 – 30 cm, though trout up to 65cm were also recorded (fig. 8). Most of these larger fish were ferox trout. Ageing of the trout was done using samples of their scales and this showed the population to be dominated mainly by 3+ year old fish with lesser numbers of 2+ and 4+ year old (fig. 9). Of the older fish aged (>= 5+) all but one were found to be ferox trout. The majority of the sonaghan and gillaroo population never exceeded an age of 4+. Growth rate patterns for each of the three trout types show that initial growth rates for all three to be quite similar up to age 3+ (fig. 10). From here on the growth rate of the ferox trout is much faster then its first three years (it is at this stage that they start to included fish in their diet). While both the sonaghan and gillaroo trout exhibit very similar growth patterns actual mean values suggest that growth is slightly faster for gillaroo throughout most of its life cycle. This difference in growth rate is probably due to the location of their spawning and nursery grounds. Generally speaking gillaroo spawn in the outflowing Drowes River while the sonaghan spawn in the numerous smaller inflowing streams. This then leads to the gillaroo also having greater weights as compared to sonaghan of the same age (table 2). Ratio structure of each of the three trout species is in the order of - 80.1%: 10.66% : 8.35%, for sonaghan, gillaroo and ferox respectively.

General diet analysis of 168 trout stomach samples was carried out on site (while processing the fish). Of these fish stomachs 53 were found to have no food, with the remaining 115 samples contained a range of dietary items (table 3) Certain food items were only recorded in the type of trout they are associated with, for example snails and gastropods were only found from gillaroo, plankton only recorded in sonaghan and fish were only encountered in ferox trout.

Rudd

Rudd were encountered in 19 of the 29 locations sampled, with a total of 319 individuals. Their distribution is fairly well scattered throughout the lake, though fewer samples were taken in the deeper waters of the southeastern area (fig. 11) Higher densities were taken from the waters of the western section. Fish were caught in both the floating and sinking nets. All fish were processed on the shore and a sub-sample taken back to the laboratory for further processing. The length frequency distribution (of all fish) (fig. 12) showed the length range to be 14 to 28cm with the majority in the range 17 to 20cm (75%). Age analysis indicate that the sample processed were dominated by 5+ and 6+ year old fish. The oldest fish aged were 9+ and only represented 10% of the sample (fig. 13). These length and age frequency distributions would suggest that the rudd population in L. Melvin is stable and dominated by relatively young fish. While some stomach and genetic tissue samples were also taken, results for these will not be presented in this document.

Rudd are an introduced species to L. Melvin and their presence in the lake have been noted since 1986 (Ferguson, 1986).

Hybrids

While initial observations suggested the presence of roach in Lough Melvin, laboratory identification showed these fish to be hybrids of rudd and roach. Their presence in the lake is quite minimal, at the moment, a total of 31 hybrids were taken from 4 netting locations (fig.14). All of these sites were located on the southwestern shore in relatively shallow waters and in areas with the greatest rudd catches. Growth rate analysis of these fish show them to be faster growing and younger then the rudd (fig. 15). This is typical of hybrids.

It is difficult to determine when and how hybrids first appeared in this lake. It would be normal to find rudd/roach hybrids in a lake after the introduction of roach to the same lake as initial spawning of the introduced roach would be with other cyprinids present in the lake – in this case rudd, therefore even though no roach were recorded in Lough Melvin during this survey it is still probable that there are roach present in the lake, though not in any great numbers.

Perch

A total of 16 perch were taken from 9 of the sites fished (fig.16). These nets were all in relatively shallow waters (<15m) and the majority located in the western half of the lake. A length frequency distribution shows all fish to be in the range of 16 to 32cm.

Charr

Twelve charr were recorded at 4 of the netting sites (fig. 17) All were taken in the deeper waters of the southeastern area of the lake. The majority of these fish were in the size range 25 –27cm (fig.18), and their average weight was 239 grams. General dietary analysis were also carried out on 8 of the 12 fish. Two stomachs were empty while the others had a dominance of plankton (mainly cladocera and copepoda) in content (table 5).

Salmon

Only 8 adult salmon were taken during this survey from 6 netting locations (fig. 19). Of these 4 were released alive back into the lake having taken length and scale samples from them. No further analysis have been carried out as there were insufficient samples available.

4. Comparisons with other L. Melvin surveys

Several studies and surveys have been carried out on L. Melvin over the years. Those of interest to this report include the 1986 survey carried out by the Central Fisheries Board and the work by Prof. A. Ferguson during the period 1977 to 1984. Also worthy of note is the work of Went (1951). The principle concerns for the earlier 2 studies was with the 'trout' of L. Melvin and so comparative data on growth rates and diet is only available for them. While the 1986 survey was very similar to the present survey as it involved the same sampling techniques at the same sampling sites and information was collected for all species of fish present in the lake.

Initial observations made between this survey and all others, indicates, major changes in the fish stock structure. The most significant of these is presence of rudd and cyprinid hybrids, which, while being mentioned as present in L. Melvin since 1986 (Ferguson,1986) have not been recorded during any other survey up to now. A comparison of the C.P.U.E. values for the 1986 and 2001 surveys shows the changes that have occurred in the fish stock structure over a 15 year period (fig. 20). While minor reductions in numbers can be seen for salmon, charr, perch and sea-trout, much more significant changes have occurred with the trout population and the introduced populations of rudd and rudd/roach hybrids.

Trout

A trout C.P.U.E. value of 8.8 was recorded in 1986 (quite a high value for trout) where as by 2001 this figure had almost doubled – CPUE for 2001 was 15.27. This is quite a significant increase. However, a comparison of the trout data, from the 1986 and 2001 surveys, in terms of growth pattern, life span and diet, illustrate no major change. Length frequency distributions, for each trout sub-species, shows no major shift in the pattern noted in 1986 to that of 2001 (fig. 21). Growth rate data is available from 1951 – 2001 (from 4 different studies) (fig. 22). These data sets again do not indicate any obvious changes in growth rates for each of the subspecies, though very minor changes are noted for different years and at different ages. While these changes may suggest a slight increase in growth rate for each of the trout subspecies since the 1986 survey they are not significant. Again the age structure data does not point to any major changes in the population (fig. 23). Other aspects of the trout biology examined included diet. When dietary items of trout, from the present survey were compared to that found in Ferguson's study (1977 – 1984) the same pattern emerged. The occurrence of each of the trout species (ratio) from 2001 compared to 1986 tells us that there has been no change in the ratio of sonaghan to gillaroo to ferox in the population as a whole.

All the above information suggest that the trout population of L. Melvin has remained relatively stable over the years and concurs with the findings of the 1986 survey. While this is so the trout CPUE values for 1986 and 2001 indicate that there are changes occurring within the lake. The almost doubling of the trout CPUE suggest that there has been a major increase in the number of trout present in the lake. A comparison of trout CPUE values for other lakes, sampled at the same time of year (fig. 24) show that the value for L. Melvin, in 2001, is the highest recorded for a trout population in Ireland in recent years (since 1992).

Rudd

As mentioned, the presence of rudd in L. Melvin has been known since 1986, though this survey is the first to take rudd in survey nets and provide any information on the population structure. Thus no comparison can be made with previous studies, only to note that they seem to be successfully colonising the lake.

Though information is available for rudd from other Irish summer sampled lakes, in particular Loughs Conn, Cullin and Gur (O'Grady and Delanty, 2001 and King and O'Grady, 1994). A look at rudd growth rates from selected Irish lakes (fig. 25) shows that L. Melvin rudd growth is most comparable to rudd from L. Gur and Coosan exhibiting slow growth, typical for rudd. Data from L. Conn and Cullin indicate much faster growing fish, but this is usually seen with fish recently introduced to a lake as is the case with L. Conn. (O'Grady and Delanty, 2001).

Charr

The number of charr recorded during this survey is more then half of the 1986 survey. Charr are more commonly found in the deeper waters of a lake and this is true for L. Melvin, but during the 1986 survey more gangs of nets were set in those areas then were in the present survey (60 nets were set in 1996 - 26 in the deeper waters, while only 30 nets were set in 2001 with 15 in the deeper areas). This offers a partial explanation for the decrease in charr numbers. Other suggestions for this decline in the population may be linked with decreased water quality over the past 10 years (pers. comm. K. Crowley) indicating that L. Melvin may now be mesotrophic. Also over the last 15 years there has been a significant increase in the cyprinid population present, which would concur with the fact that eutrophication (poor water quality) will favour cyprinids over other salmonids (Igoe et al). Indeed charr are known to be very sensitive to eutrophication (Maitland & Lyle, 1992) and will usually be the first species to disappear as a consequence of pollution.

With such few charr samples available little information is provided for comparison with other Irish charr data. Though diet of the charr was examined (D. Doherty) and is still predominantly plankton as noted by Ferguson (1986). Length range of the charr appears not to have altered much either. While it may seem that the average weight of the charr has increased since previous surveys, no actual weight data is available for comparison and when the L. Melvin data is compared with that of other Irish lakes, with a healthy charr population, (in particular L. Mask) the average weight of L. Melvin charr appears to be quite similar to those recorded elsewhere (Mask data CFB, 1996).

5. Conclusions

There has been a substantial increase in the trout stock in L. Melvin in 2001, compared to 1986. It is interesting that such change relates only to an increase in the population density, i.e. growth patterns, ratio of sonaghan/gillaroo/ferox and dietary habits of the three trout species all remain unchanged. The increase in trout densities could be as a consequence of either one of two factors: -

A) Drought conditions in the early 1980's may have reduced trout recruitment rates to the lake compared to recent years where summer rainfall levels have been at, or above average and so would not have a negative effect on recruitment. Lower recruitment rates, due to possible drought conditions, may have resulted in a lower CPUE value being obtained during the 1986 survey and would not have reflected the true trout stock population of the lake in 'normal' circumstances.

B) Also it has noted from other Irish lakes that an increase in the trout carrying capacity is often the initial stage of a cultural eutrophication problem.

The substantial increase in cyprinid numbers captured in the 2001 survey, are a cause for concern. The substantial increase in this fish stock may be another reflection of the enrichment process since rudd were known to be present in the lake in 1986, yet none were captures in the survey in that year.

The 2001 survey indicates that there is still a significant charr population in L. Melvin relative to the stock recorded in the survey of 1986. This suggests that any enrichment process has not yet reached an advanced stage. The demise of charr in three large Irish lakes over the last 15 years (Loughs Corrib, Conn and Leane) has been observed.

In management terms the most critical programme in the Lough Melvin Catchment, in future years, must involve a reversal of the current trend of an increasing nutrient load to the lake. Unless this problem is resolved the extinction of the charr population and a sharp decline in the trout population is inevitable.

6. References

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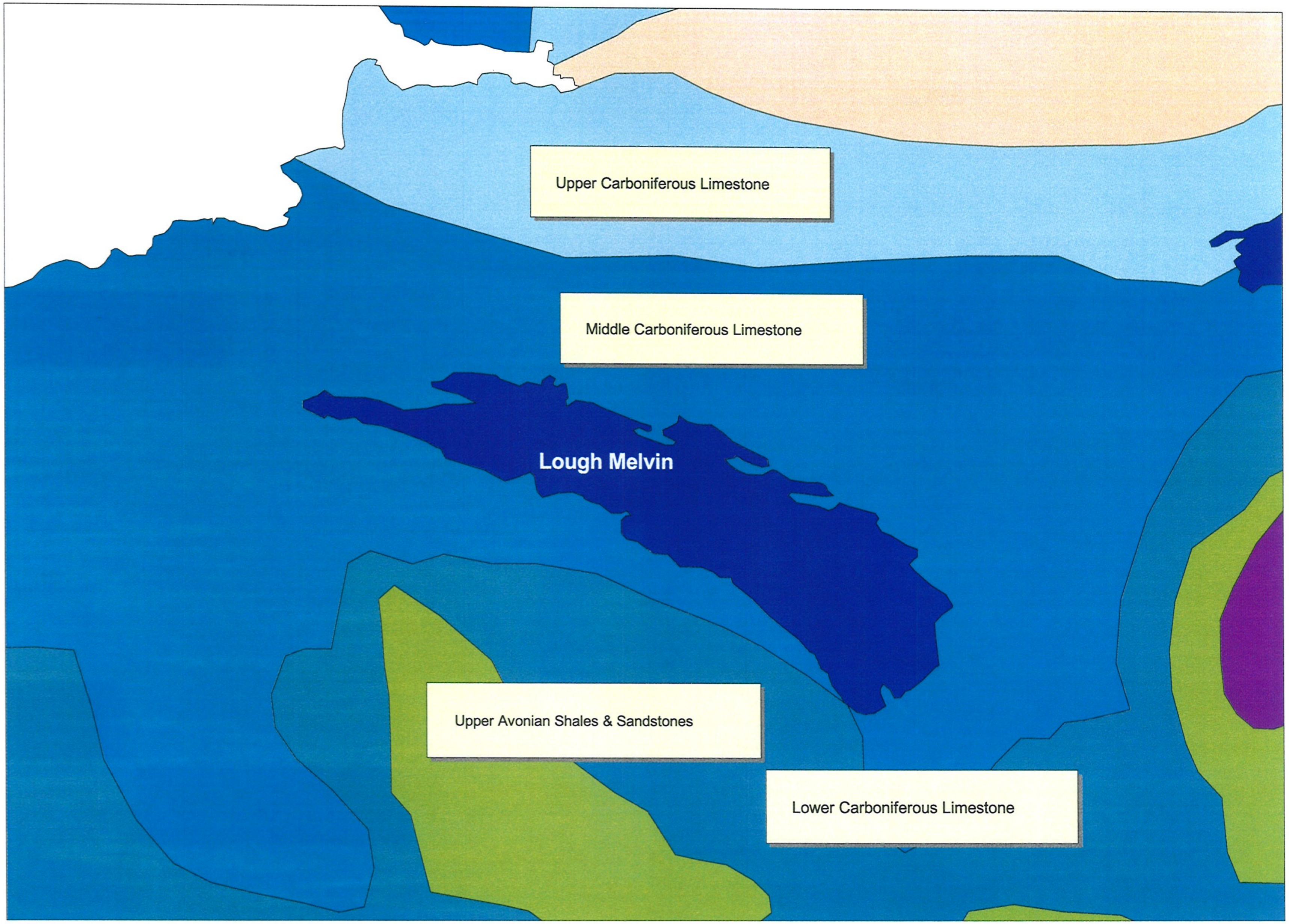


