National Rivers Authority

South Western Region

Review of fishery regulations on the Rivers Taw and Torridge

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1.0 Introduction

1.1 The National Rivers Authority (NRA) has two principal objectives relating to the migratory salmonid fisheries in the Rivers Taw and Torridge. These are to conserve the stocks and to promote sustainable exploitation.

1.2 The fisheries are regulated by various mechanisms to achieve these objectives. Net fishing is regulated by a reducing Net Limitation Order (NLO), presently limiting the number of licensed nets to a maximum of fourteen, and by byelaws which define the type of instrument and the operational, temporal and geographical conditions of its use. Angling is regulated by the sale of licences, with no power to limit the number, and by byelaws which have similar purposes to those for net fishing, as well as that of limiting the catch.

1.3 The NLO expires on 6 February 1996 and Byelaw SW3, which limits angler catches, expires on 30 September 1995.

1.4 In this report, the status of the stocks of salmon and, to a lesser extent, sea trout in the Rivers Taw and Torridge are considered, as are the options for future regulation of the net and rod fisheries. It is considered that salmon smolt production has to be increased by a significant amount. Management objectives are to increase the escapement of potential spawning fish and to ensure that the aquatic environment is conducive to natural production. It is proposed that this might be achieved by adopting a byelaw prohibiting netting for salmon and sea trout in the tidal waters, by modifying and extending the existing byelaw controlling anglers' bag limits, by encouraging further voluntary restrictions and by extending the work on environmental improvements.

1.5 The need to protect sea trout stocks is less clearly defined but there is some concern. Several of the proposed measures apply to both salmon and sea trout, and it is considered that the adoption of these will give adequate protection to the stocks of migratory trout.

2.0 Background

2.1 There is a long history of decline in the salmon stocks of the Rivers Taw and Torridge. Between 1953 and 1980, thirty six nets operated. Declining catches and the low abundance of juvenile fish led South West Water Authority, the regulatory body at that time, to apply in 1980 for a package of measures which included an NLO of 14 and the adoption of voluntary agreements to restrict the angling catch. These measures were modified slightly and approved but an appeal by the net fishermen on the basis of their dependency on fishing was upheld by the High Court and the number of licences issued was increased to 22, although the NLO remained at 14.

2.2 It was not until 1987 that the number of licensed netsmen had fallen to 14 but it was then considered that further restrictions were necessary to give the stocks the opportunity for natural recovery. During 1988 and 1989, negotiations with the netsmen

led to much reduced fishing effort as a consequence of ten of them being paid not to fish.

2.3 In 1990, this arrangement was extended to all 14 netsmen and the NRA applied for, and obtained, a reducing NLO of 14. At the same time, a byelaw was introduced to limit the angling catch by individual anglers on both rivers.

3.0 Description of the River Taw catchment

3.1 The River Taw and its tributaries drain large areas of north and mid Devon. The River Taw rises on Dartmoor at 550 m Above Ordnance Datum (AOD) and flows generally northwards, being joined by its tributaries, the Rivers Yeo (Lapford), Little Dart and Mole, before discharging to the Taw estuary at Newbridge, some 72 km from its source. The principal tributary, the River Mole, rises on Exmoor at 350 m AOD and flows generally south westerly to its confluence with the River Taw, some 34 km from its source. The catchment is mainly rural in nature and is sparsely populated with farmsteads, villages and small towns.

3.2 Geologically, the catchment is in three parts. In the south there is Dartmoor granite and thermally metamorphosed shales. The central section consists of Carboniferous sandstones, shales and siltstones. In the north there are Upper Devonian sandstones, slates and shales. Soils reflect the underlying geology, with peat and humic podzols over the granite, clay pelosols, loamy brown podzols and alluvial deposits in the central section, and brown earths, pelo-stagnogleys and alluvial deposits in the north.

3.3 Historically, metal mining was an important industry and there are fifty eight known abandoned mines in the catchment, most of which are on the fringe of Exmoor, with just one in the upper River Taw catchment at Sticklepath. Drainage from abandoned mines and metal enriched rocks increases the metal concentrations in some rivers in the catchment.

3.4 Currently, the most important industry in the catchment is agriculture, principally dairy farming, livestock rearing and fish farming, with some arable and forestry. Surface water abstractions for fish farms account for the largest licensed use of water resources in the catchment. Other industries include dairy processing, quarrying, timber processing, cider production, tourism, power generation and light industry.

3.5 There are no impassable weirs on the River Taw. The steeper slopes of Dartmoor act as naturally impassable barriers to migratory salmonids. There are two dams in the headwaters of the River Yeo (Barnstaple) system and one on the River Bray which act as barriers.

3.6 Generally, water quality is good, with the majority of reaches complying with all their targets. Limited problems occur in a few areas, notably on the River Yeo (Lapford) (organic material and ammonia), the lower reaches of the Rivers Little Dart and Venn (zinc) and at a few sites on Exmoor (zinc and copper).

3.7 Silting of salmonid spawning gravels has occurred throughout much of the catchment, particularly in the River Mole catchment, the River Little Dart and middle reaches of

the River Taw. Gravel cleaning has been undertaken in some of these areas but considerable sections in the catchments of the Rivers Mole and Little Dart continue to give concern. Trash dams have been removed from substantial parts of the Rivers Yeo (Lapford), Little Dart, Mole, Yeo (Barnstaple) and Bradiford Water. Further work is needed on parts of the Rivers Yeo (Lapford) and Little Dart.

3.8 Some details of the catchment are shown on the map in Figure 1. Further details are available in the River Taw Catchment Management Plan Consultation Report (NRA 1994a).

4.0 Description of the River Torridge catchment

4.1 The River Torridge drains a large part of north west Devon. The main river rises near the north Devon coast at 200 m AOD and flows south east, being joined by its tributaries, the Rivers Waldon and Lew. Thereafter, it turns north and flows to the estuary at Bideford, being joined by further tributaries, the Rivers Okement, which drains part of Dartmoor, and Mere. The main river is about 100 km long. The catchment is also rural in nature, being sparsely populated by farmsteads, villages and small towns.

4.2 Geologically, much of the catchment consists of Carboniferous shales and sandstones, with a small area of boulder clay. The headwaters of the River Okement are on Dartmoor granite, which is overlain with peat soil. Brown earths, pelosols and surface-water gleys are predominant in most of the catchment.

4.3 The most important industry is agriculture, with dairying, sheep and beef rearing being the principal activities. Meat processing, quarrying for stone and ball clay, tourism and light industry are also important.

4.4 There are seventeen weirs and obstacles on the River Torridge and its tributaries, three of which, all relatively well upstream on the River Okement system, are impassable to migratory salmonids.

4.5 Generally, water quality is good and much improved on the conditions obtained in the mid 1980's. The majority of reaches comply with their targets. Non-compliant sections are distributed throughout the catchment, the most common reasons for failure being high concentrations of organic material, ammonia and, occasionally, zinc.

4.6 During the mid 1980's, pollution events on the River Waldon and the upper reaches of the River Torridge resulted in fish mortalities, caused by discharges of organic waste from farms. A vigorous publicity campaign and the introduction of regulations controlling the storage of farm wastes have reduced the risk of such problems recurring. During the 1980's and 1990's, there were several pollution events on the River Okement which resulted in fish mortalities. Most were caused by natural and industrial discharges of highly acidic and, occasionally, highly alkaline material. Much has been done to minimise the risks of accidental discharge from industry and to minimise the effects of natural acidic events. A programme of broodstock development and fry stocking has been established to mitigate any effects of pollution. A maximum of

20,000 salmon fry are used for this purpose each year and, since they replace lost stocks, they are not considered to have an impact on overall stock levels.

4.7 Silting of salmonid spawning gravels is a problem, as are trash dams and bank erosion. A considerable amount of work has been done, particularly since 1990, to rectify this, including gravel cleaning and trash dam removal, but much remains to be done.

4.8 Some details of the catchment are shown on the map in Figure 2. Further details are available in the River Torridge Catchment Management Plan Consultation Report (NRA 1993a).

5.0 Description of the Taw and Torridge estuary

5.1 The principal freshwater discharges to the estuary are the Rivers Taw and Torridge, both of which have individual estuaries which join at Appledore. There is a short joint estuary which discharges to Bideford Bay. The Taw estuary also receives the Rivers Venn, Yeo (Barnstaple), Bradiford Water and Caen, and the Torridge estuary also receives the River Yeo (Bideford). All of these estuary tributaries are relatively small.

5.2 The upper reaches of both main estuaries are narrow, winding and muddy. Both become wider although, at low tide, drainage is through a complex of narrow braided channels in large areas of mud, sand and saltmarsh. The joint estuary is short and broad, and has extensive sand and gravel banks. A substantial sand bar across the mouth is exposed at low water.

5.3 The tidal range exceeds four metres. The ebb tide is extended and the flood tide is short and vigorous. The separate estuaries can become temporarily salinity stratified but the joint estuary is fully mixed. Current speeds between 1.0 and 1.7 m/s are measured on spring tides. On neap tides, speeds are generally between 0.5 and 1.0 m/s.

5.4 There are several towns and large villages around the estuaries, the most important being Barnstaple and Bideford.

5.5 The major industries are tourism, gravel extraction, shipbuilding and waste disposal. There are limited port facilities. There is significant use of the area by the military and emergency services. Some sea and shell fisheries operate and the estuaries are used for sewage disposal.

5.6 Generally, water quality is good and there are relatively few problems which might have an effect on fish. High concentrations of ammonia are observed in the middle and upper reaches of the Taw estuary in summer and high concentrations of chlorophyll, indicating substantial algal growth, occur in the middle reaches in summer. Ammonia may affect the passage of migratory fish and algal blooms can cause conditions detrimental to fish health, although there is no evidence of such a problem here.

5.7 Some details of the estuary are given on the map in Figure 3. Further details are available in the Taw/Torridge Estuary Catchment Management Plan Consultation Report (NRA 1993b).

6.0 The net fishery

6.1 Fourteen licences to operate seine nets are issued each year, under the terms of the NLO. The season runs from 1 April to 31 August with a weekly close season from 1800 hours on Friday to 0600 hours on the following Monday. The maximum permitted dimensions of unarmoured netting are 200 yards length and 8 yards depth, without bags or pockets. Mesh size is limited to 50 mm in extension from knot to knot except for a single section, not exceeding one fifth of the maximum permitted length of netting, which may have a mesh not less than 38 mm in extension from knot to knot. Monofilament and multi-monofilament netting is not permitted.

6.2 In operation, shooting and hauling must be without pause or delay and not more than three quarters of the width of the water may be fished. The estuary of the River Taw upstream of a line between NGR SS 528345 and NGR SS 523343 is a sanctuary area where fishing is not permitted. That part of the River Torridge estuary upstream of Bideford Bridge is also a sanctuary area until 1 July each year.

6.3 No netting has taken place since 1990 as a result of an agreement between the NRA and the licensed netsmen.

6.4 Modern records of the net catch began in 1953. From 1955 to 1959, fishing was allowed on an experimental basis during November and December. From 1956 to 1960 inclusive, fishing was allowed in September and in 1962 also in March. In subsequent analyses, data from these few extra months have been ignored. Season totals for salmon for the period 1953 to 1989 are shown in Figure 4. The number of nets operating has varied during this period, being 36 until 1980, 14 in 1981, 22 in 1982 and 1983, 17 in 1984 and 1985, 16 in 1986, 14 in 1987 and 4 in 1988 and 1989.

6.5 For salmon, it is clear that there has been an overall decline in the total catch. Since 1981, some of this is likely to be due to the reduced number of nets operating. However, during the period 1953 to 1980 when 36 nets were operating, the decline in catches and, by definition, catch per unit effort, was unequivocal. From 1981 to 1989 when fishing effort was extremely variable, catch was inversely related to effort, despite the high probability of a declining stock during this period. What is clear is that when only four nets were operating, they were capable of taking between 26% and 51% of the catch previously taken by 14 to 22 nets.

6.6 The number and proportion of different sea ages in the catch has changed over the period 1953 to 1989. Spring-run salmon, the majority of which are two sea winter (2SW) fish, have declined significantly, as shown in Figure 5. The assumption is made that fish caught in April are multi sea winter (MSW) spring-run salmon.

6.7 The catch of grilse increased significantly to the mid 1970's but thereafter has declined. The assumption is made that the majority of fish caught in July and August are grilse. Figure 6 shows the catches of this group of fish. The decline from the mid 1970's was evident before the reduction in fishing effort in the early 1980's.

6.8 Between the 1950's and the mid 1970's, the decline in catches of large 2 SW spring fish was, to some extent, compensated for by the increasing catches of smaller grilse.

However, from the mid 1970's, both elements of the salmon stock were either low or declining. Since 1981, the reduced fishing effort has also resulted in lower catches.

6.9 As the proportion of fish of different sea ages has varied, the average weight of fish caught has declined, as shown in Figure 7, and there is a suggestion that the average weights of fish caught in different months have also declined, as shown in Figure 8. If the assumptions that fish caught in April are almost certainly all 2 SW fish and those caught in July and August are principally grilse are correct, the probability is that there has been an overall decline in the size of fish in the two principal sea age groups over the period 1972 to 1989. The declines in numbers and, probably, in size have significant implications for the potential egg deposition by fish which escape to spawn.

6.10 The seasonal total net catches of sea trout for the period 1953 to 1989 are shown in Figure 9. There is considerable variation from year to year and it is likely that reduced netting effort since 1981 has contributed to recent lower catches.

6.11 Prior to 1981, catches in April and May, which tend to be of the larger, multiple return sea trout, were rising, as shown in Figure 10, and those for July and August, which have a high proportion of fish returning after only a few months at sea, appeared to be relatively high but stable, as shown in Figure 11. There is no evidence that the proportion of different sea ages of sea trout has changed.

6.12 Monthly mean weights of net caught sea trout are either stable or rising slightly, as shown in Figure 12.

7.0 The rod fishery

7.1 On both rivers, the salmon season runs from 1 March to 30 September and that for trout, including sea trout, is from 15 March to 30 September. From 1978 to 1980, fishing for salmon was allowed in February. In subsequent analyses, data from these few extra months have been omitted.

7.2 No spinning is allowed after 30 April and shrimps, prawns, worms and maggots are not permitted as baits at any time. A byelaw restricts the bag on the River Taw to two salmon per day, three per week or ten per season and five sea trout per day, fifteen per week or forty per season. On the River Torridge, the mandatory bag limits are two salmon per week or five per season and two sea trout per day, five per week or twenty per season.

7.3 Modern records of the catch began in 1953. Season total catches of salmon from both rivers for the period 1953 to 1993 are shown in Figures 13 and 14. It is clear that salmon catches on both rivers have declined. The various mandatory and voluntary restrictions since 1980 may contribute to recent lower catches.

7.4 Rod catches of salmon have declined or remained relatively stable in all months of the season on both rivers, with the exception of September on the River Taw, for which there is some evidence of an increase. On both rivers, there has been a decline in the proportion of spring-run fish in the catch, as indicated by catches in March and April (Figures 15 and 16), and an increase in the proportion of grilse, as indicated by catches

in August and September (Figures 17 and 18). This change almost certainly reflects the changes taking place naturally in the stocks but the voluntary restrictions have, almost certainly, made a contribution.

7.5 Season total catches of sea trout are shown in Figures 19 and 20. Catches on both rivers have declined. Recent low catches may, in part, be due to the various voluntary and mandatory restrictions operating since 1980.

8.0 Radio tracking

8.1 Between 1988 and 1994, salmon have been caught by netting in the estuary, fitted with radio tags, released and tracked. This exercise was part of an assessment of a water resource development proposal. The majority of the fish, 254, were caught and released in the Taw estuary with the remainder, 12, being caught and released in the Torridge estuary.

8.2 Fixed monitoring points on both rivers detected the movement of fish into and within the freshwater reaches. Overall, 33% of tagged fish were undetected for a variety of reasons but, of the fish which were tracked, the majority ascended the river of the estuary in which they had been caught and released. However, between 12% and 40% each season, on average 25%, ascended the other river.

8.3 The majority of fish arrive at or near the head of tide within seven days of their release in the estuary but 31% stay in the estuary or coastal waters for one to four weeks and 17.5% remain there for more than four weeks before finally entering freshwaters. Residence times in tidal water vary considerably from year to year, being significantly shorter in wet years.

9.0 Potential egg deposition

9.1 Egg deposition targets are based on the relationship between spawning adults and recruits to the stock, as defined by a stock-recruitment curve. The precise shape of these curves is still a matter for debate but it is clear that they are not linear (NRA, 1994b). As the number of eggs deposited in the gravel increases with the greater escapement of adults, so does the number of smolts produced from those eggs, but not in a proportional way. At high egg densities, any increase generates progressively smaller increments in the number of smolts and may result in reduced numbers. The number of eggs resulting in the maximum smolt production should be the target adopted when stocks are significantly reduced and in need of conservation.

9.2 In Canada, a target of 240 eggs/100 m^2 of total wetted area of river has been adopted on many rivers for several years. However, there is a recent suggestion that this value may be too low (NRA, 1994b).

9.3 In the U.K., the most comprehensive study is that undertaken on the River Bush in Northern Ireland (Kennedy & Crozier, 1993). Varying egg deposition values are related to different habitats. For the total wetted area of river, irrespective of whether or not salmon can use it, values of 190-280 eggs/100 m^2 apply. For total usable area, the values are 390-580 eggs/100 m^2; for all best quality rearing habitat, the values are 660-

980 eggs/100 m^2 and for normally used best quality habitat, 950-1420 eggs/100 m^2 apply. Two studies from Scotland indicate maximum values exceeding 2000 eggs/100 m^2 on rivers with a high proportion of high quality habitat.

9.4 Potential salmon egg deposition densities, using estimates of total usable area, have been calculated for both rivers for three ten year periods, 1959-68, 1971-80 and 1984-93, and are shown in Table 1. Details are provided in Appendix A. Those for the earliest period, when conditions were considered to be satisfactory in that both salmon catches and juvenile production were high, are around 400 eggs/100 m^2. This is similar to the value of 390 eggs/100 m^2 adopted by NRA Welsh Region in its review of Net Limitation Orders and Fishery Byelaws (NRA, 1994b) and is within the range for total usable area determined for the River Bush.

9.5 It seems reasonable to adopt a target of 400 eggs/100 m^2 for the Rivers Taw and Torridge but, because of the difficulties in setting targets and monitoring compliance, they will be reviewed as more data and information become available. It is clear that in recent years this target has not been achieved on either river. For 1984-93, the potential egg deposition was only 53% of the target on the River Taw and 15% on the River Torridge. An extra escapement of 950 adults is required on the River Taw and 1680 on the River Torridge to make good the shortfall in potential egg deposition.

9.6 Similar calculations have not been done for sea trout because its reproductive biology and population dynamics are less well understood.

10.0 Juvenile surveys

10.1 Surveys of juvenile salmon and trout have been carried out on numerous occasions on the River Taw between 1968 and 1993. On many of these, the method employed has allowed the calculation of juvenile densities. Surveys with less than ten sites are of limited value, being unable to reflect the fisheries status of the whole catchment. Mean densities of fish aged one year or more (parr) in surveys with ten or more sites are shown in Table 2. In the last two surveys, in 1992 and 1993, mean densities of salmon parr have been the lowest recorded and mean densities of trout parr are also relatively low.

10.2 In 1993, twenty five additional sites were surveyed by a less precise method, from which can be obtained statistics representing catch/time period or presence and absence. The average catch in 20 minutes is shown in Table 3.

10.3 The 1993 survey was comprehensive, with 114 sites throughout the whole catchment, of which 107 were available to salmon. Salmon fry (fish aged less than one year) were absent from 28 available sites (26.2%), salmon parr from 27 available sites (25.2%), trout fry from 31 sites (27.2%) and trout parr from 1 site (0.9%). The principal available areas where salmon were absent were the most downstream part of the main river, much of the River Yeo (Lapford) and some small tributaries on Exmoor, in the lower reaches and the estuary. Trout fry were absent from the lower reaches of the main river, parts of the River Yeo (Lapford) and the lower reaches of the River Mole.

10.4 On the River Torridge, similar surveys have been carried out between 1964 and 1992.

Mean densities of parr in surveys with ten or more sites are shown in Table 4. In the last two surveys, in 1991 and 1992, mean densities of both salmon and trout parr were the lowest recorded.

10.5 Since 1989, additional sites have also provided data which enable the average catches in 20 minutes to be calculated. These are shown for main river sites in Table 5 and for the River Okement in Table 6.

10.6 In the 1992 survey, there were 78 sites throughout the whole catchment, of which 76 were available to salmon. Salmon fry were absent from 14 available sites (18.4%), salmon parr from 24 available sites (31.6%), trout fry from 14 sites (17.9%) and trout parr from 21 sites (26.9%). The principal areas where salmon were absent were the upstream tributaries. Trout were absent from many sites in the middle and lower reaches of the main river.

10.7 In the most recent surveys, habitat data are available for 77 sites on the River Taw and 48 sites on the River Torridge. These, together with salmon parr densities, have been used to calculate relative grades as defined in the Fisheries Classification Scheme (NRA, 1994c). The numbers and proportions of sites in each grade are shown in Table 7, which also includes data from the River Taw survey of 1968 for comparison. Data from the River Torridge survey of 1964 are not available because habitat measurements were not recorded. There is a significant difference between the 1968 and 1993 distributions on the River Taw.

11.0 Fishery status

11.1 It is clear from the evidence presented above that the salmon stocks of the Rivers Taw and Torridge are relatively low. The combination of low and declining net and rod catches, involving all sea age components, and a relatively poor distribution and abundance of juveniles, all lead to the conclusion that the salmon stocks are depressed. This is confirmed by the calculations of potential egg deposition, which show a considerable reduction from the target. It might be argued that the restrictions imposed in recent years have contributed to the low catches and this is acknowledged as a factor. However, there is strong evidence of a significant decline in stocks before the restrictions were introduced and, since then, there has been no sign of a sustained recovery. The factors causing this depressed state are likely to be numerous and many are outside the control of the NRA.

11.2 The situation with sea trout is not so clear. It is common for catches to fluctuate widely from year to year but, prior to the reduction in effort in 1981, there was a brief period when net catches were relatively stable. However, rod catches had been in decline since the late 1960's. The recent reduction in this rate of decline has coincided with the period of restrictions. The decline in rod catches and the relatively poor production of juveniles in recent years lead to some concern about the status of the sea trout stocks.

11.3 There is some evidence from rod catches of salmon and from juvenile surveys that limited improvements are occurring. The recent distribution of juvenile salmon in the River Torridge is slightly better than it has been and there have been some sites with large numbers of juveniles in recent years. In particular, the River Okement, the

principal tributary of the River Torridge, has exhibited good juvenile production for several years but it is at high risk of suffering from pollution events. Rod catches of grilse in 1994 and MSW fish in 1995 are believed to have been higher than recently, although this was a general feature of many south western rivers. These are encouraging signs that the restrictions and management actions operating at present are having some beneficial effect. But there is no sign of a sustained recovery.

11.4 The NRA wishes to capitalise on these small but encouraging indications of recovery. A further period of restrictions will be beneficial to the stocks, giving them the greatest opportunity of making a full and sustained recovery. However, the lengthy reproductive cycle of salmon means that recovery is unlikely to be rapid.

12.0 Basis for management

12.1 The NRA's basis for management of fisheries is defined in the legislation. Within that framework, policies have been determined and presented in the NRA's draft salmon management strategy (NRA, 1994d).

12.2 Under the Salmon and Freshwater Fisheries Act (SFFA) 1975, the NRA has a duty to regulate fishing for salmon and sea trout. The methods are by a system of licensing (Section 25) and by orders limiting the number of licences (Section 26).

12.3 Under the Water Resources Act 1991, the NRA has the power to make byelaws for the better execution of the SFFA 1975 and the better protection, preservation and improvement of any salmon, trout, freshwater and eel fisheries (Section 210 and Paragraph 6 of Schedule 25). It is considered that measures to maximise smolt production and to control the exploitation of stocks for better conservation can be adopted under this part of the legislation.

12.4 There is neither duty nor power in the legislation for the NRA to apportion the catch of fish between nets and rods. Socio-economic arguments are irrelevant and are not considered in this assessment.