Figure 1: Geology map of surrounding catchment for L. Melvin

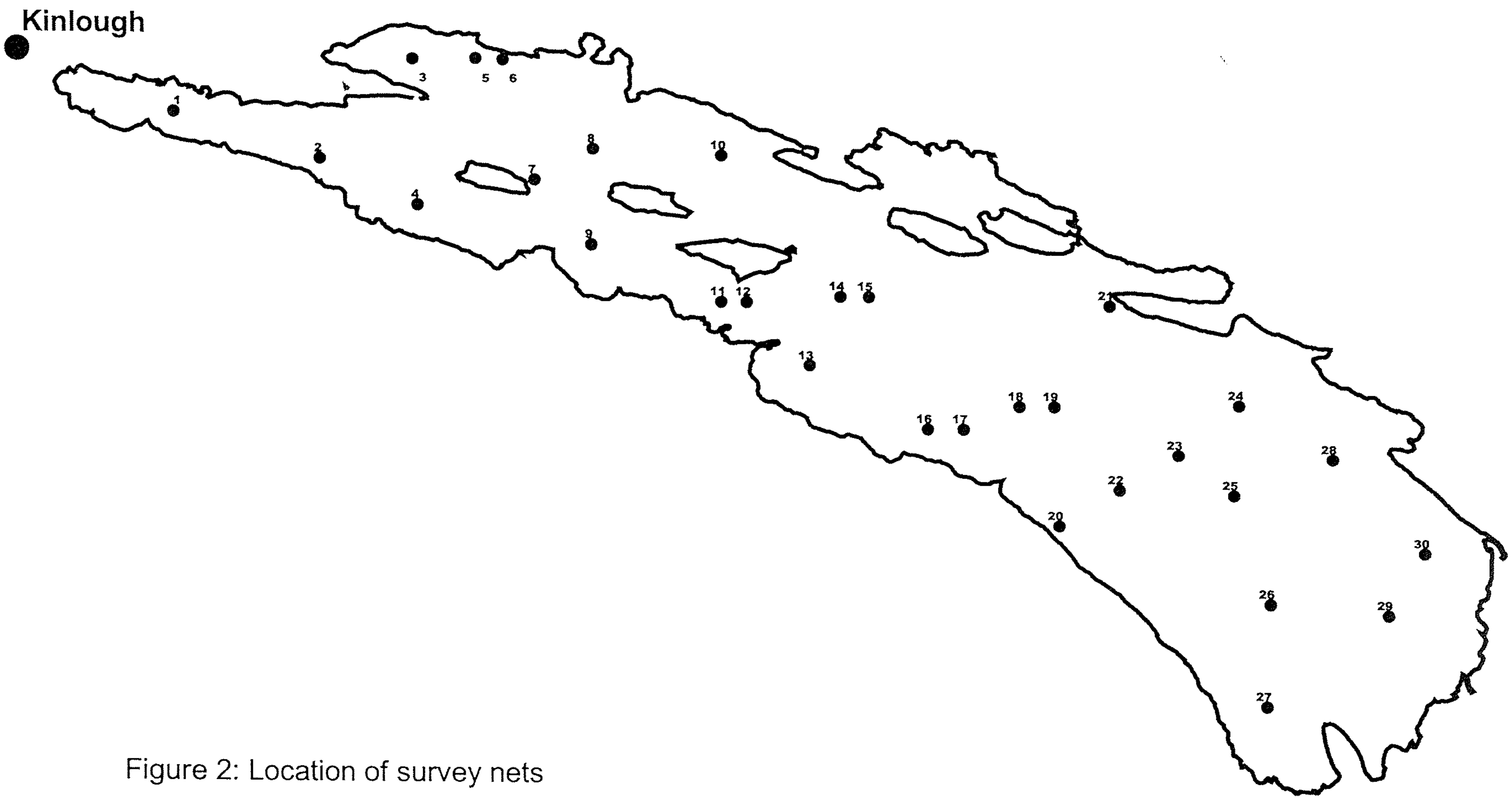


Figure 2: Location of survey nets

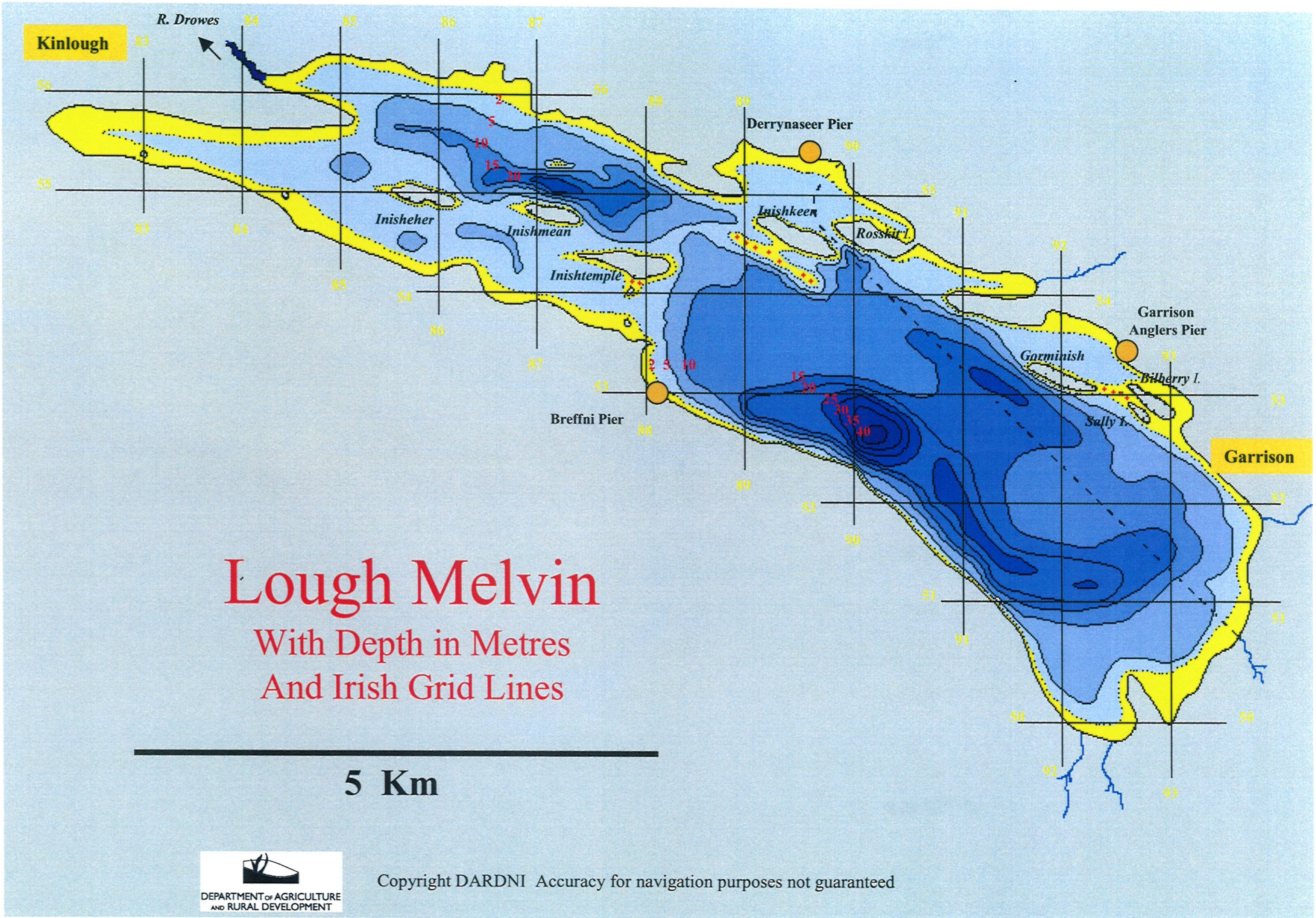


Figure 3: Contour map of Lough Melvin *(and grid used for hydro-acoustic survey)*

Sq. no.	Net Type	Species					
		Trout	Salmon	Charr	Perch	Rudd	Hybrids
1	s	13	1		4	87	13
2	s	29			3	12	5
3	f	11	1		1	16	
4	s	30				14	12
5	s	11			1	58	
6	s	6			2	6	
7	f	9					
8	s	1					
9	s	10				28	
10	f	24			2	1	
11	s	4				20	1
12	s	5				11	
13	f	1			1	20	
14	f	31			1	1	
15	f	47					
16	f	2		3		12	
17	f	2	1			6	
18	f	23				1	
19	f	6				12	
20	s	4	2				
21	s	2					
22	s	*not fished*					
23	f	47					
24	s	6					
25	f	65				1	
26	f	1		5			
27	s	7	2	2	1	6	
28	f	34					
29	f	4					
30	s	22	1	2		7	
Total		*457*	*8*	*12*	*16*	*319*	*31*

s - sinking net
f - floating net

Table 1: Lough Melvin Netting Survey Results, 2001.

Plate 1: Gillaroo and Sonaghan trout taken from L. Melvin, 2001.

Plate 2: Gillaroo and Ferox trout taken from L. Melvin, 2001.

Plate 3: Charr taken from L. Melvin, 2001

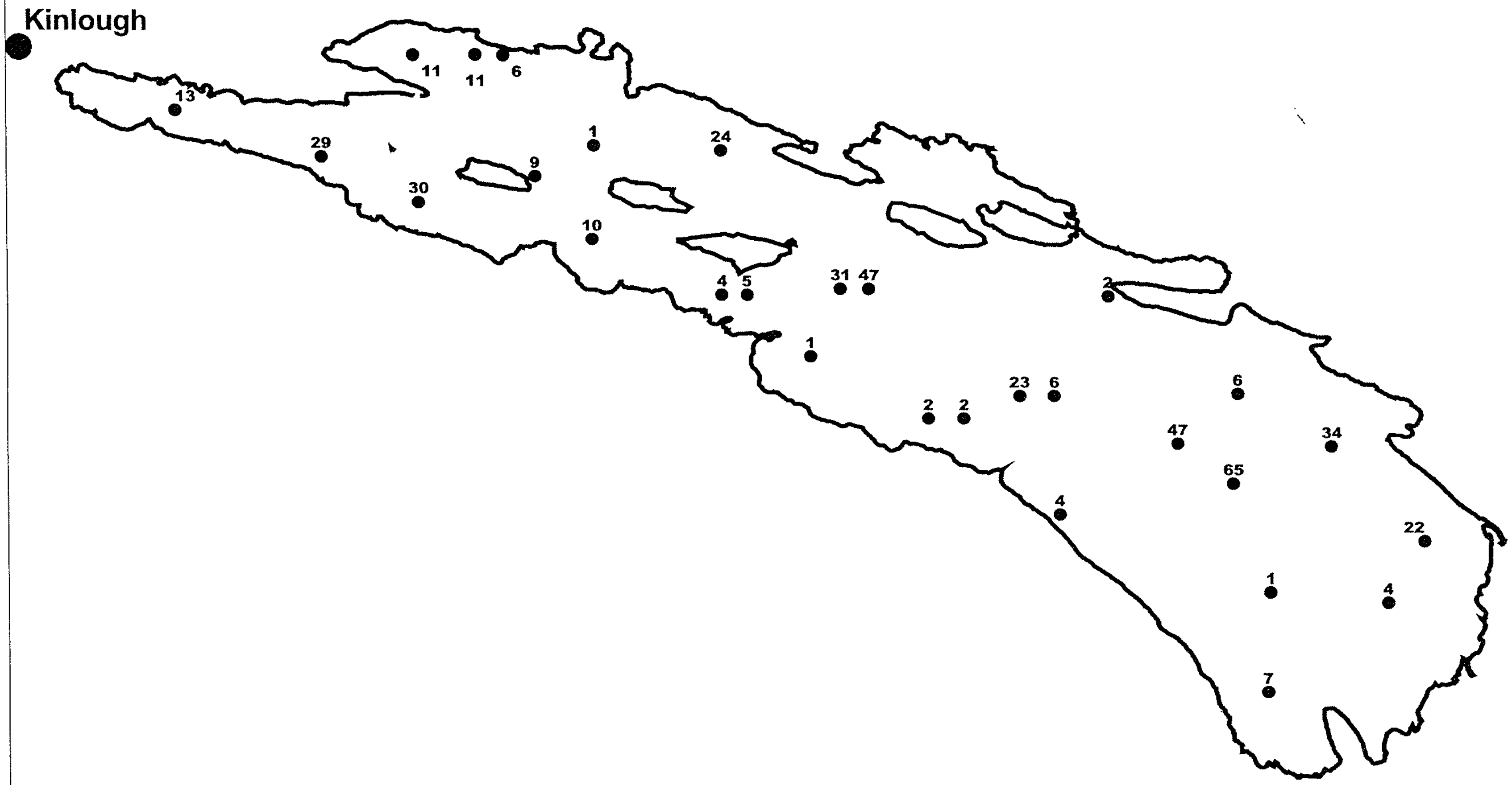


Figure 4: Location of nets with trout taken and the total number of fish caught in each.