12.5 There is a presumption that exploitation of single stocks is preferable to the exploitation of mixed stocks. The phasing out of mixed stock fisheries is proposed as NRA policy, but this applies to coastal fisheries rather than an estuary fishery such as the Taw and Torridge. The NRA's long term objective here is for a sustainable fishery, exploited by both nets and rods. It is inevitable that all net fisheries and some rod fisheries exploit salmon and sea trout from more than one river stock to some extent and this is certainly true for the Taw and Torridge fisheries. The River Torridge salmon stock appears to have suffered a greater decline than has that of the River Taw and this makes the management of fisheries for conservation purposes a difficult task. Management needs to be adapted to ensure the conservation of the stock in most need of protection.

12.6 It is now considered inappropriate for the NRA to use decreasing public funds to buy back the right to use a net licence on a public fishery. However, opportunities exist for third parties to fund such arrangements and the NRA can act in a facilitating role to assist in establishing such agreements.

12.7 The precautionary principle is central to NRA policy when dealing with factors which might affect the natural aquatic environment: if an action is likely to cause a deterioration, it should be prevented. It is clear from the numbers of fish caught by the reduced number of nets operating in 1988 and 1989 that even a small relaxation of restrictions would have a significant impact on the required spawning escapement.

12.8 Three further assumptions are made. Existing licences should not be reduced in number to compensate for any intractable illegal fishery. The public right to fish is not automatically abolished because that right is not being exercised. Consideration is given to protecting uncommon or unique forms of net fishing. None of these are contentious issues on the Taw and Torridge.

13.0 Management options

13.1 In broad outline, there are four options. These are to do nothing, to allow some relaxation of restrictions, to maintain existing controls or to extend the restrictions.

13.2 The do nothing option would result in the reversion to a relatively uncontrolled situation, which is undesirable. Consideration has been given to the possibility of some relaxation. For much of the period of record, 36 nets have operated but, between 1981 and 1989, the number varied between 4 and 22. The relationship between salmon catch and the number of nets operating is positive but, almost certainly, not linear. The average salmon catch per net is higher as the number of nets operating decreases. Limiting the nets to a very small number, even one, would still allow a large number of fish to be caught, to the extent that spawning escapement would be restricted.

13.3 Netting is relatively easy in the joint estuary and in parts of the River Taw and not so easy in the River Torridge. Despite the large size of the estuary, the success of netting is determined by the number and availability of narrow sections or holding areas. There are nine such sites at low tide which are about twenty metres wide. Large numbers of fish can be taken from such sites.There is a possibility of setting sanctuary areas around these narrow holding sites but they are distributed throughout much of the estuary and, given the present constraints on staffing levels, would be difficult to police. Expanding the sanctuary area to take in all the narrow sites effectively closes the bulk of the estuary, which is a more logical approach.

13.4 The possibility of allowing a limited period of fishing was also considered. Achievement of the long term egg deposition objective of 400 eggs/100 m^2 is dependant, in part, on an extra escapement of 2630 salmon. Since net catches have generally been less than this since 1964, limited fishing does not appear to be a viable option. Achievement of an interim target of 300 eggs/100 m^2 would give some indication of partial recovery and it might then be appropriate to consider a limited relaxation of restrictions, dependant on the nature of the recovery. Such a relaxation would inevitably delay the achievement of the long term objective. Similarly, the use of traditional netting materials rather than the more efficient modern, lightweight netting would also result in fish being taken and the required spawning escapement not being realised. This option was also considered to be inappropriate.

13.5 The do nothing option and the relaxation of some restrictions would result in increased

exploitation, a reduced opportunity for the stocks to effect a recovery and thus are considered to be inappropriate in this case.

13.6 Only the maintenance or extension of restrictions is appropriate to conserve and encourage the recovery of the stocks of the Rivers Taw and Torridge. The present arrangements allow for the issuing of fourteen licences but the licensees are paid not to fish. As indicated in paragraph 12.6 above, it is considered inappropriate for the NRA to continue with this arrangement, particularly in view of reduced public funding through grant-in-aid. Present restrictions have been operating for five years and there is only a limited indication of recovery in some, but not all, components of the stocks. It seems likely that the recovery of salmon stocks requires a long period with a substantial reduction in fishing effort and it is concluded that an extension to the existing restrictions should be adopted. Within this broad category, there are several actions which can be taken.

13.7 A further period of no netting is essential. Consideration of the arguments in paragraphs 13.2 to 13.4 leads to the conclusion that a byelaw closing the whole estuary would be more appropriate.

13.8 With the continued absence of netting, both rivers will have larger numbers of fish available for exploitation by angling. It is important that anglers exercise restraint so that these fish are allowed to spawn. Management options are byelaws, voluntary agreements and publicity campaigns dealing with restrictions to fishing period, location, method and catch. Where fishery rights are private, their removal would render the NRA liable to considerable compensation claims. Furthermore, there are no spawning areas where significantly high catches are taken and which might, therefore, be considered as possible sanctuary areas. For these reasons, restrictions on fishing period and location are considered to be inappropriate.

13.9 The possibility of introducing a byelaw prohibiting the use of any lure other than a fly at any time has been considered but rejected on the basis that definition of a fly is impossible and a voluntary restriction would be more acceptable to, and thus adopted by, the majority of anglers. A local publicity campaign to encourage the use of barbless hooks and knotless mesh landing nets has been rejected but the concepts have been incorporated into a leaflet on catch and release, available nationally during 1995.

13.10 A byelaw to enforce the release of large and late-caught salmon has been considered but not pursued, again on the basis that a voluntary agreement is more likely to be acceptable and, therefore, adopted. The national publicity campaign will reinforce the NRA's approval of the catch and release principle.

13.11 There has been a suggestion that anglers do not comply with current bag limits. This is likely to be the case for a few individuals but the NRA's view is that most subscribe to the spirit of the byelaw. The existing byelaw to control the angling catch by imposing bag limits should be retained but modified by the addition of a clause restricting the catch of salmon per angler to one in the period 1 March to 31 May, deleting the clauses referring to cessation of angling and the date when the byelaw ceases to have effect. The maintenance of bag limits gives some protection to the potential spawning stocks. The modification restricting the catch to one salmon in

the early part of the season gives added protection to the spring-run component of the stocks whilst enabling local hotels to continue offering spring fishing. With the promotion of catch and release (see below), there is no requirement for fishing to stop once the bag limit has been reached.

13.12 The adoption of voluntary measures will be encouraged. These are designed to give further protection to spring-run fish and to ensure that there are sufficient salmon, particularly MSW fish and large grilse, available to spawn. They include:

* the use of fly only in March and April;

* the return of all female salmon, and male salmon greater than 70 cms (27.5 inches) length (approximately 7.5 lbs), caught during August and September; and

* catch and release, generally, at all times.

13.13 Work to improve and maintain juvenile salmonid habitat should be continued, in order to maximise the production of smolts arising from increased spawning escapement. This includes gravel cleaning, trash dam removal and bank protection by fencing and the establishment of bankside vegetation. Additional work on improving fish passes and the establishment of artificial spawning channels will be progressed if funds are made available. Enforcement efforts, particularly in the lower reaches of the River Taw, should be increased.

14.0 Summary of consultations

14.1 Consultations have been held by meetings and correspondence with the netsmen, the Riparian Owners' Associations of both rivers, the Salmon and Trout Association, hoteliers from both rivers, the Torridge Environmental Forum, interested members of the public and the NRA's Devon and South West Regional Advisory Committees.

14.2 The majority of consultees accept that management action needs to be taken. However, the netsmen are unwilling to lose the opportunity to fish or the payments they have been receiving for the last few years. Many of the riparian owners, anglers and hoteliers were unhappy with the initial proposal of mandatory controls, suggesting instead that voluntary measures would have more likelihood of being accepted and, thus, followed by the majority. The NRA has taken account of these arguments and modified the proposals accordingly.

14.3 Initially, the Advisory Committees were concerned about the timing and perceived severity of the proposals. The consultation period was extended and, taking into account all the comments received, the proposals have been modified to those presented here.

14.4 It seems likely that the netsmen will object to these proposals and negotiations are continuing between the NRA, the netsmen and the Riparian Owners' Associations in an effort to reach an agreement enabling the proposals to be acceptable to those parties. As part of these negotiations, the NRA has indicated that an interim egg deposition target of 300 eggs/100 m^2 has also been adopted. When this has been reached on both

rivers, the phased re-introduction of netting will be considered, dependant on the nature of the recovery. This would be based on 14 nets operating for a restricted period of time and would be reviewed annually. Bag limits restricting rod catches will also be reviewed when interim targets are reached. It must be understood that such relaxation of restrictions will delay the achievement of long term targets.

14.5 The NRA is also committed to monitoring the state of the fisheries by annual assessments of catches, triennial surveys of both river systems to provide catchment overviews of juvenile distribution and abundance, and annual surveys of key sites to assess recovery in the worst affected areas. Data from the monitoring programmes will be used annually to assess compliance with targets.

14.6 For habitat work, the NRA will make £6,000 available during 1995/96 for improvements to North Tawton Weir (River Taw) and Head Weir (River Mole), and limited fencing and bank protection work on the River Taw. Further funds will be sought to enable gravel cleaning, trash dam removal and bank protection work to be continued during the period 1996-2000, and to deal with specific problems on both rivers.

14.7 There is the possibility that some funds will be made available by the Riparian Owners' Associations, either for paying the netsmen some compensation for loss of fishing or as a contribution to habitat improvement works.

15.0 Conclusions

15.1 It is concluded that:

* salmon stocks of the Rivers Taw and Torridge are in a depressed state and that sea trout stocks give rise for concern;

* there is a need for a further period of increased restrictions on fishing effort to enable the stocks every opportunity to make a sustained recovery;

* the NRA's proposals will assist this recovery; and

* it is unlikely that all interested parties will accept the proposals.

16.0 Summary of the proposals

16.1 In summary, the NRA's proposals are as follows:

* a byelaw prohibiting fishing for salmon and migratory trout in the Taw and Torridge Fishery District (with the exception of the River Lyn) by any method other than rod and line;

* the retention of Byelaw SW3, with modifications to restrict the catch of salmon per angler to one in the period 1 March to 31 May and to remove the requirement to stop fishing when the bag limit has been

reached;

* the encouragement of voluntary measures including the use of fly only in March and April, the return of all female salmon, and male salmon greater than 70 cms length, caught during August and September, and catch and release generally at all times; and

* the continuation of work to improve salmonid spawning and rearing habitat, and access to these areas by adult fish.

16.2 The byelaws and voluntary restrictions will be reviewed when the interim egg deposition target of 300 eggs/100 m^2 has been reached.

17.0 Recommendation

17.1 The approval of the NRA's proposals is recommended.

18.0 References

Kennedy, G.J.A. & Crozier, W.W., 1993. Juvenile Atlantic salmon (Salmo salar) production and prediction. In R.J. Gibson & R.E. Cutting (eds), Production of juvenile Atlantic salmon, Salmo salar, in natural waters. Can. Spec. Publ. Fish. Aquat. Sci., **118**, 179-187.

NRA, 1993a. River Torridge Catchment Management Plan Consultation Report. NRA South Western Region report, 84 pp + figs & appendices.

NRA, 1993b. Taw/Torridge Estuary Catchment Management Plan Consultation Report. NRA South Western Region report, 104 pp.

NRA, 1994a. River Taw Catchment Management Plan Consultation Report. NRA South Western Region report, 102 pp + tables, figs & appendices.

NRA, 1994b. Review of Net Limitation Orders and Net Fishing Byelaws. NRA Welsh Region report, 12 pp + figs & appendices.

NRA, 1994c. The NRA National Fisheries Classification Scheme - A Guide for Users. R&D Note 206.

NRA, 1994d. A National Strategy for the Management of Salmon. Draft report, 33 pp.

Table 1. Potential salmon egg deposition in the Rivers Taw and Torridge, numbers/100 m^2

	R. Taw	R. Torridge
1959 - 68	396	428
1971 - 80	274	148
1984 - 93	211	60

Table 2. River Taw - parr densities in surveys with ten or more sites

Year	68	74	75	79	83	88	89	90	92	93
Salmon	3.34	2.69	3.29	2.15	4.87	2.69	5.64	2.53	1.09	1.62
Trout	21.08	21.97	28.97	12.5	19.49	13.61	20.04	8.61	13.1	13.31

Mean densities of fish aged one year or more in Numbers/100 m^2

Table 3. River Taw - average catch of juveniles in 20 minutes

Year	Number of sites	Salmon 0+	Salmon >0+	Trout 0+	Trout >0+
1993	25	22.1	15.2	0.7	8.4

Table 4. River Torridge - parr densities in surveys with ten or more sites

Year	64	79	83	86	89	90	91	92
Salmon	4.71	1.9	4.75	2.24	3.02	2.32	1.19	1.64
Trout	19.06	8.95	9.19	6.83	12.39	9.48	5.38	6.7

Mean densities of fish aged one year or more in Numbers/100 m^2

Table 5. River Torridge - average catch of juveniles in 20 minutes

Year	Number of sites	Salmon 0+	Salmon >0+	Trout 0+	Trout >0+
1989	28	7.5	1.7	0.1	1.0
1990	8	6.1	0.1	0.0	0.1
1991	28	2.4	3.4	0.04	0.4
1992	20	29.7	10.7	0.9	0.9
1993	15	11.2	6.2	0.2	1.7
1994	20	12.6	5.6	0.2	1.0

Table 6. River Okement - average catch of juveniles in 20 minutes

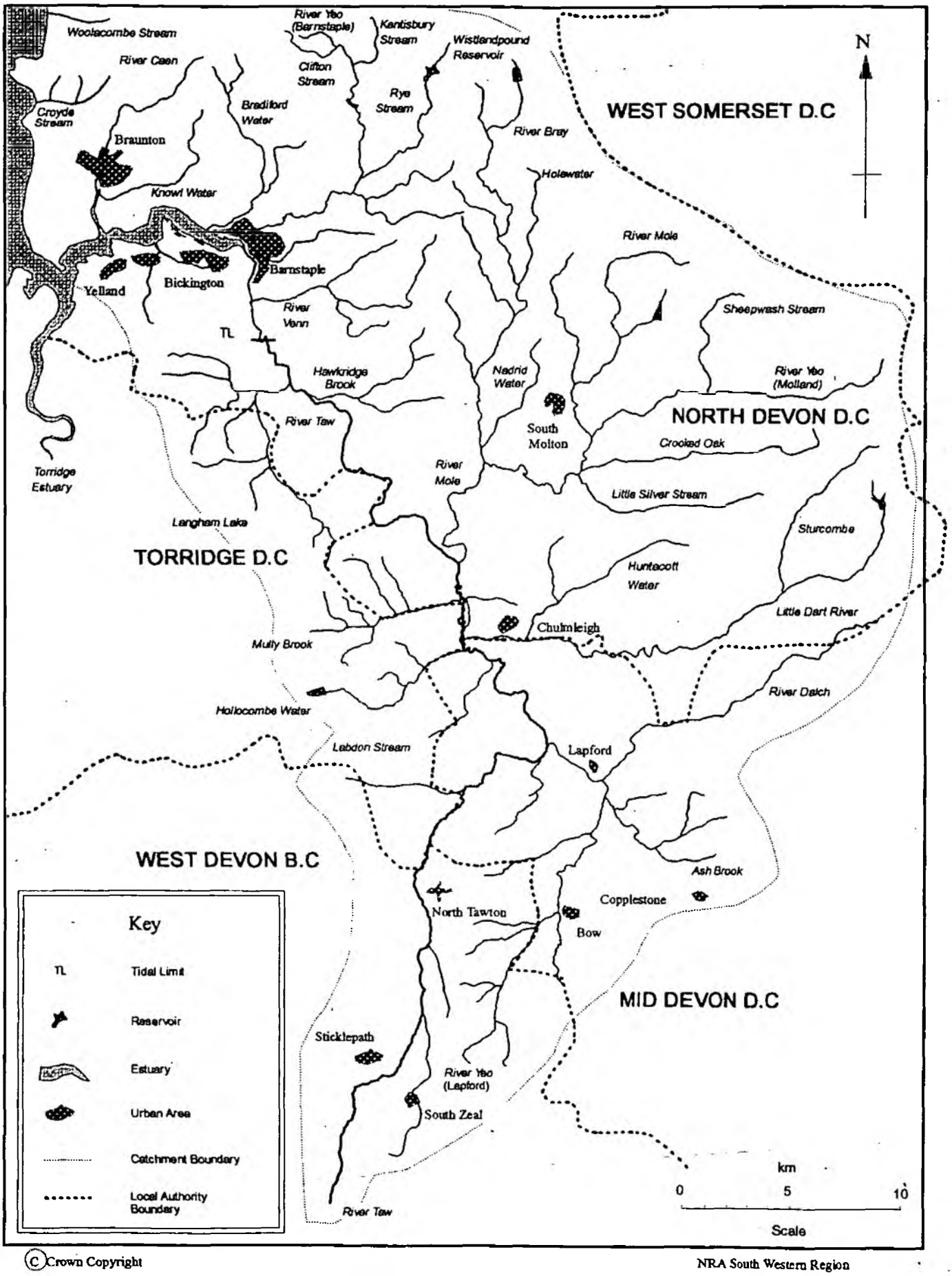
Year	Number of sites	Salmon 0+	Salmon >0+	Trout 0+	Trout >0+
1992	10	168.1	40.4	3.8	3.5
1993	10	31.0	20.0	15.2	6.2
1994	10	88.1	11.7	2.8	1.8

Table 7. Fisheries Classification Scheme Grades

	River Taw, 1968		River Taw, 1993		River Torridge, 1992	
Grade	Number of sites	%	Number of sites	%	Number of sites	%
a	4	5.7	0	0	1	2.1
b	10	14.3	3	3.9	6	12.5
c	18	25.7	21	27.3	6	12.5
d	15	21.4	19	24.7	12	25.0
o	23	32.9	34	44.2	23	47.9

Chi squared test shows R Taw 1993 distribution to be significantly different from R Taw 1968 distribution at $p<0.01$ level.