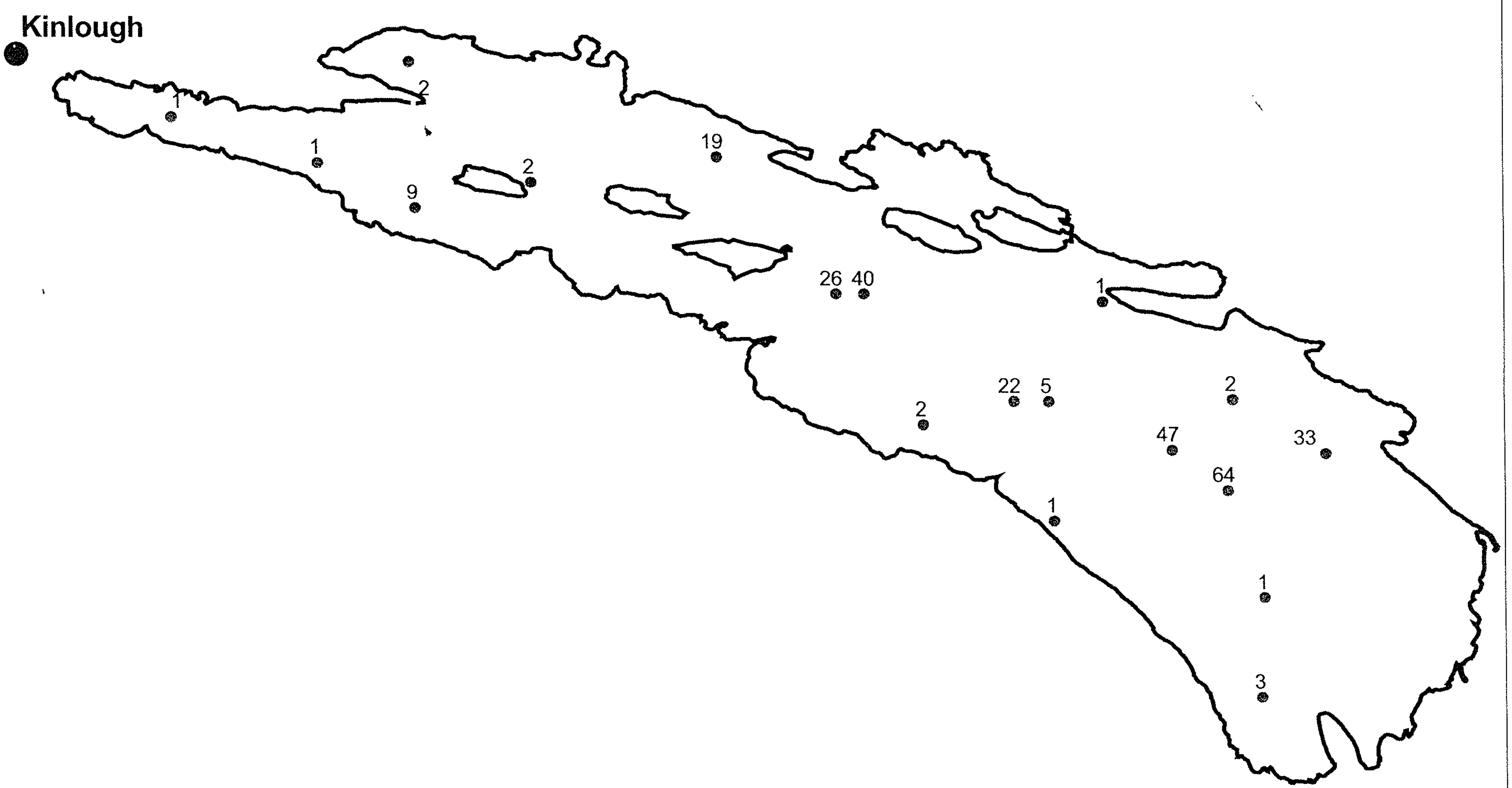


Figure 5: Location of sonaghan trout and total numbers caught in each net.

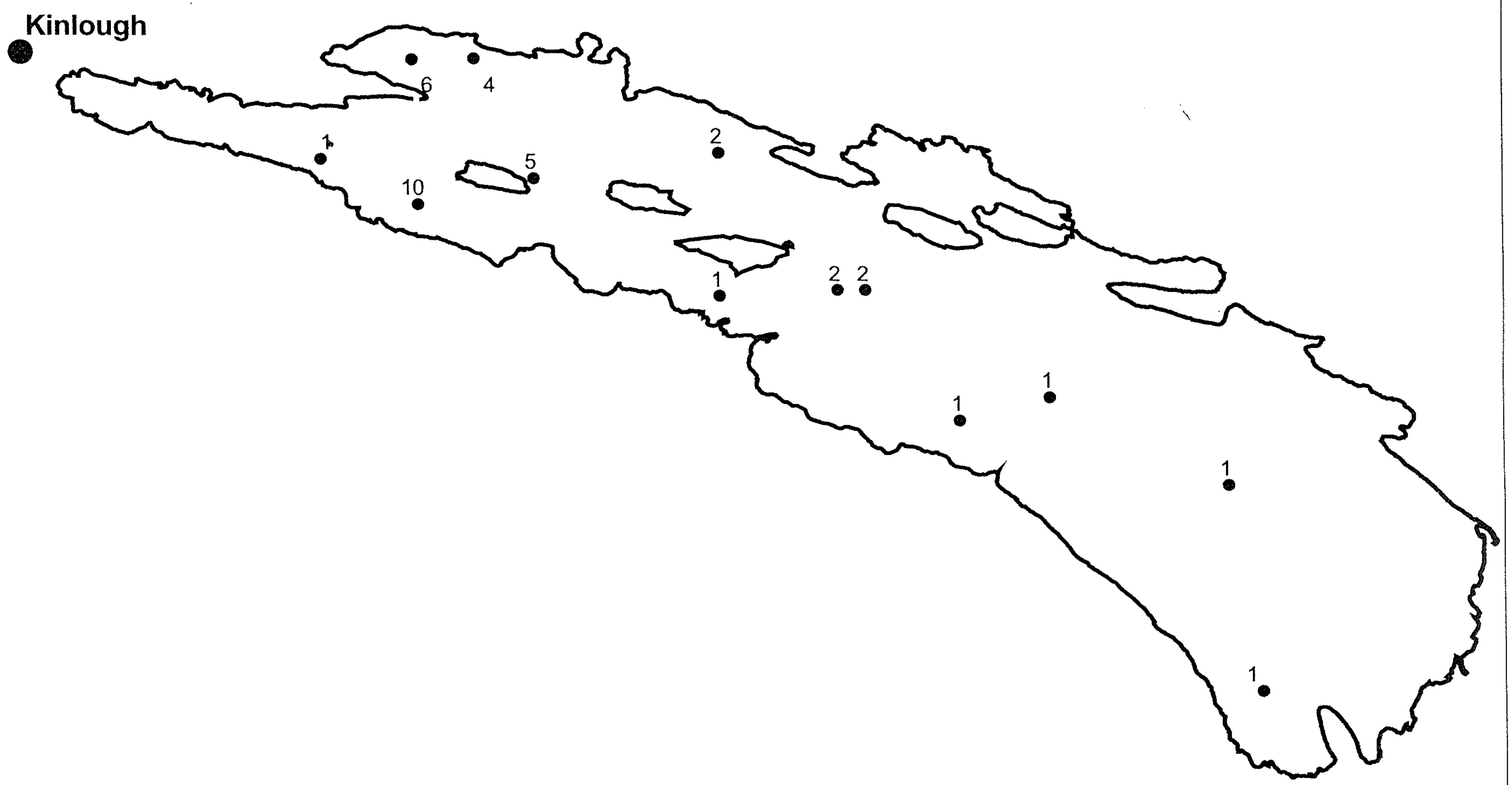


Figure 6: Location of nets with gillaroo trout taken and total numbers caught in each.

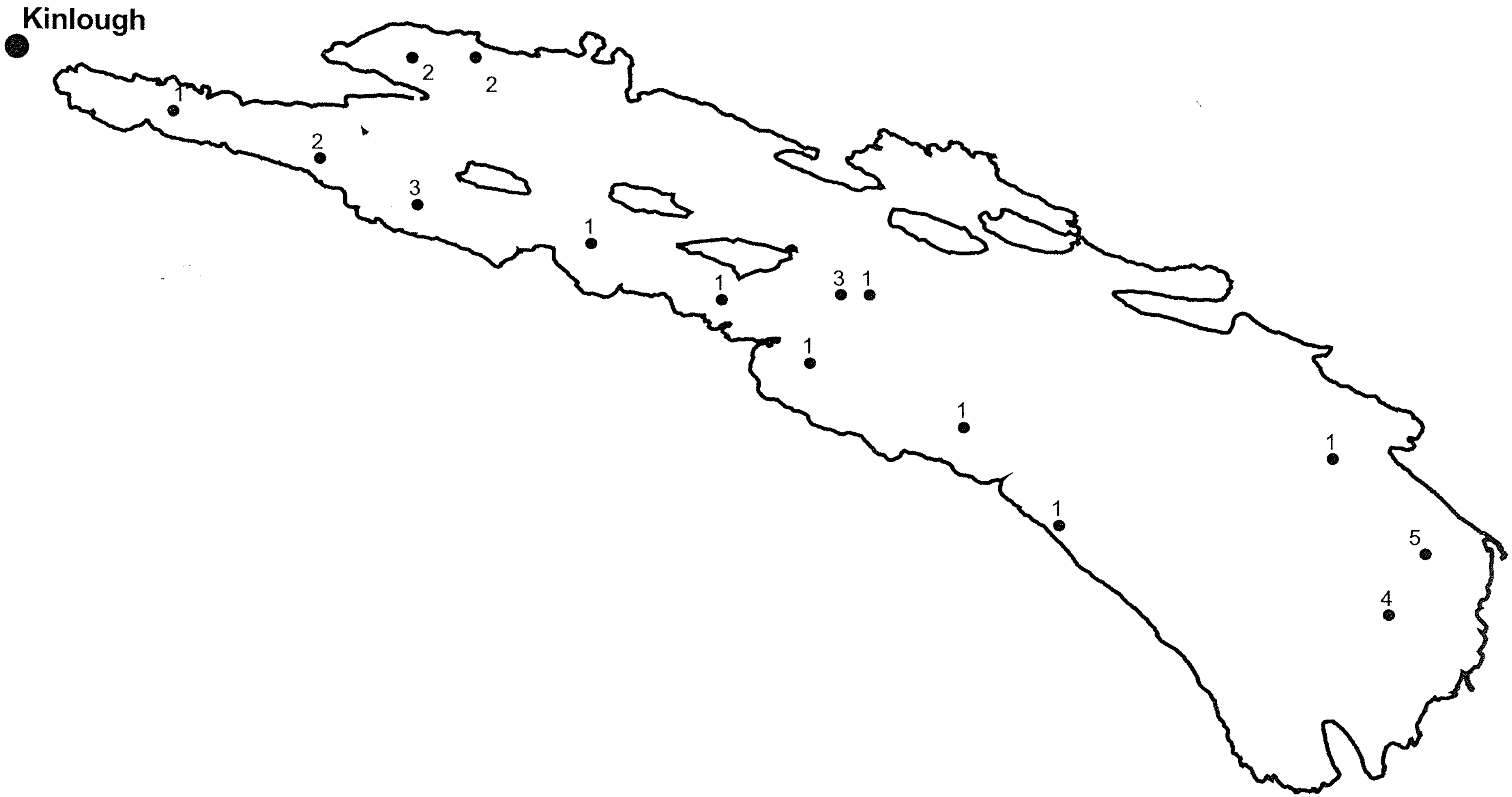


Figure 7: Location of nets with ferox trout and total numbers caught in each.

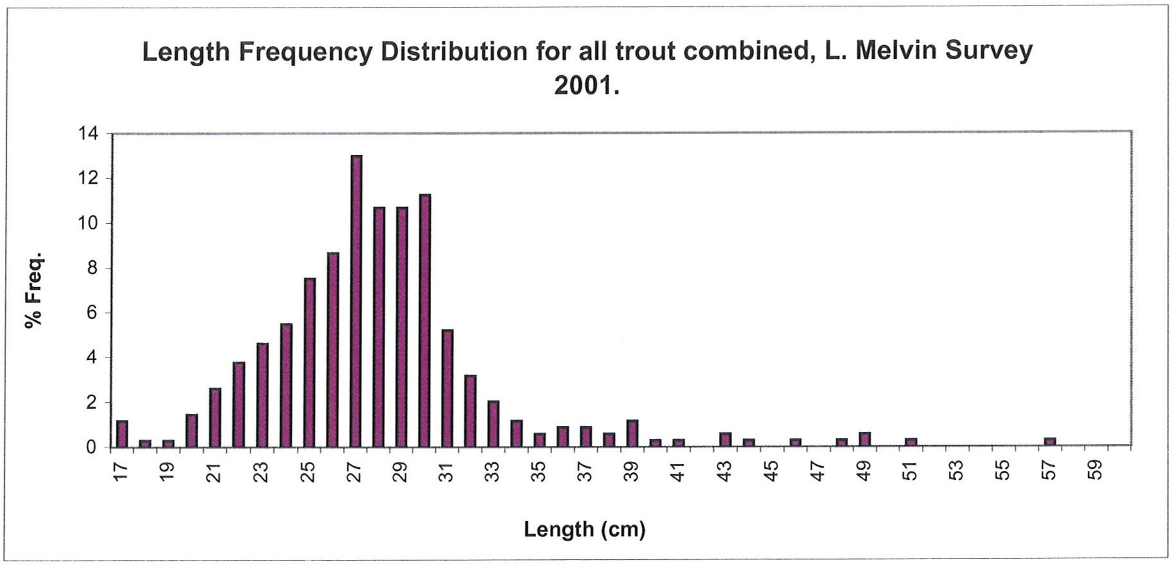


Figure 8: Length frequency distribution of trout from L. Melvin, 2001.

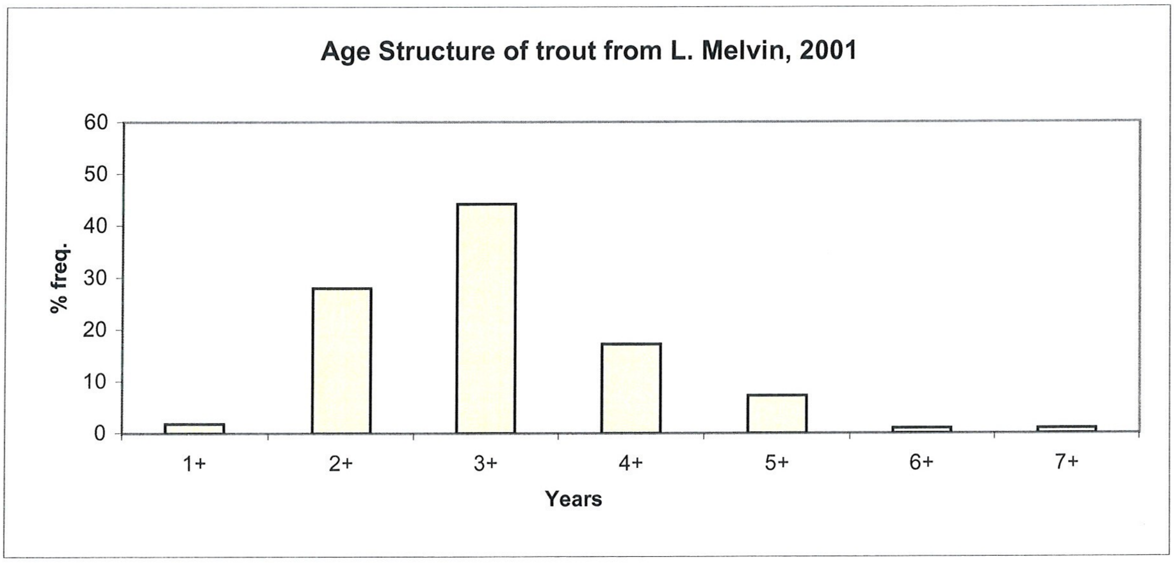
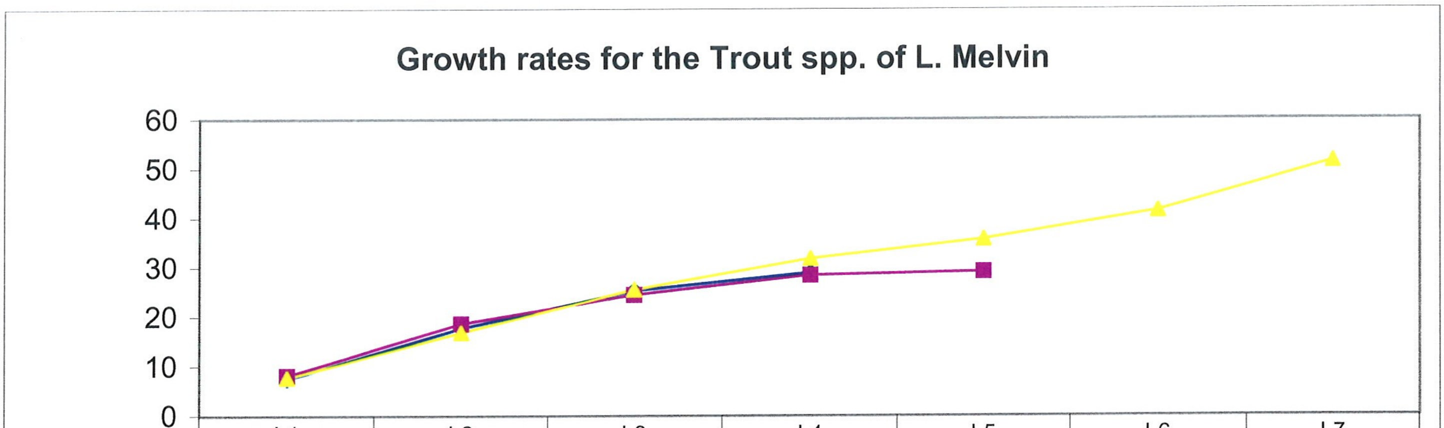


Figure 9: Age structure of trout population from L. Melvin, 2001



	L1	L2	L3	L4	L5	L6	L7
sonaghan	7.51	17.70	25.22	28.83			
gillaroo	8.13	18.62	24.33	28.27	29.02		
ferox	7.69	16.77	25.36	31.63	35.59	41.29	51.23

Figure 10: Growth patterns of each of the trout types of L. Melvin, 2001

	Mean length (cm)			Mean weight (grams)		
Age	sonaghan	gillaroo	ferox	sonaghan	gillaroo	ferox
1	7.51	8.13	7.69	87.5		
2	17.70	18.62	16.77	143	197	
3	25.22	24.33	25.36	287	302	486
4	28.83	28.27	31.63	362	491	805
5		29.02	35.59		475	821
6			41.29			1158
7			51.23			2152

Table 2: Details of mean length at age and mean weight at age, for each of the trout types of L. Melvin

	Sonaghan		**Gillaroo**		**Ferox**	
Food item	count	%	count	%	count	%
Cladocera	21	17.5				
Chaoborus	13	10.8	1	3.3	1	11.1
Chironimd larvae/pupae	31	25.8	2	6.7		
Trichoptera larvae	18	15.0	10	33.3		
Trichoptera adults	3	2.5				
Gammarus			3	10.0	1	11.1
Terrestrial insects	14	11.7				
Ceratoporidae	15	12.5				
E. danica	1	0.8	2	6.7		
Corixids	1	0.8				
Beetles	1	0.8				
Mollusca			12	40.0		
Fish					6	66.7
Unidentified invertebrates	2	1.7			1	11.1

Table 3: Principle food items in the stomachs of 131 sonaghan, 21 gillaroo and 16 ferox.

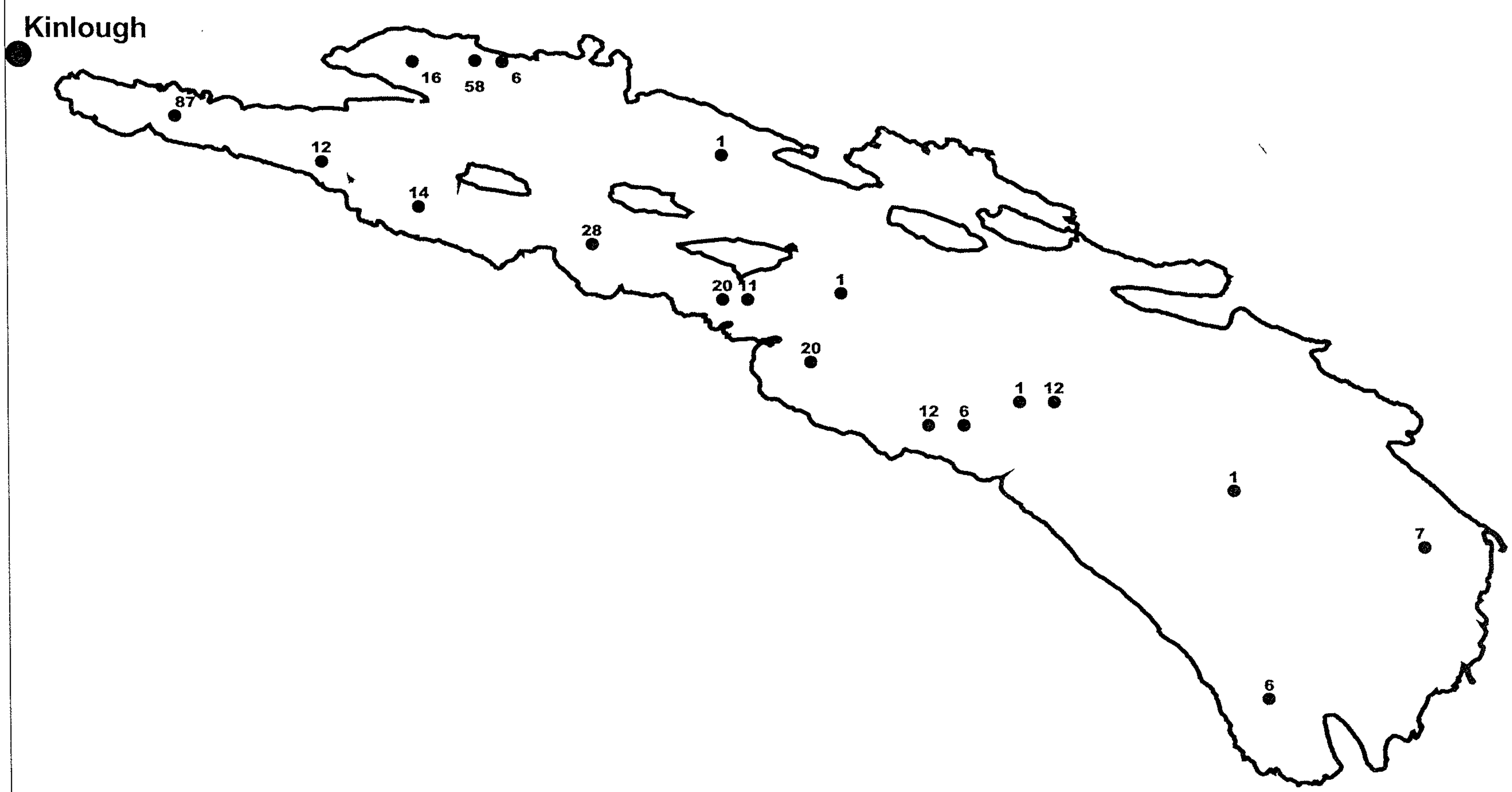


Figure 11: Location of nets with rudd taken and total numbers caught in each.

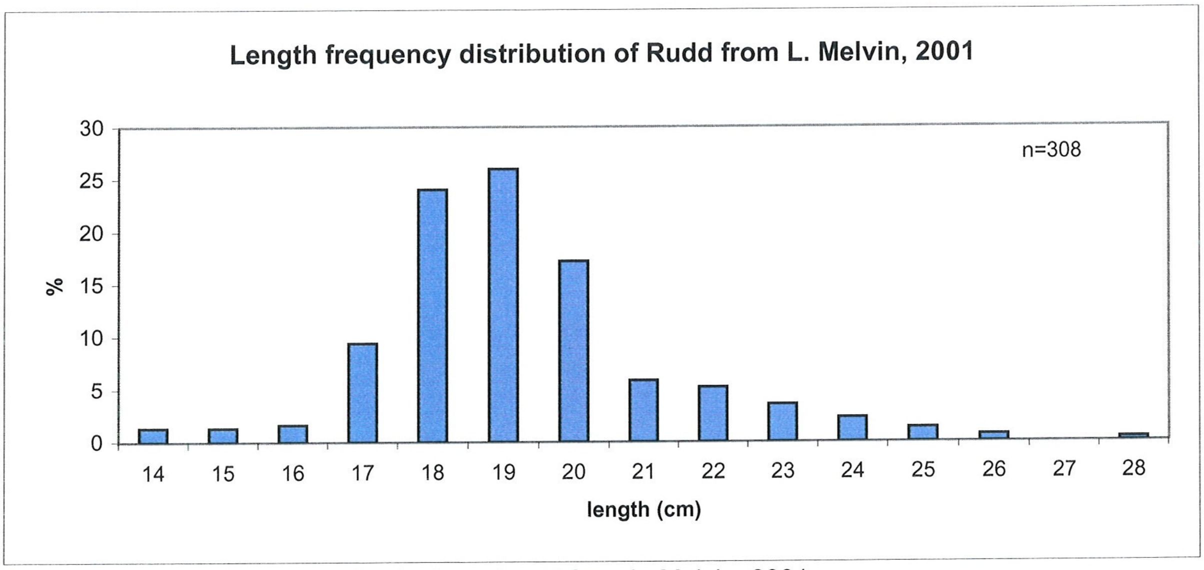


Figure 12: Length frequency distribution of rudd from L. Melvin, 2001.