FIGURE 1 - THE RIVER TAW CATCHMENT



NRA South Western Region

FIGURE 2 - THE RIVER TORRIDGE CATCHMENT

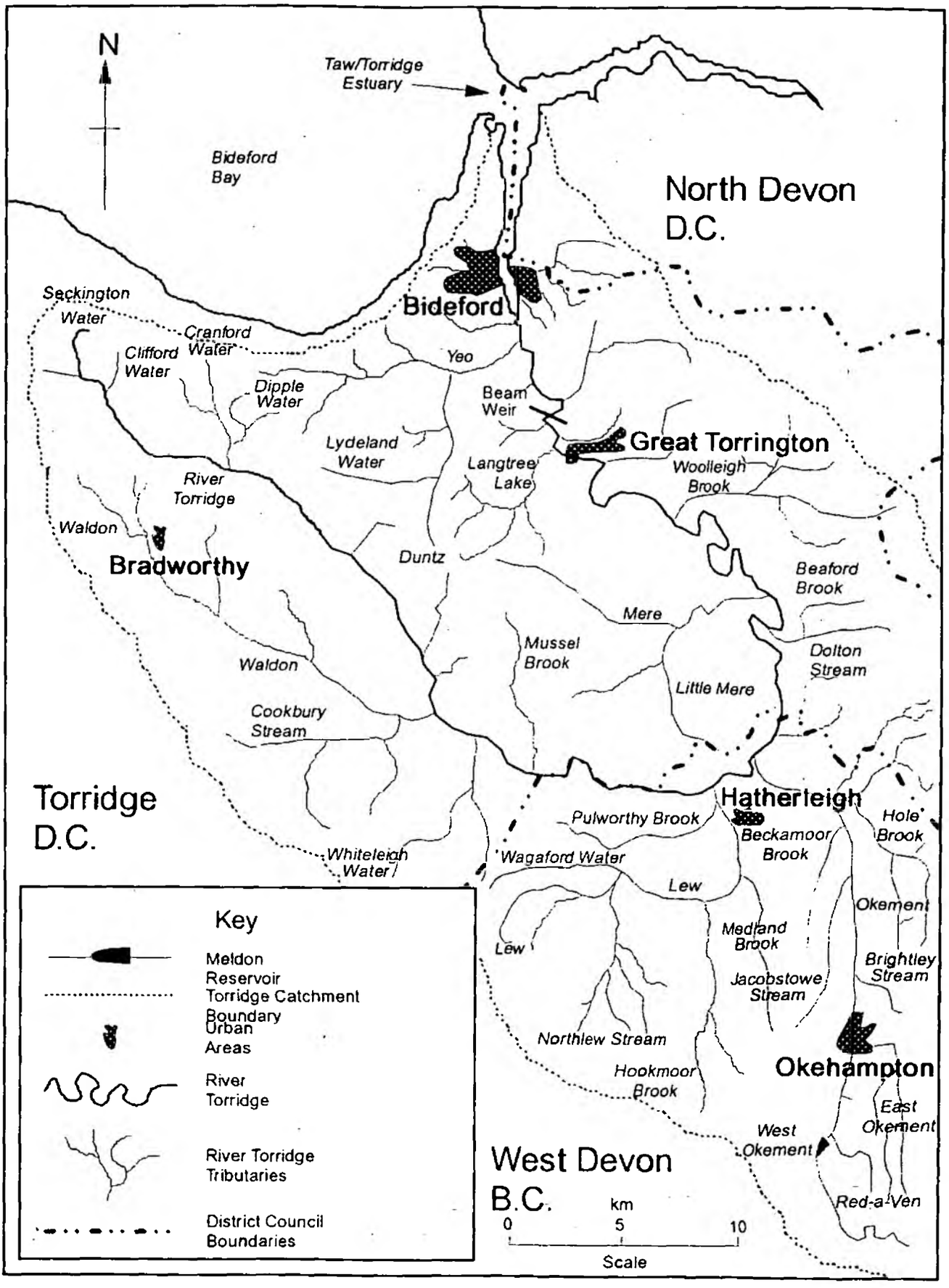


FIGURE 3 - TAW/TORRIDGE ESTUARY CATCHMENT

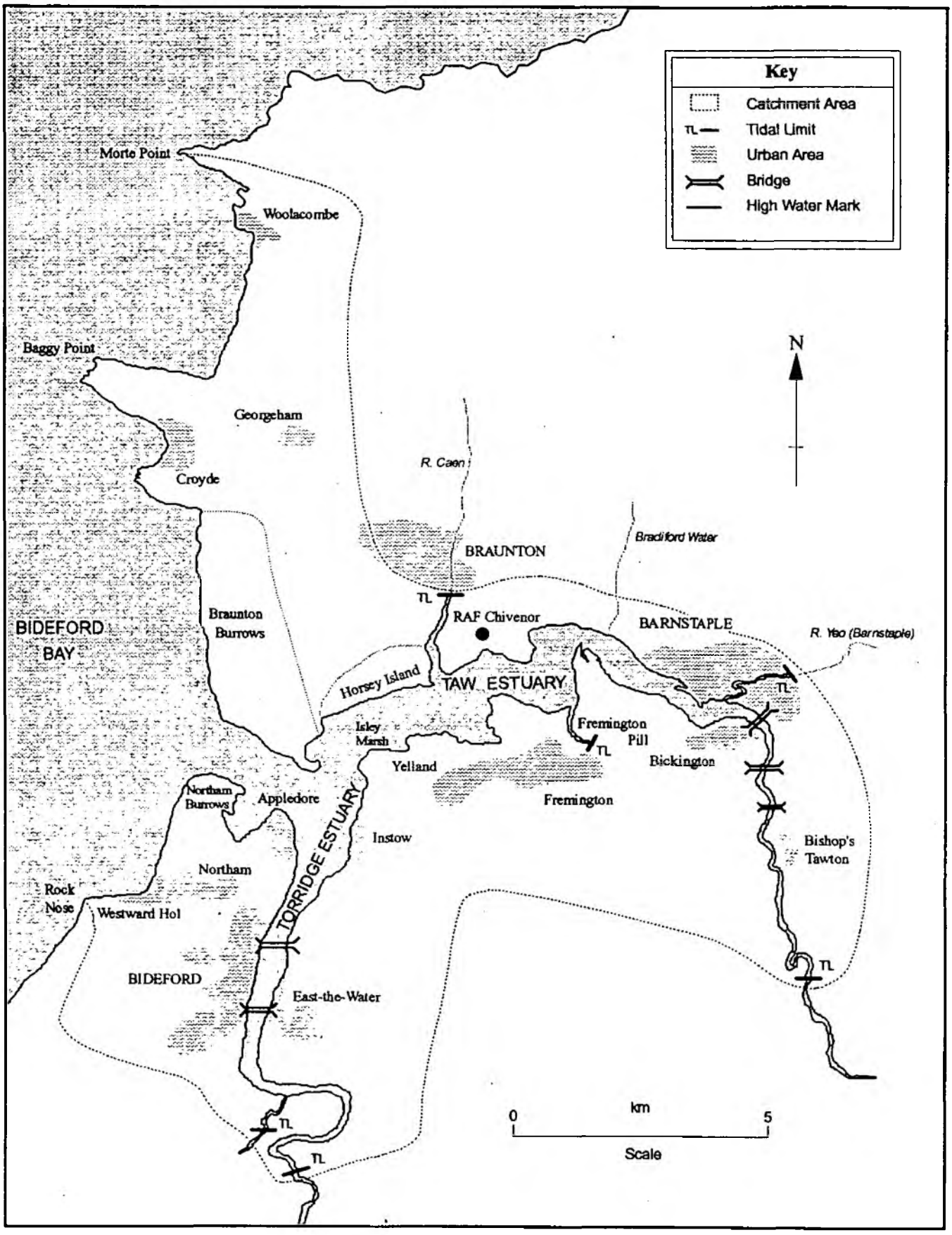


Figure 4 - Salmon Net Catch, Season Totals 1953 - 89

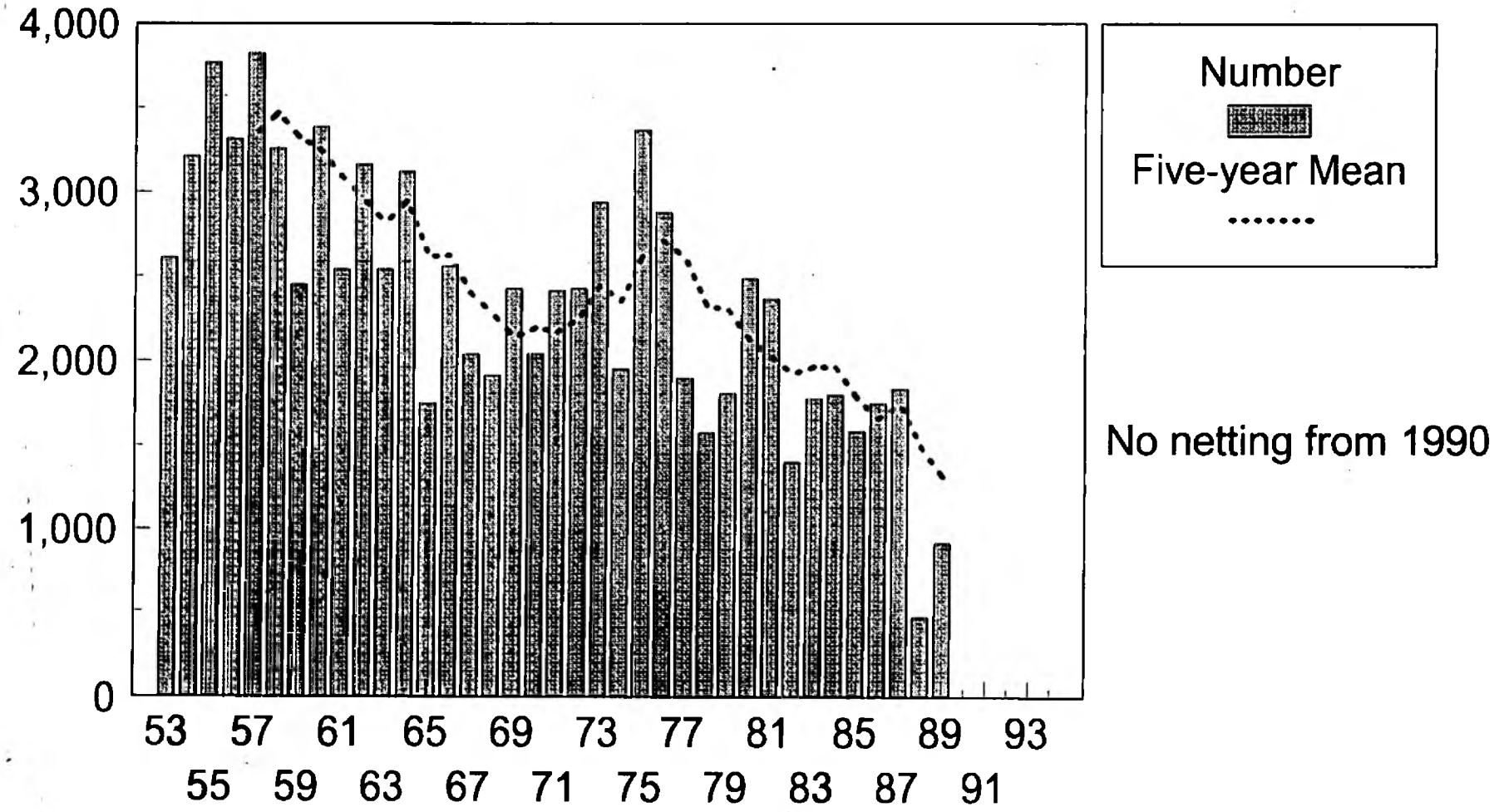


Figure 5 - Salmon Net Catch, April 1953 - 89