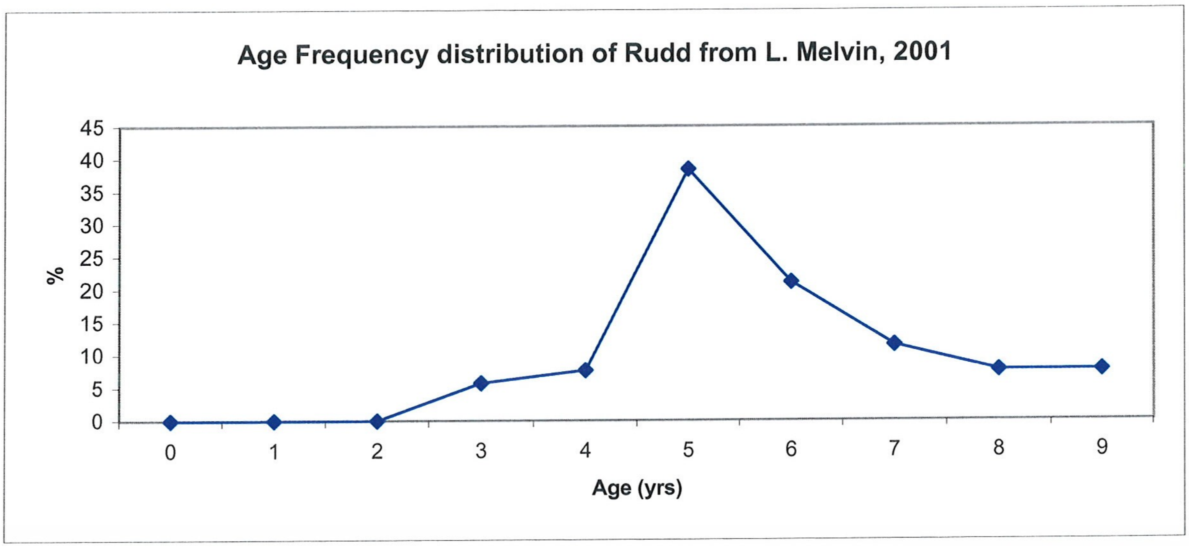


Figure 13: Age structure of rudd population in L. Melvin, 2001

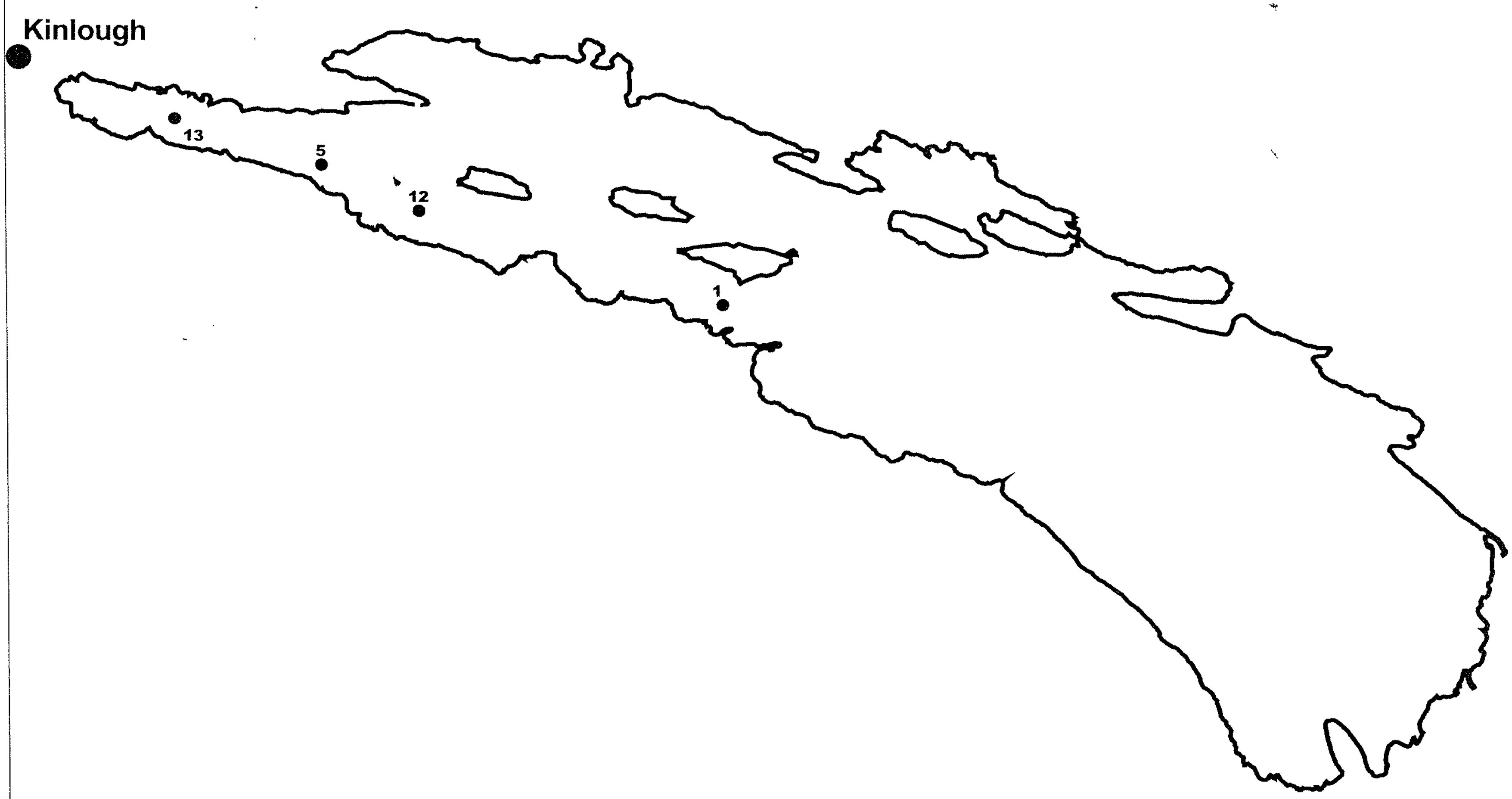
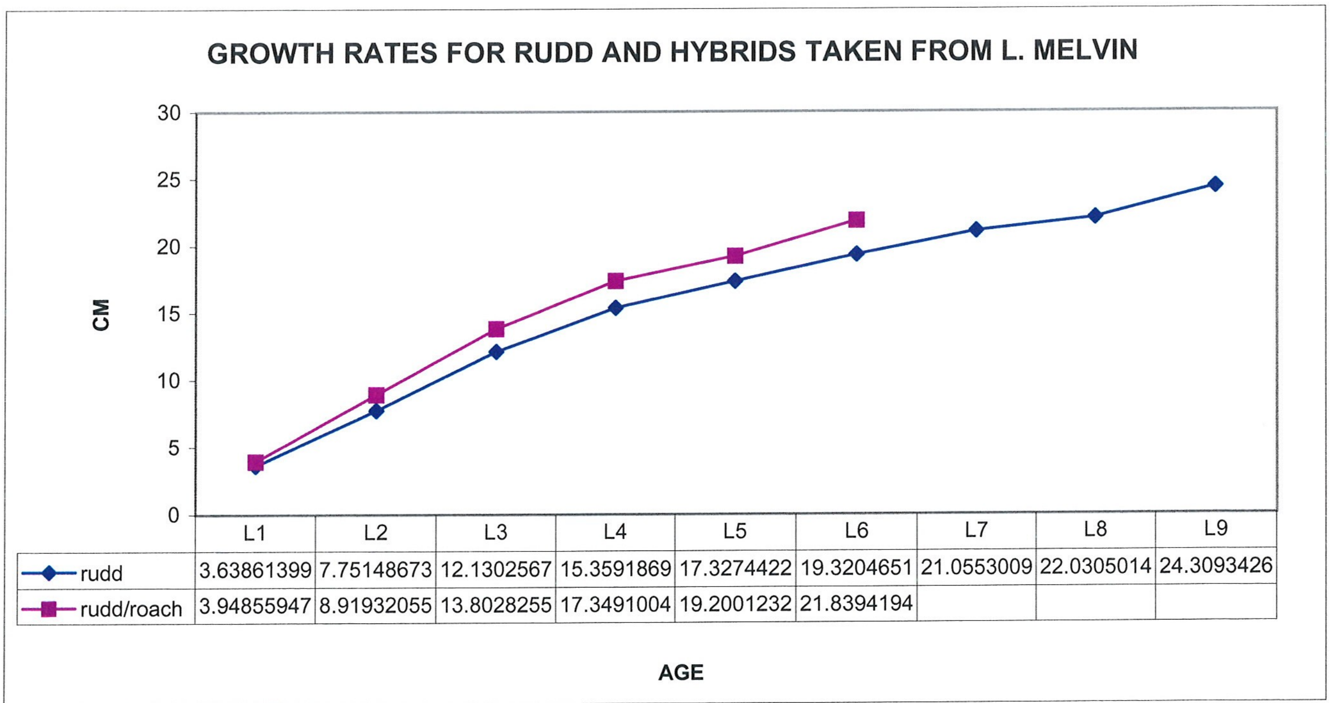


Figure 14: Location of nets with hybrids taken and total numbers caught in each.



	L1	L2	L3	L4	L5	L6	L7	L8	L9
rudd	3.63861399	7.75148673	12.1302567	15.3591869	17.3274422	19.3204651	21.0553009	22.0305014	24.3093426
rudd/roach	3.94855947	8.91932055	13.8028255	17.3491004	19.2001232	21.8394194			

Figure 15: Growth patterns for Rudd and Hybrids from L. Melvin, 2001.

		L1	L2	L3	L4	L5	L6	L7	L8	L9
Rudd	min	1.71007	5.14904	5.97115	12.2148	14.0004	16.6107	17.8762	18.9836	22.575
	max	5.81169	11.7257	16.2857	20.4	20.8457	22.4743	23.5897	24.4297	25.669
	mean	3.63861	7.75149	12.1303	15.3592	17.3274	19.3205	21.0553	22.0305	24.309
	n	*48*	*49*	*49*	*47*	*43*	*24*	*14*	*8*	*4*
Rudd/Roach Hybrids	min	2.78899	6.12366	10.6022	14.784	17.5216	19.824			
	max	5.25328	13.1203	17.5464	21.0241	21.1852	23.8548			
	mean	3.94856	8.91932	13.8028	17.3491	19.2001	21.8394			
	n	*11*	*11*	*11*	*10*	*6*	*2*			

Table 4: Backcalculated lengths at age for rudd and hybrids from L. Melvin, 2001.