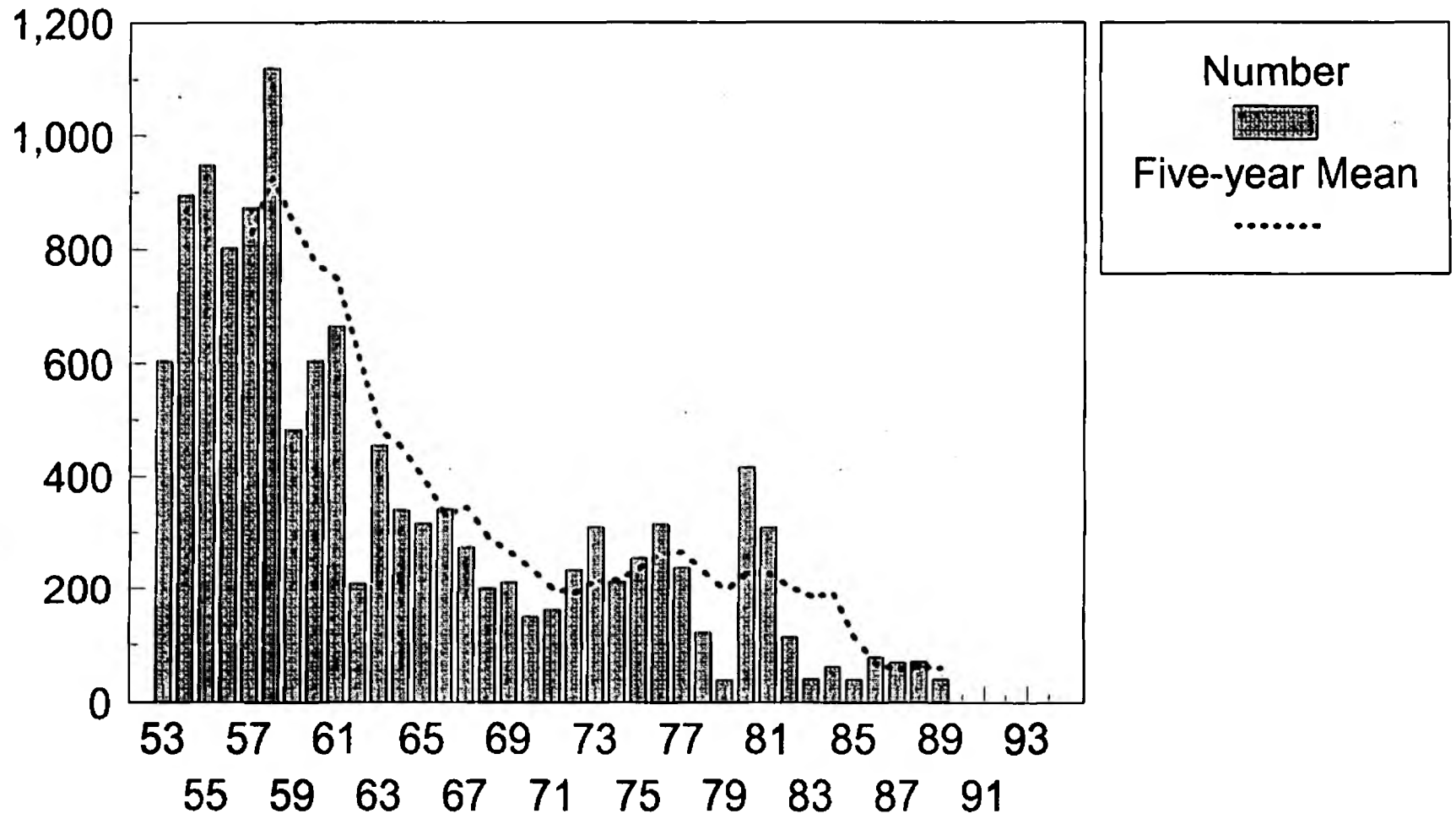


Figure 6 - Salmon Net Catch, July & August 1953 - 89

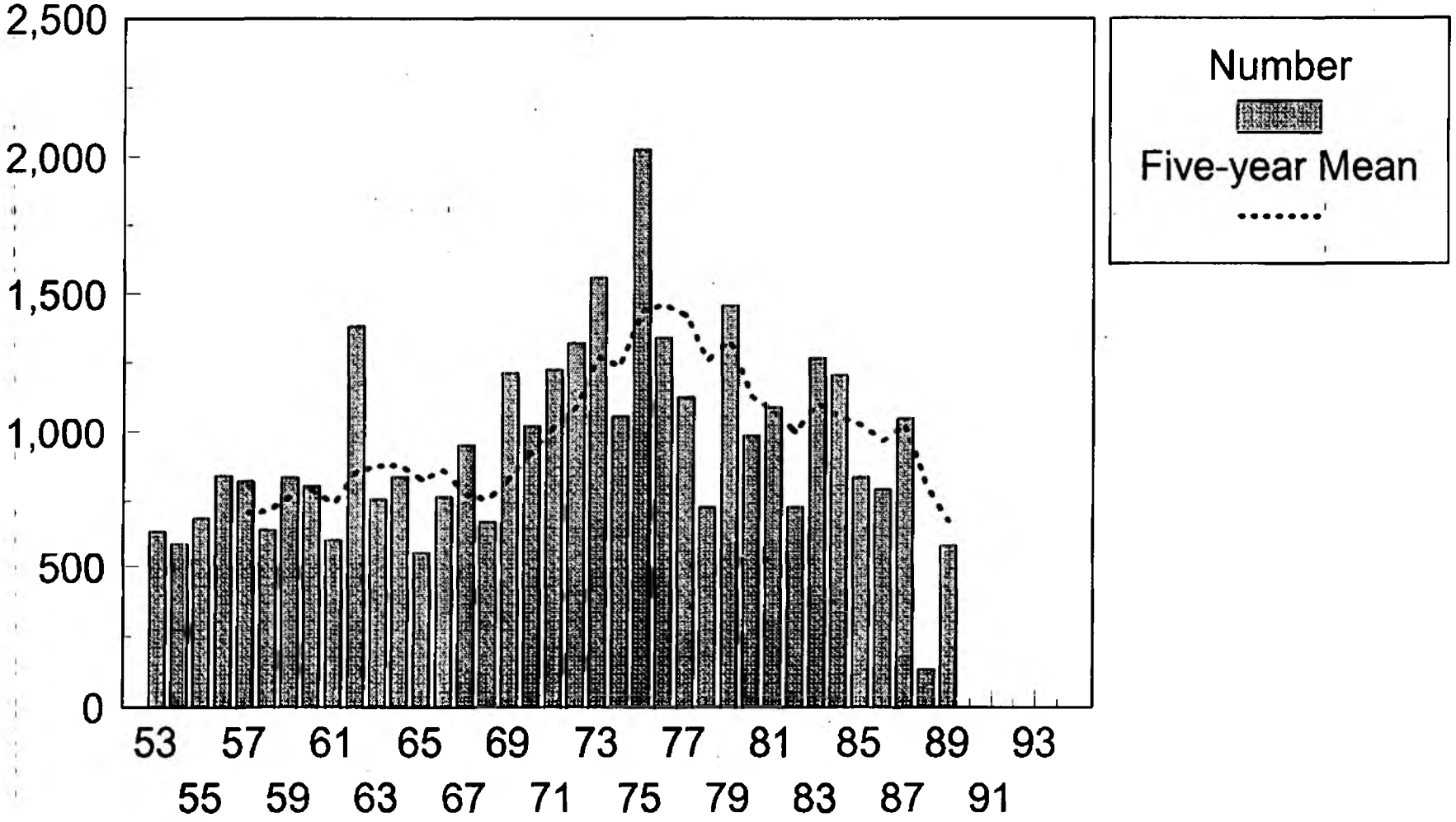


Figure 7 - Net Caught Salmon, Average Weight, lbs

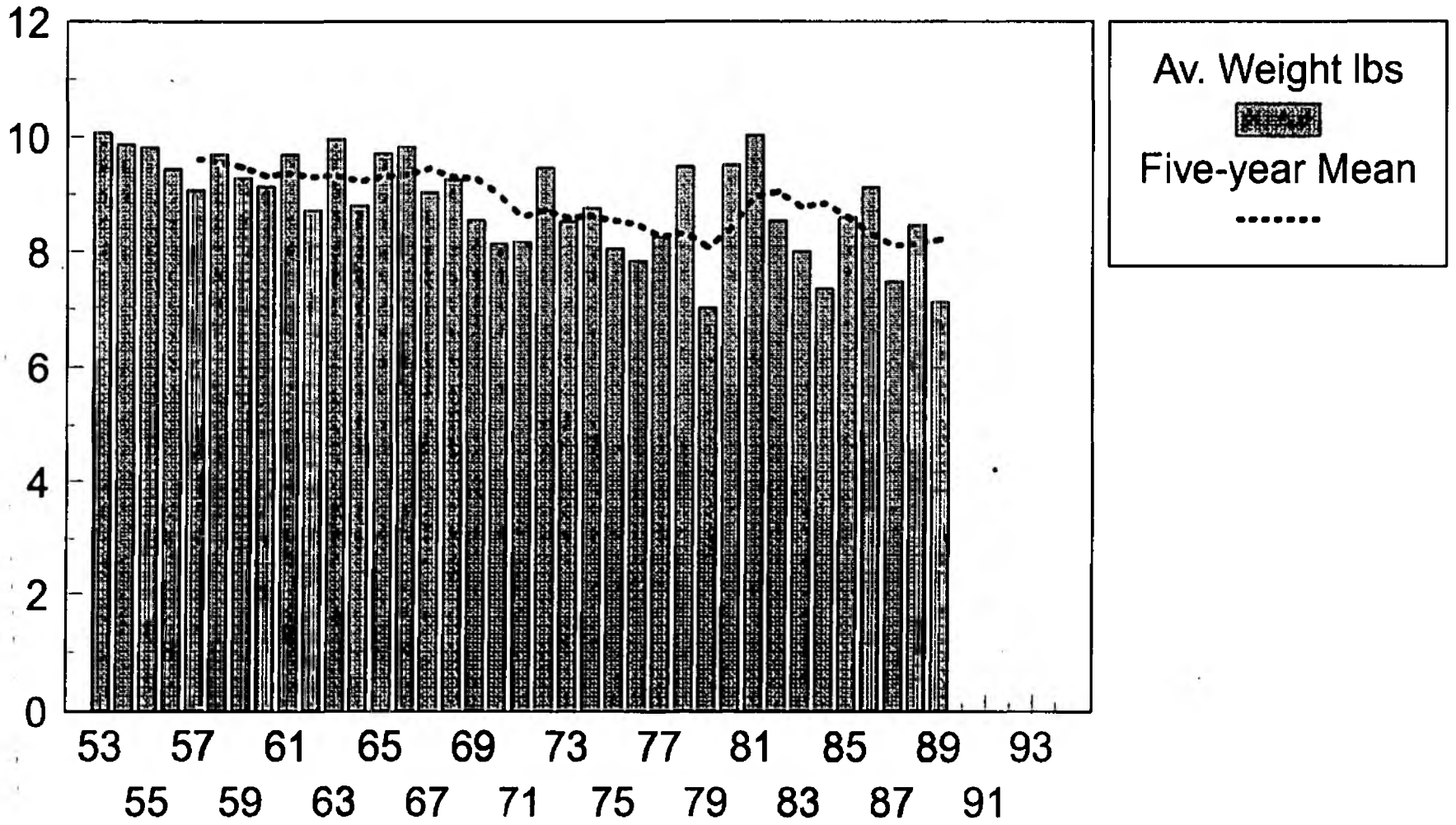


Figure 8 - Average Weights, lbs

1972 - 89

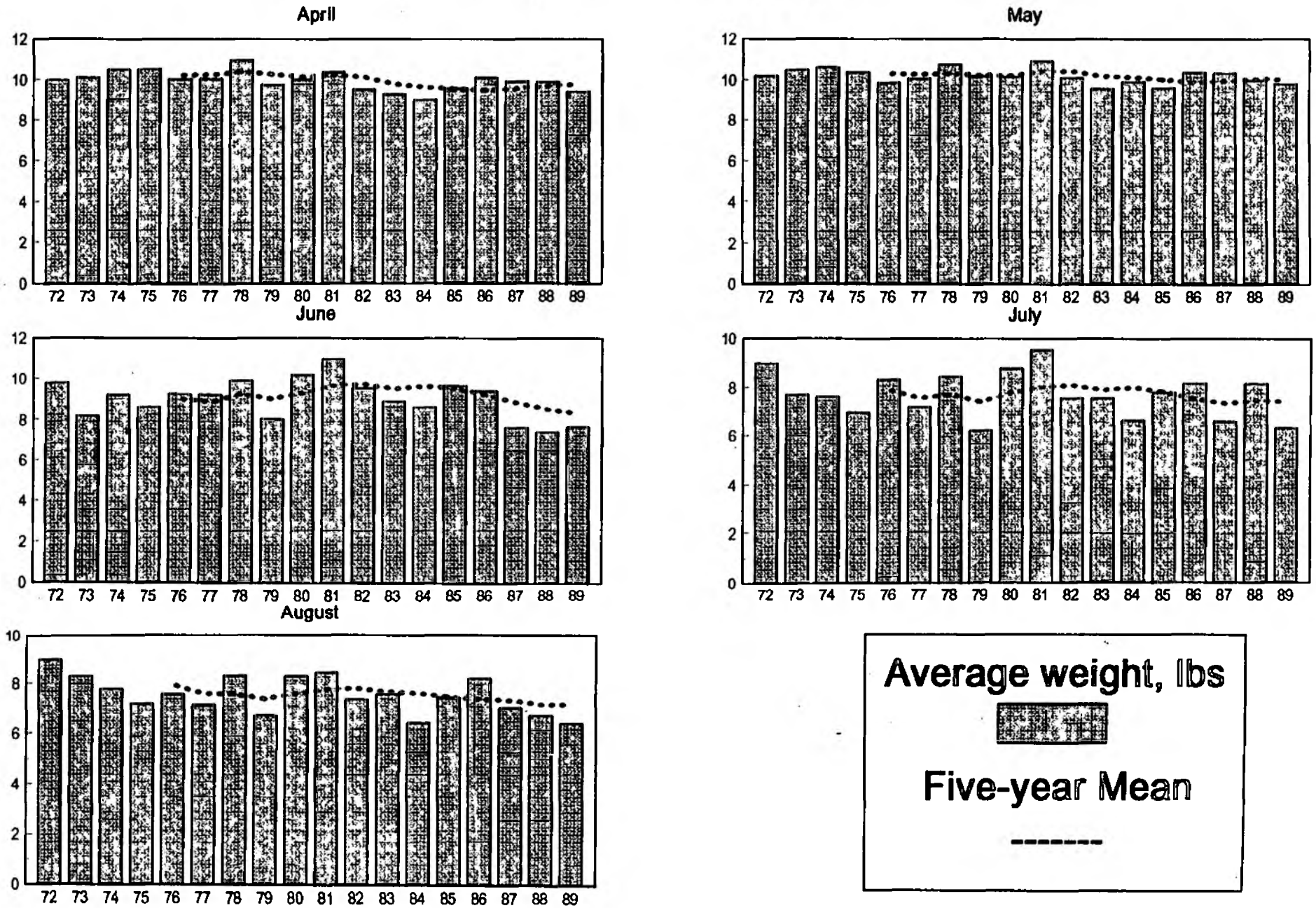


Figure 9 - Sea Trout Nets, Season Totals, 1953 - 89

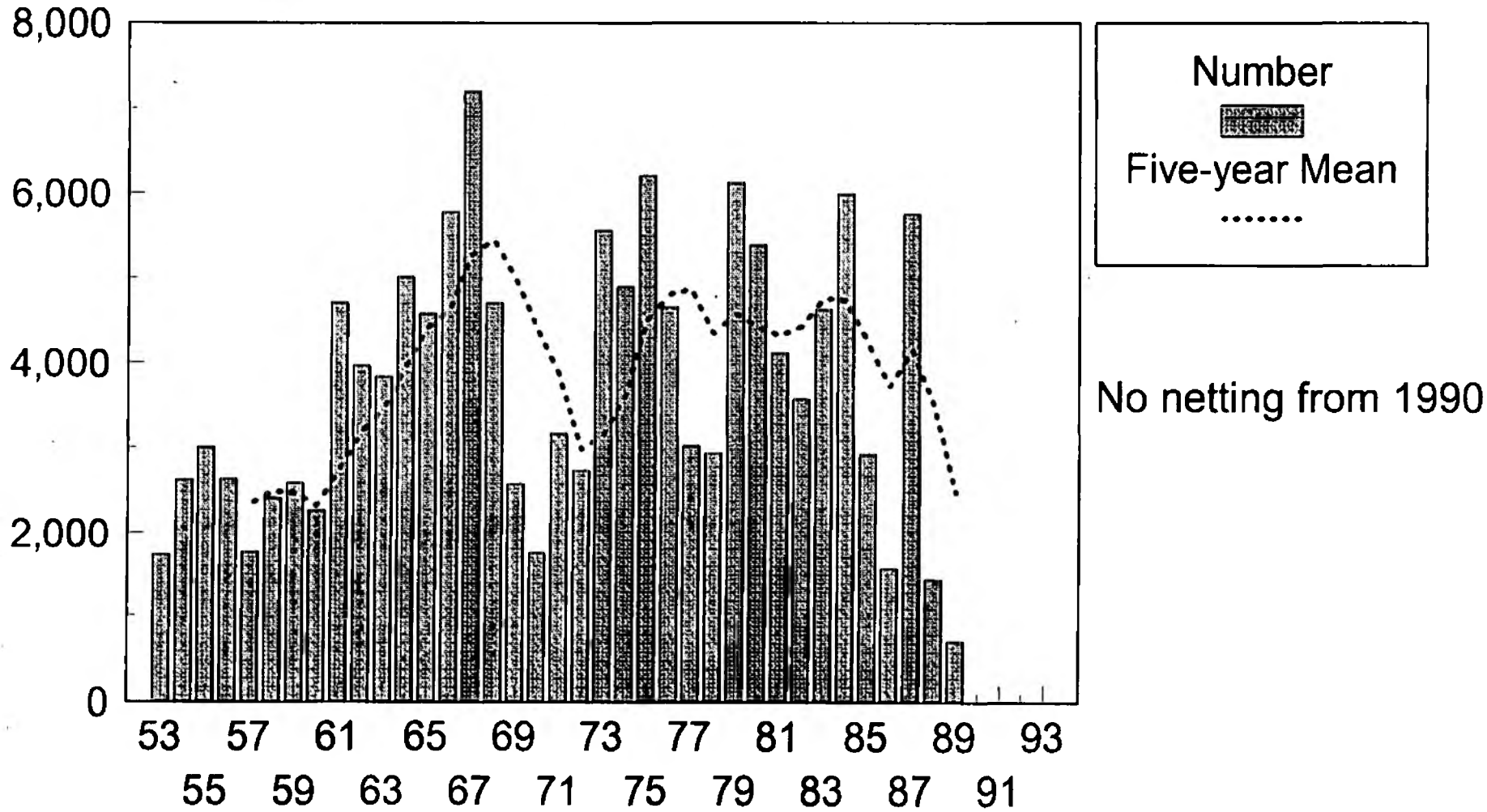


Figure 10 - Sea Trout Nets, April - May, 1953 - 89

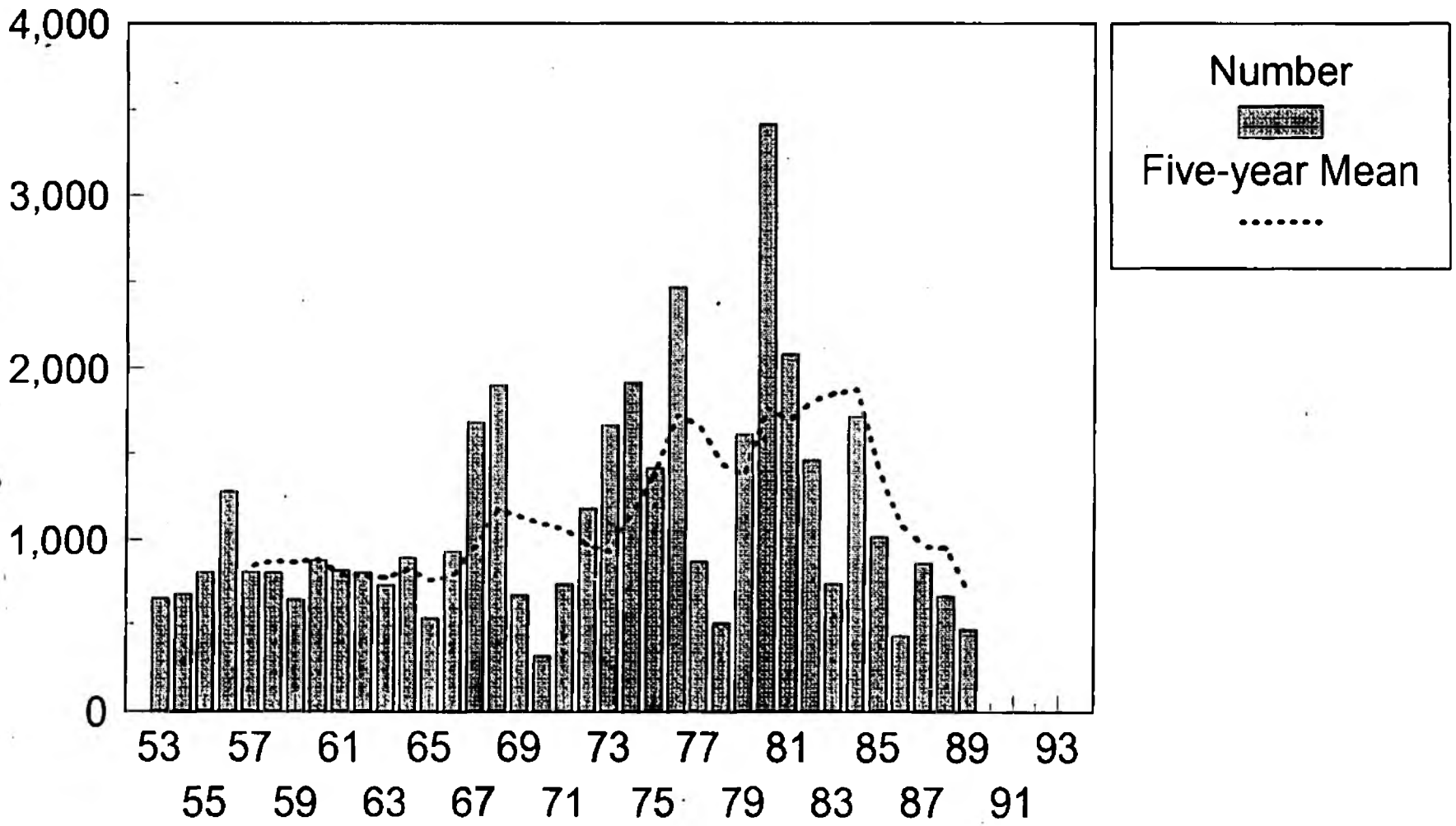


Figure 11 - Sea Trout Nets, July - August, 1954 - 89

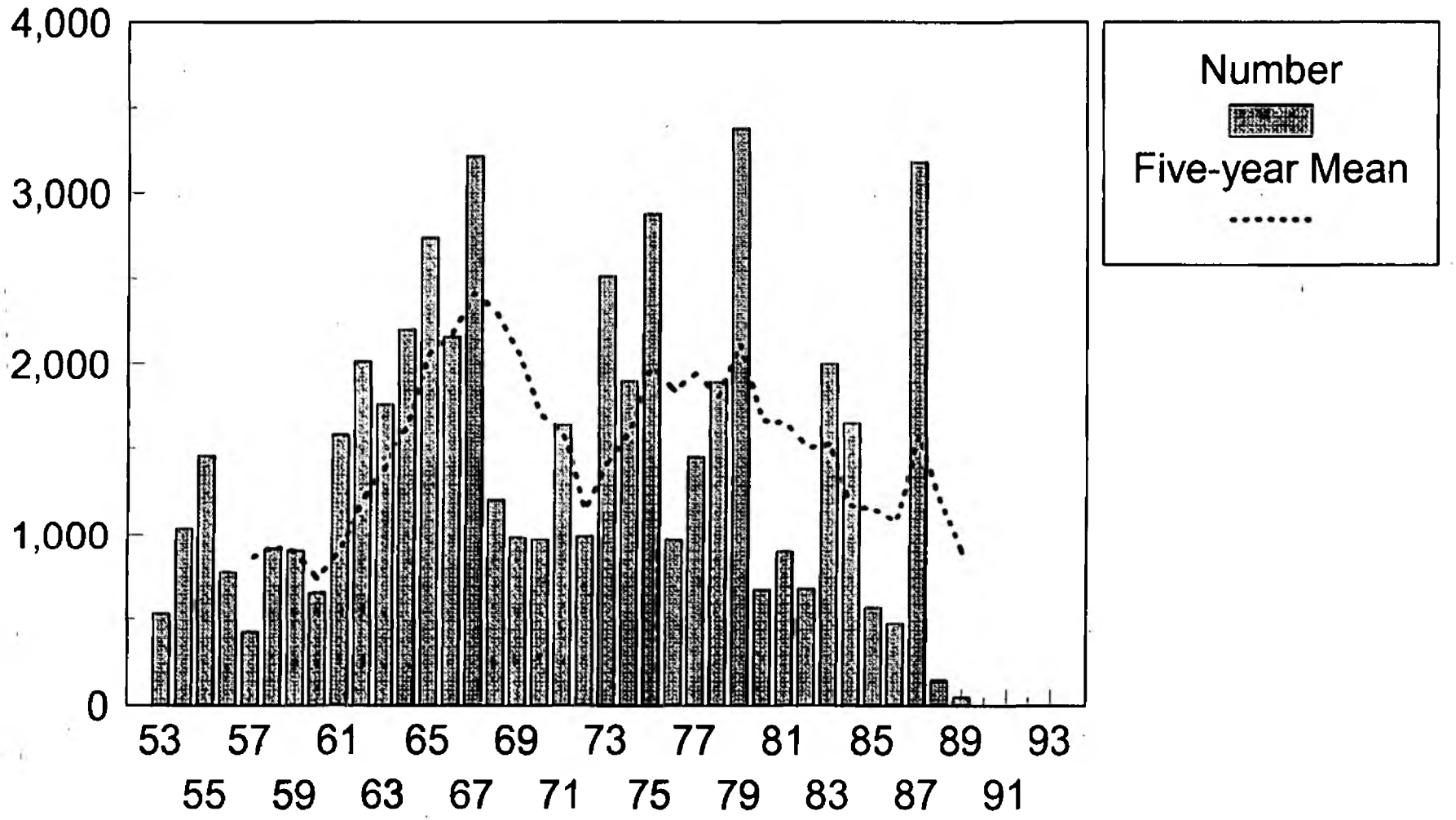


Figure 12 - Sea Trout Nets, Monthly Average Weight, 1972 - 89

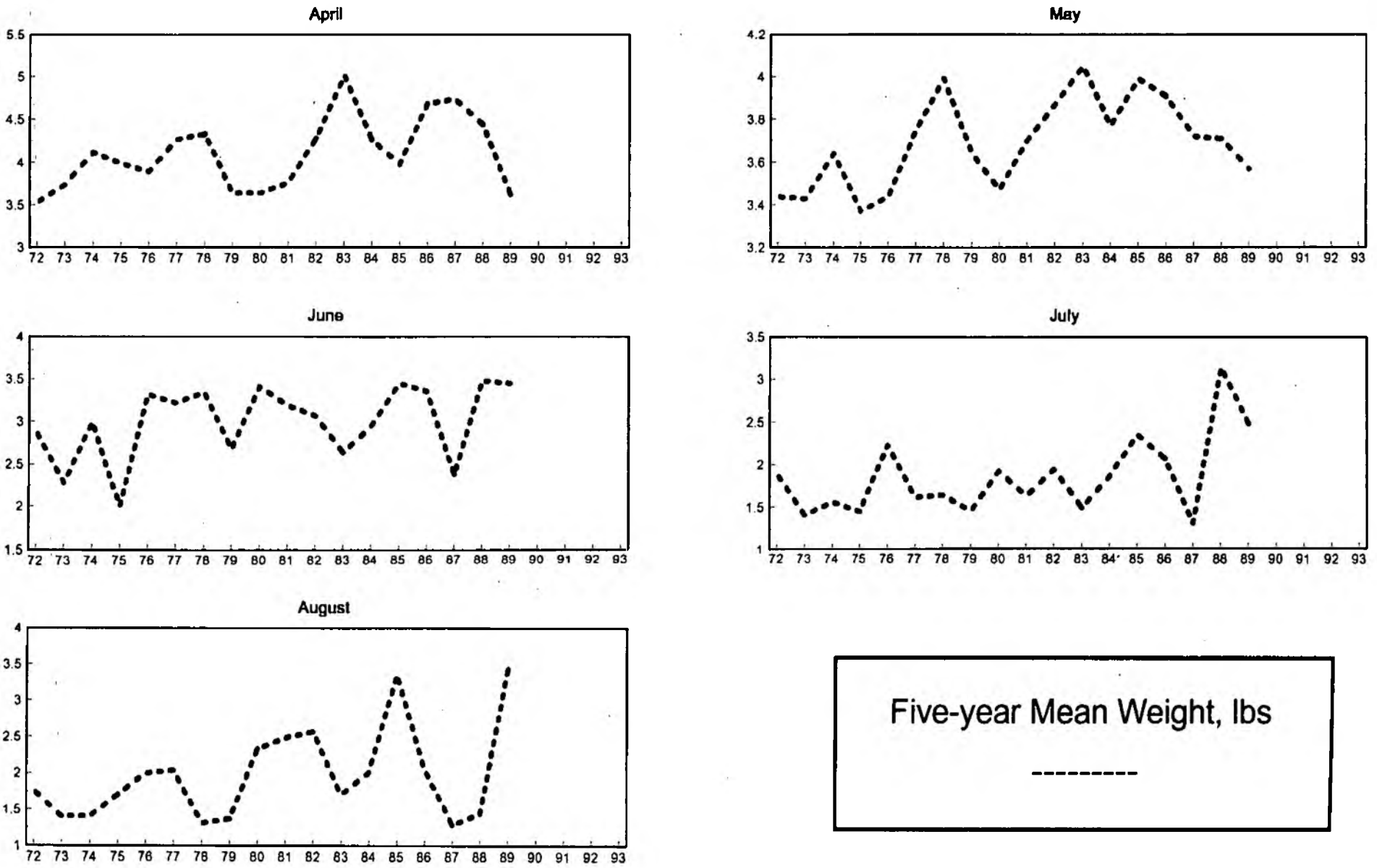


Figure 13 - River Taw Salmon Rod Catch Season Totals, 1953 - 93