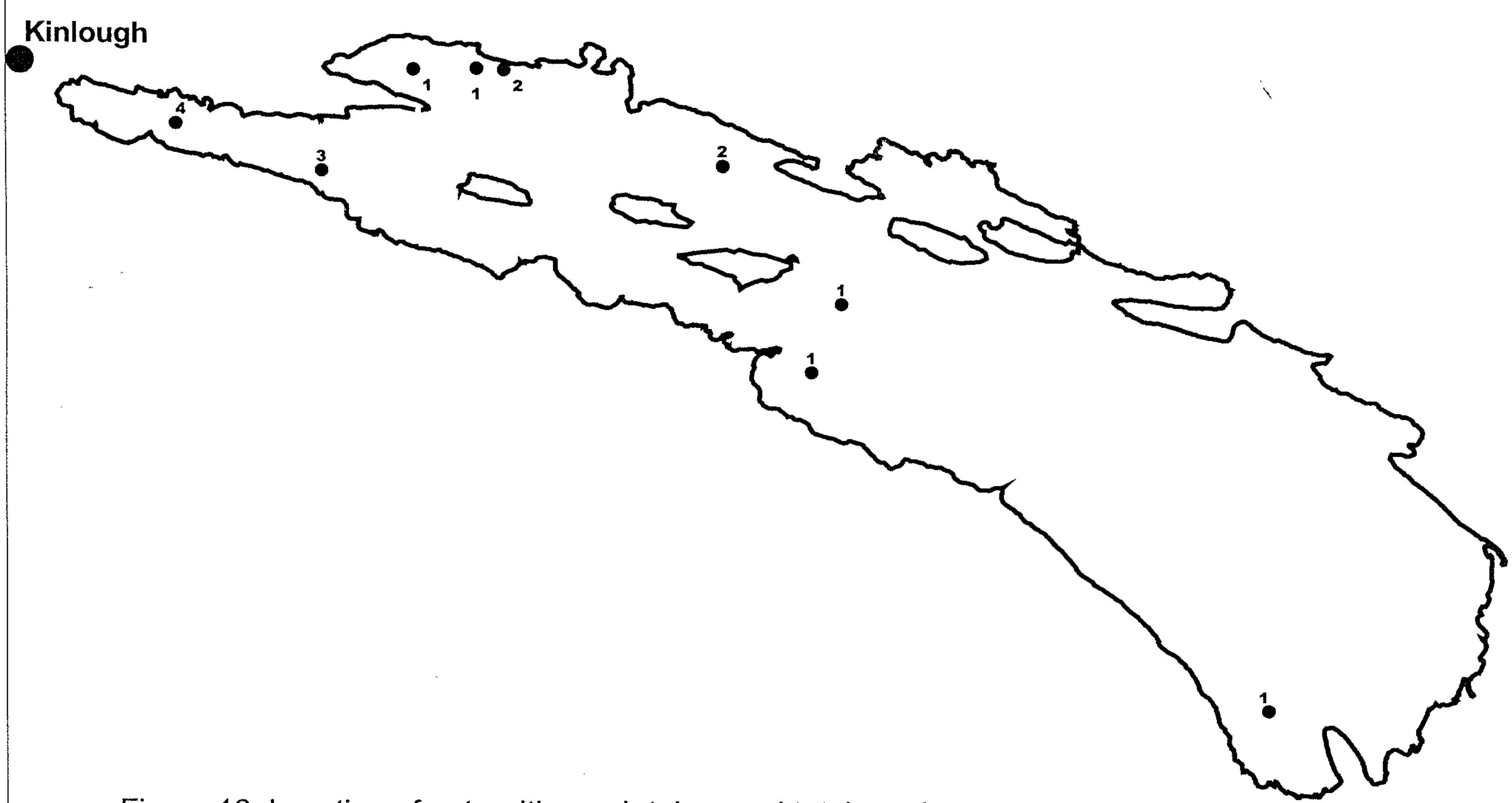


Figure 16. Location of nets with perch taken and total numbers caught in each.

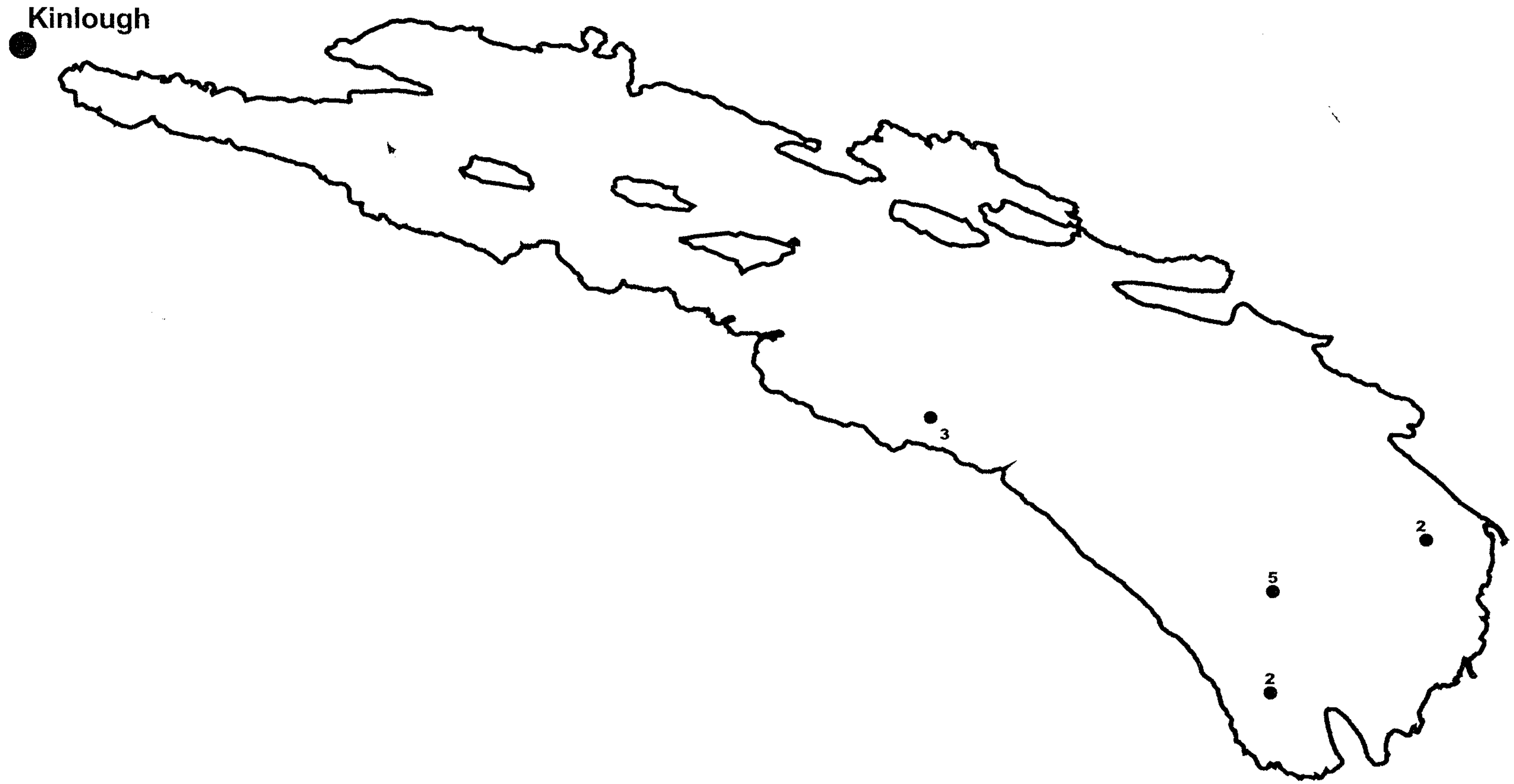


Figure 17. Location of nets with charr taken and total numbers caught in each

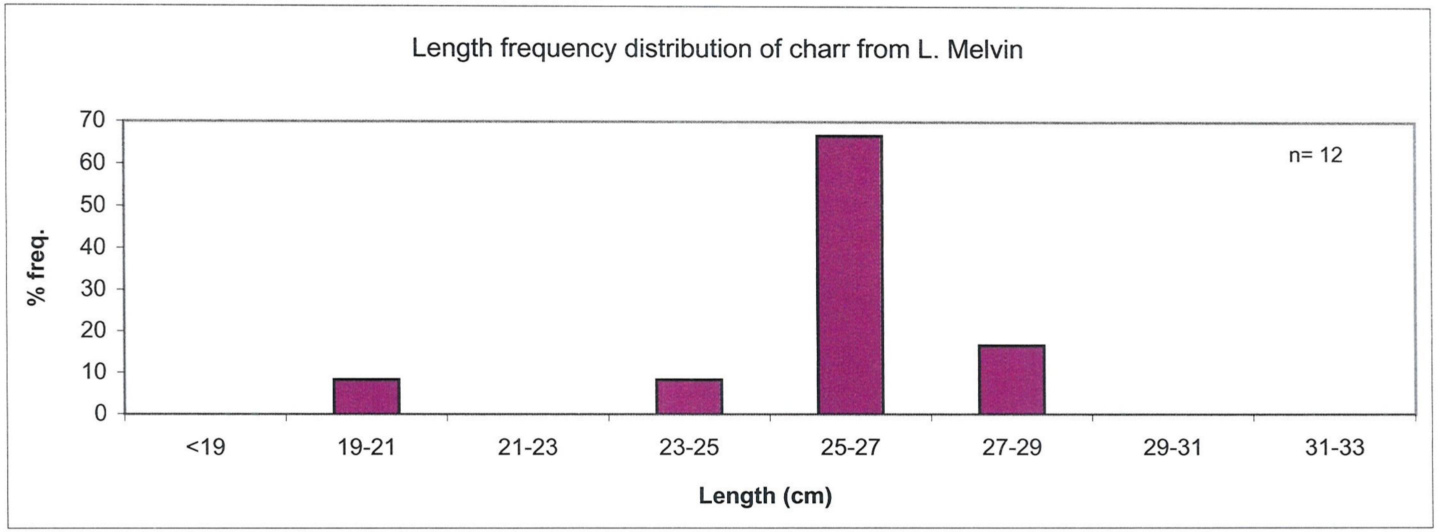


Figure 18: Length Frequency Distribution of Charr from L. Melvin, 2001

Fish Number	Length (mm)	Weight (g)	Sex	Stomach content weight (g)	Dietary Items
1	26.3	273.1	female	0	empty
2	27.4	264.3	male	0	empty
3	26.3	303	male	2.3	Plankton (Cladocera and Copepoda)
4	27.6	253.8	male	0	empty
5	25.2	246.1	female	0.9	Ephemoptera and Plankton (Cladocera and Copepoda)
6	24.9	225.6	male	0	empty
7	25.3	244.3	female	1.1	Plankton (Cladocera and Copepoda)
8	24.7	223.9	female	0.8	Plankton (Cladocera and Copepoda)
9	23.1	188.6	male	0.3	Plankton (Cladocera and Copepoda)
10	26.2	260	female	0	empty

Table 5: Details of Charr Diet.

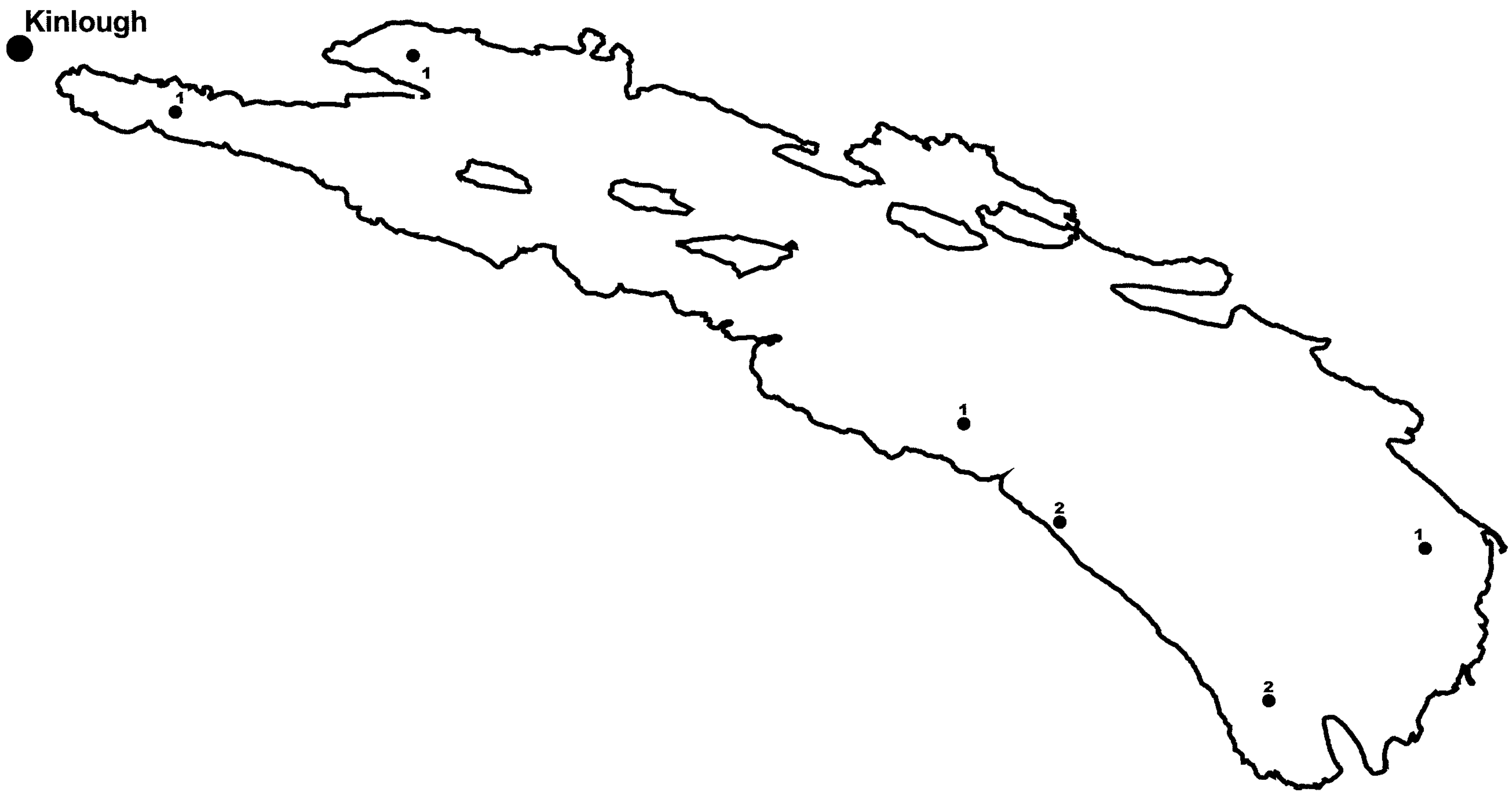
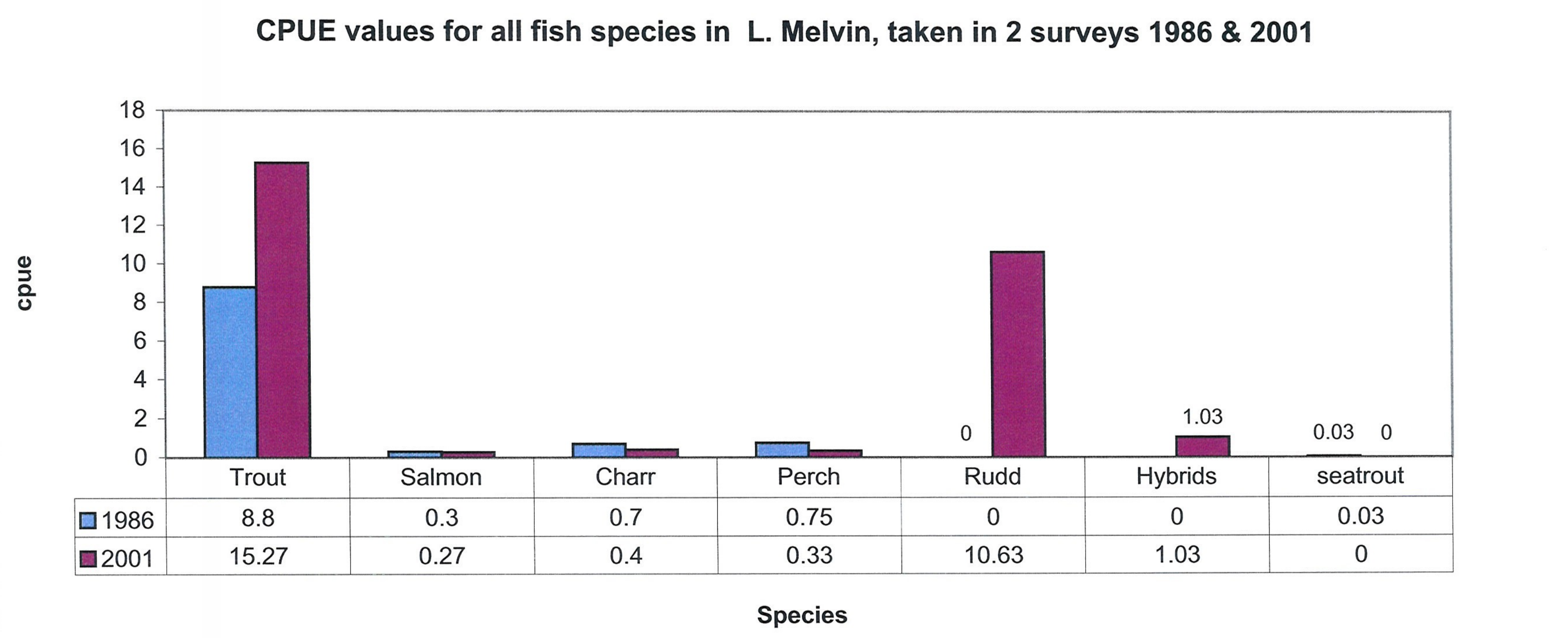


Figure 19: Location of nets with salmon taken and total numbers caught in each.



	Trout	Salmon	Charr	Perch	Rudd	Hybrids	seatrout
1986	8.8	0.3	0.7	0.75	0	0	0.03
2001	15.27	0.27	0.4	0.33	10.63	1.03	0

Figure 20: CPUE values for each species from 2 CFB surveys of L. Melvin, 1986 & 2001.

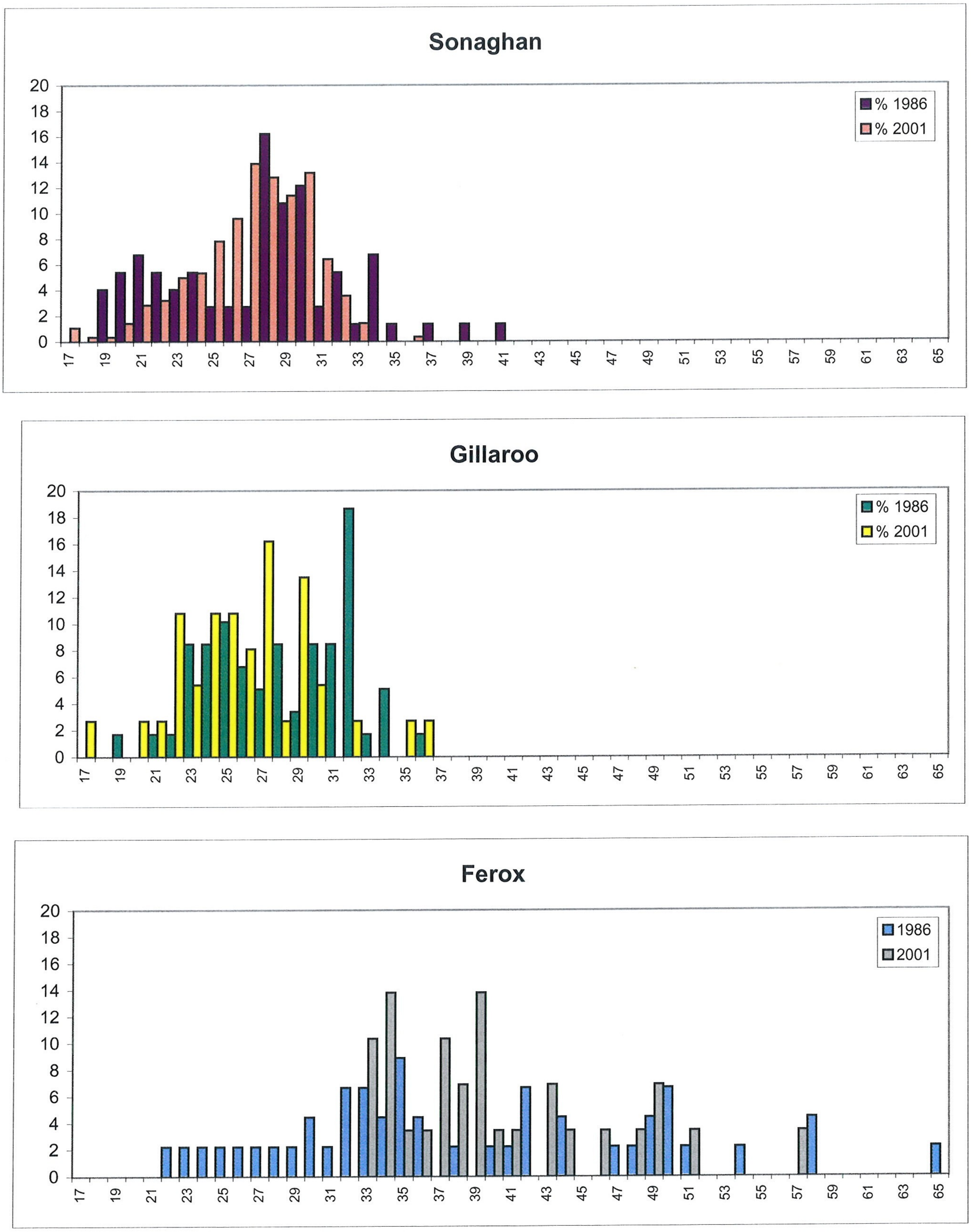
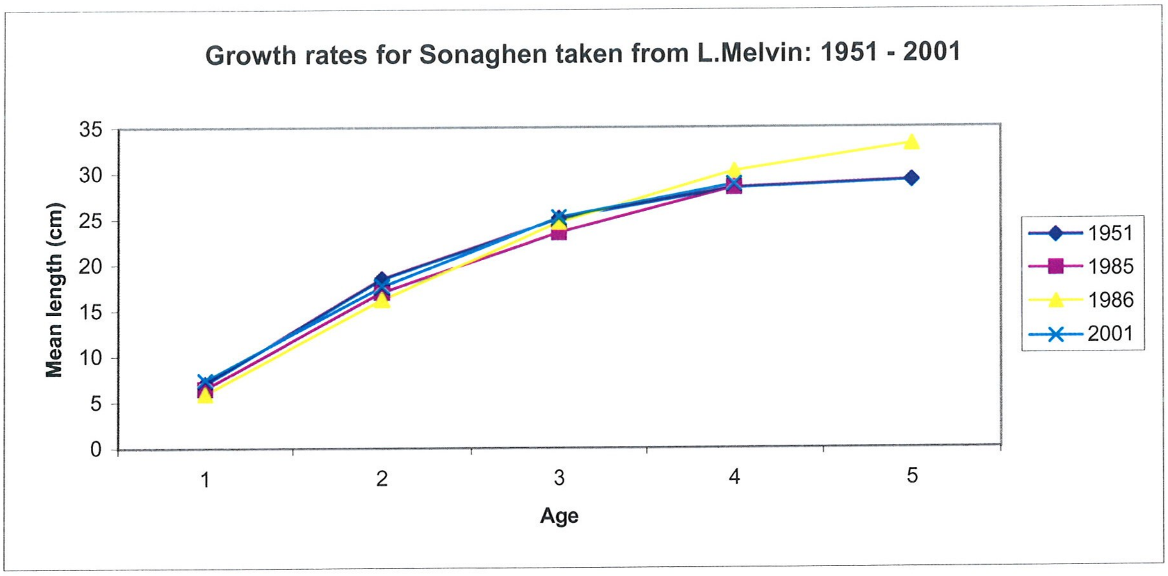
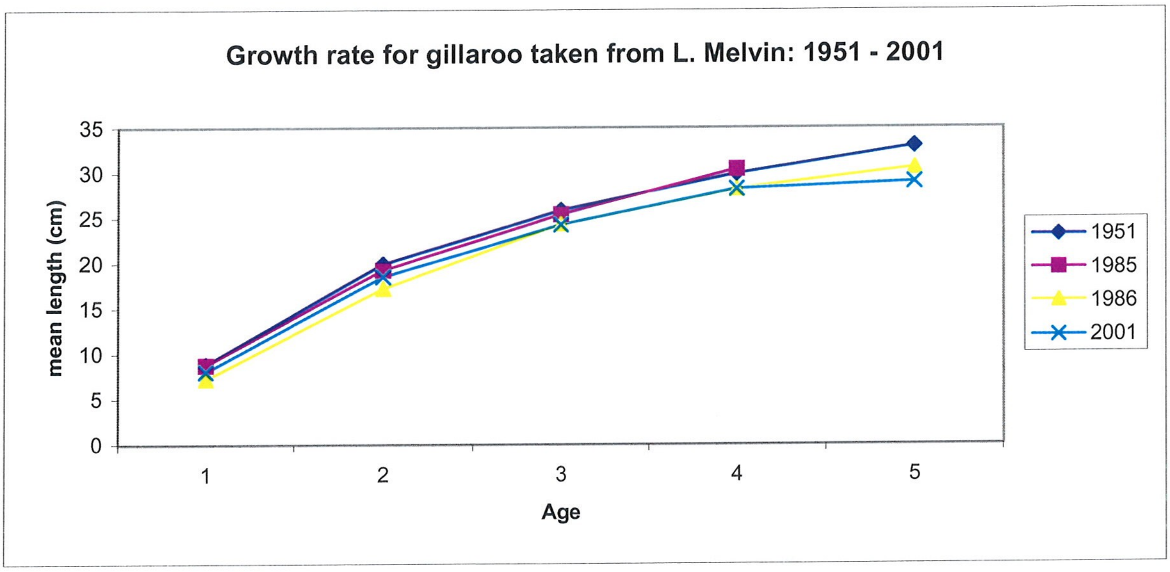


Figure 21: Length Frequency Distribution of each of the trout types, from both CFB surveys, 1986 & 2001.





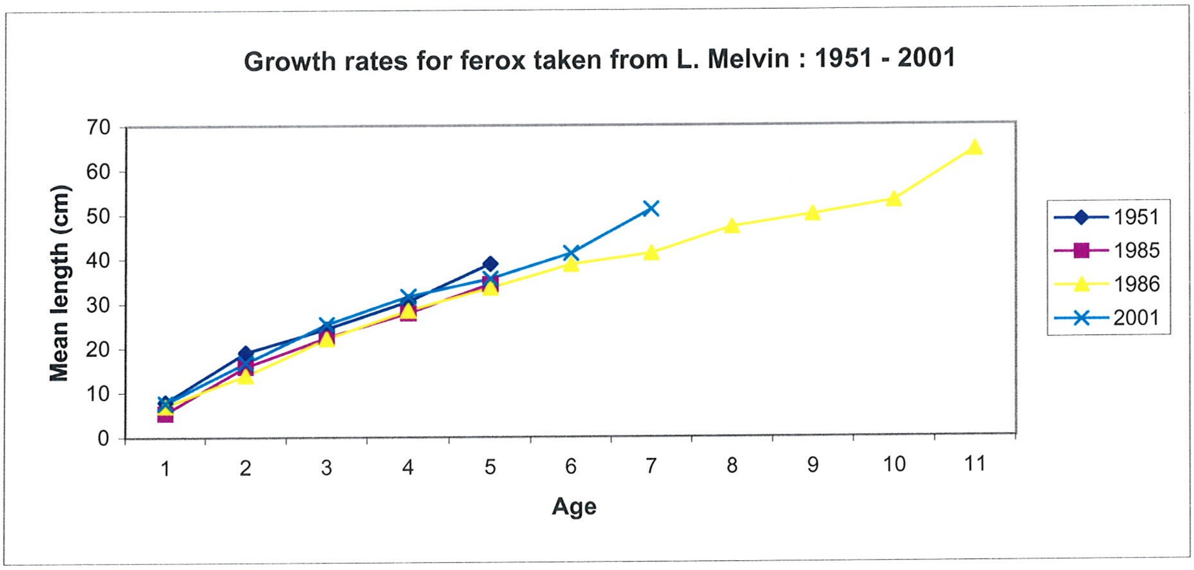


Figure 22: Growth rates (and length at age) for each of the three trout types from L. Melvin, 2001
(1951 & 1985 data taken from Ferguson, 1986)

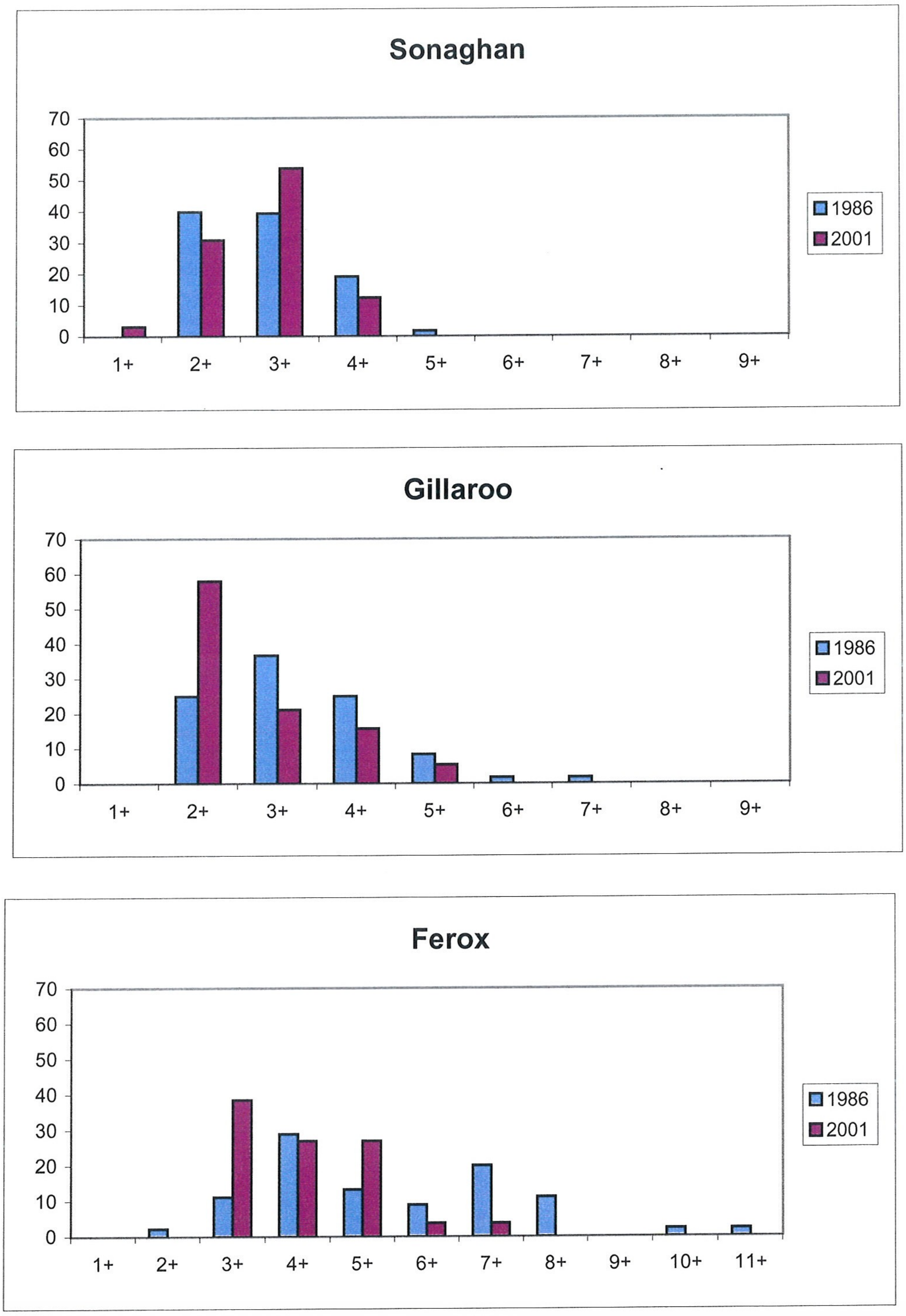


Figure 23: Age Structure of the trout spp. from L. Melvin 1986 and 2001

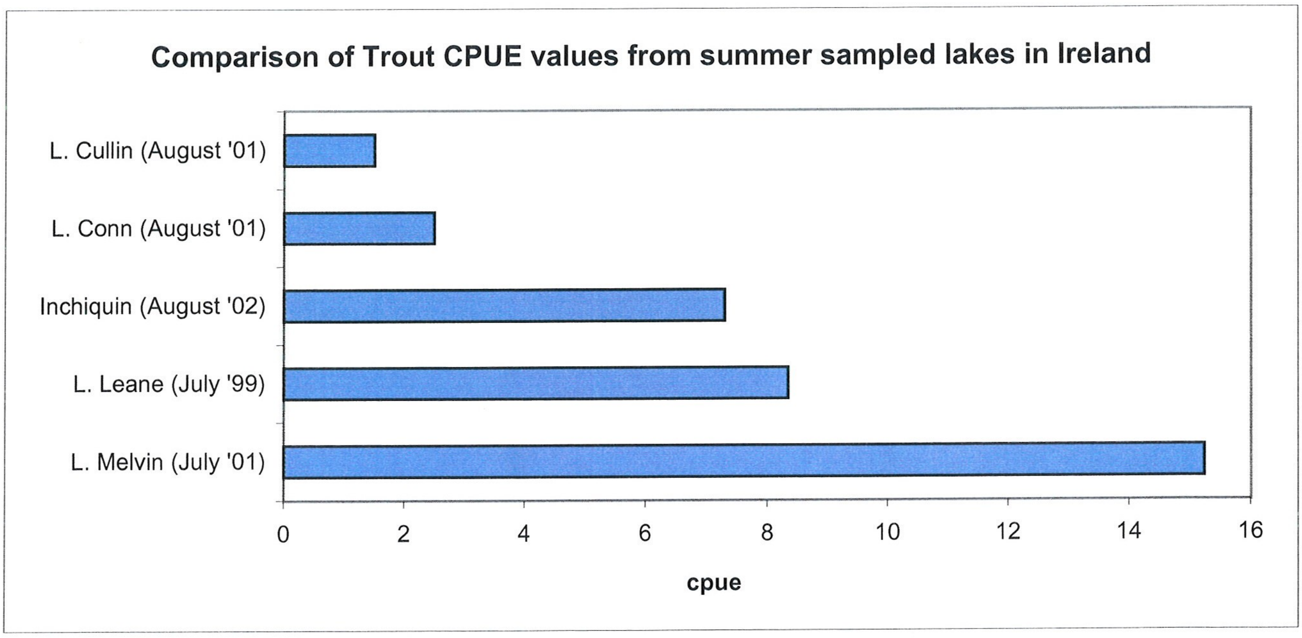


Figure 24: Comparison of trout CPUE data from other Irish summer sampled lakes.

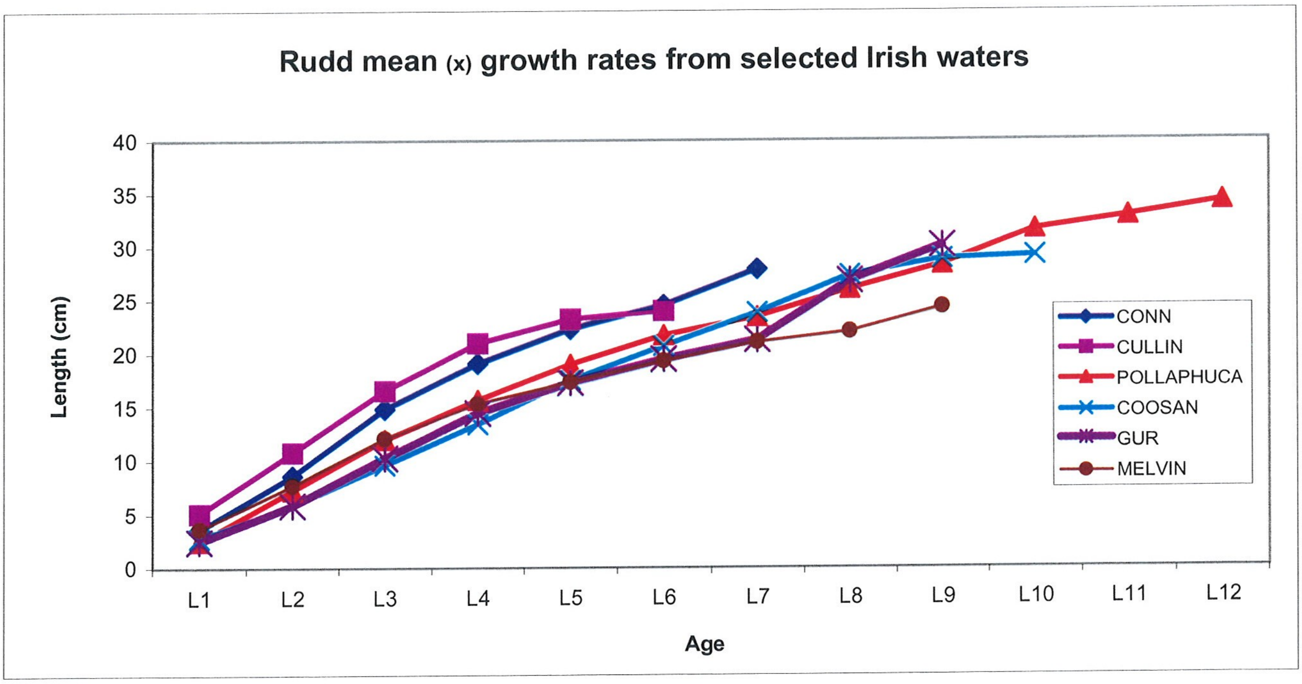


Figure 25: Growth patterns of rudd from Irish waters

Appendix I

Appendix I: Details of net locations and fish caught in each.

ID	X_COORD	Y_COORD	Total no. fish from each net	Depth (ft)	Trout	Salmon	Charr	Perch	Rudd	Hybrids	trout: *ferox*	trout: *sonaghen*	trout: *gillaroo*
1	183179.37	355421.84	100		13	1		4	87	13	1	1	
2	184374.19	355048.46	49	12-15	29			3	12	5	2	1	1
3	185129.25	355878.19	28	18	11	1			16		2	2	6
4	185170.74	354675.08	56	35-40	30				14	12	3	9	10
5	185643.69	355886.49	71	10-14	11			1	58		2		4
6	185867.71	355878.19	12	12-18	6			2	6				
7	186124.93	354890.81	19	16-17	9				7			2	5
8	186606.18	355148.03	1	36-50	1								
9	186589.58	354368.08	17	18	10				7		1		
10	187651.64	355106.54	26	16-20	24			2	1			19	2
11	187651.64	353911.72	25	13-18	4				20	1	1		1
12	187859.08	353911.72	5	16-18	5				11				
13	188373.51	353397.29	2		1				20		1		
14	188622.43	353961.51	50	30	31			1	1		3	26	2
15	188854.76	353961.51	47	40	47			1			1	40	2
16	189336.01	352882.85	5		2		3		12			2	
17	189626.41	352882.85	8		2	1			6		1		1
18	190082.77	353073.69	23		23				1			22	
19	190364.88	353073.69	7		6				12			5	1
20	190406.36	352086.31	6	48	4	2					1	1	
21	190812.93	353903.43	1		2							1	
22	190895.91	352385.01	not fished										
23	191377.15	352675.42	47		47							47	
24	191875.00	353090.29	6	43	6							2	
25	191833.51	352343.52	66		65				1			64	1
26	192132.21	351447.41	6		1		5					1	
27	192107.32	350617.68	19	30	7	2	2	1	6			3	1
28	192638.35	352650.53	34		34						1	33	
29	193094.71	351364.44	4		4						4		
30	193393.41	351870.57	33	36	22	1	2		7		5		
					457	**8**	**12**	**15**	**305**	**31**	**29**	**281**	**37**

Web version (2017)