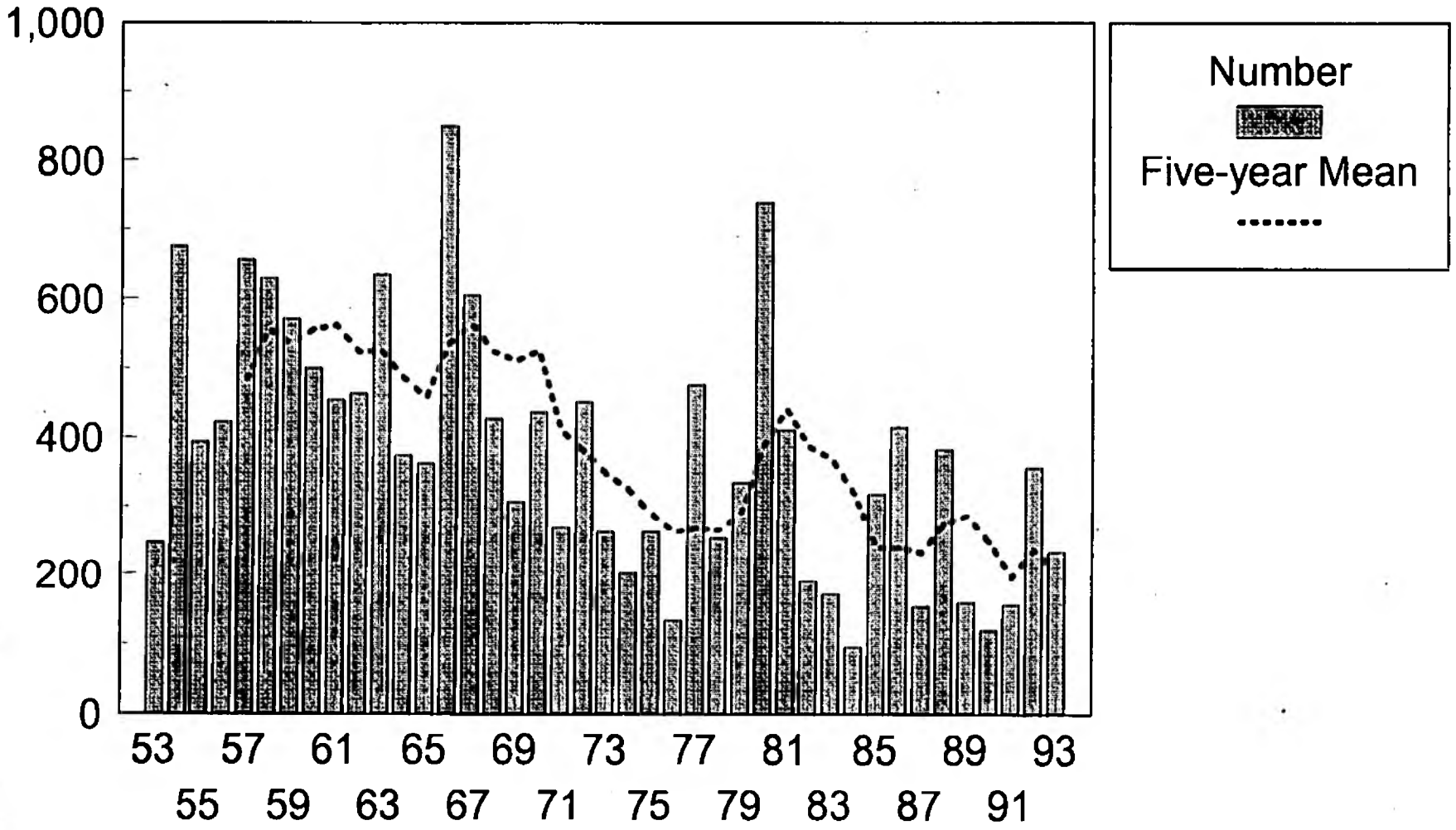


Figure 14 - River Torridge Salmon Rod Catch Season Totals, 1953 - 93

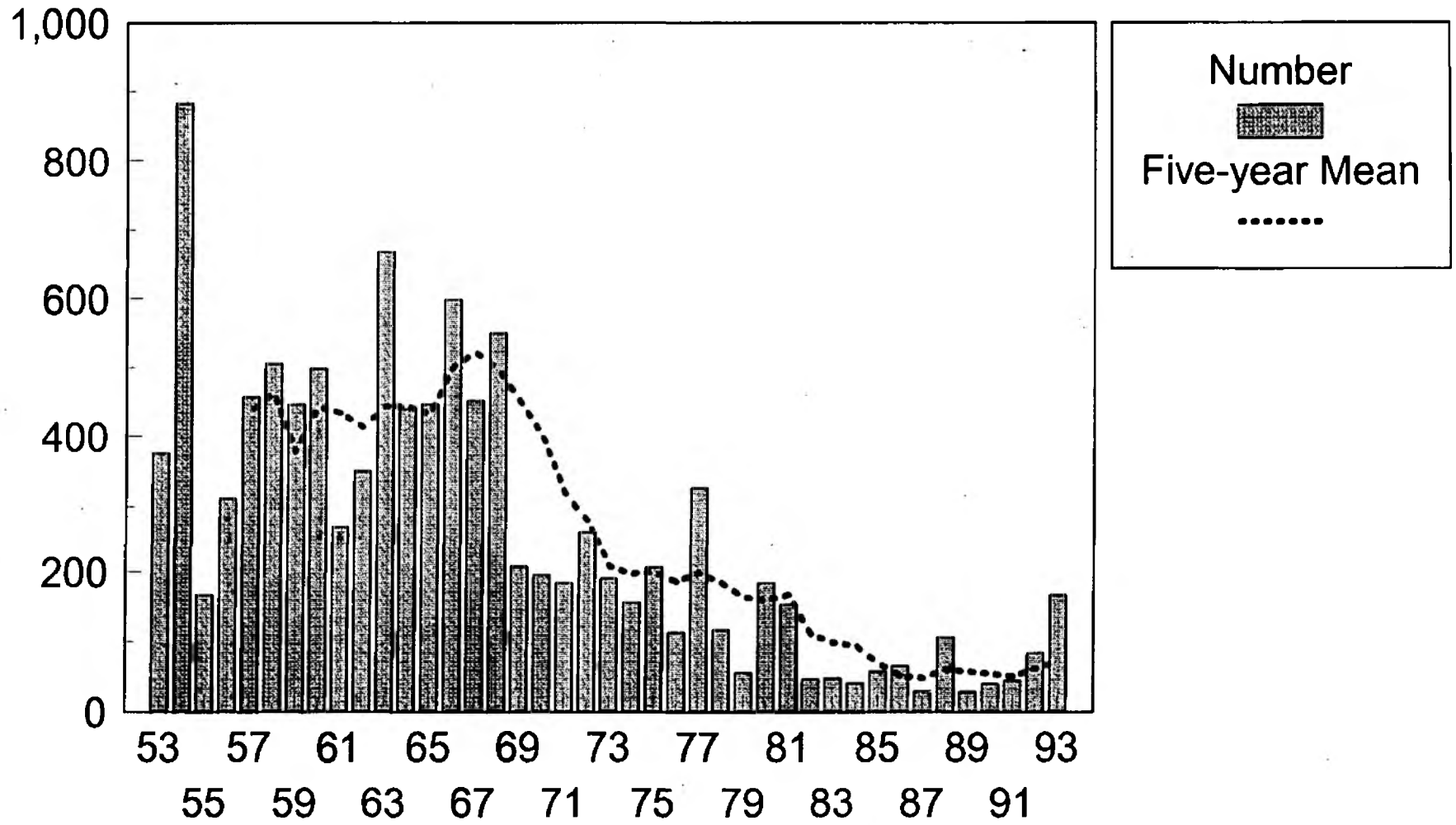


Figure 15 - River Taw Salmon Rod Catch, March - April, as % of Season Total, 1956 - 93

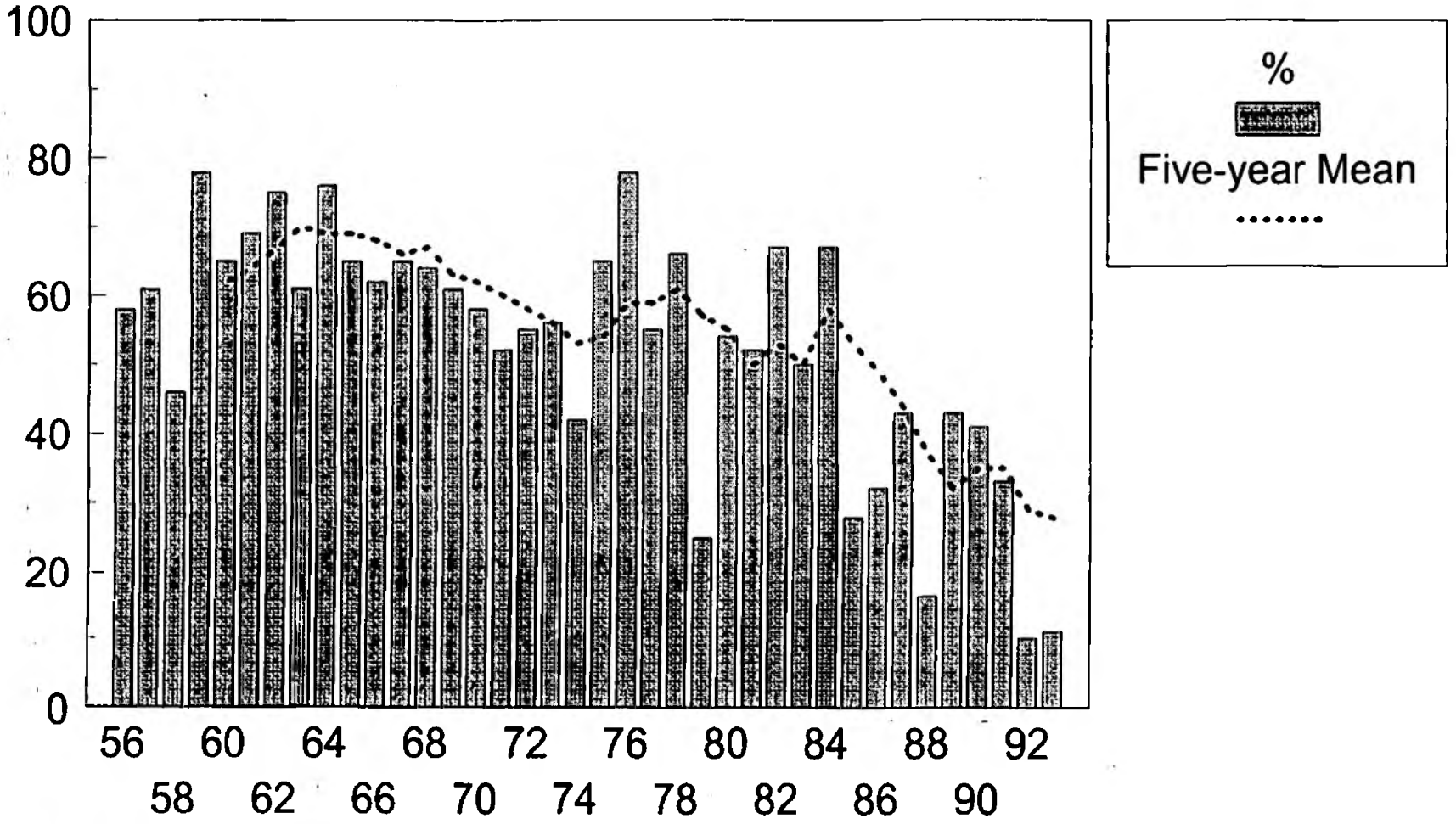


Figure 16 - River Torridge Salmon Rod Catch, March - April, as % of Season Total, 1956 - 93

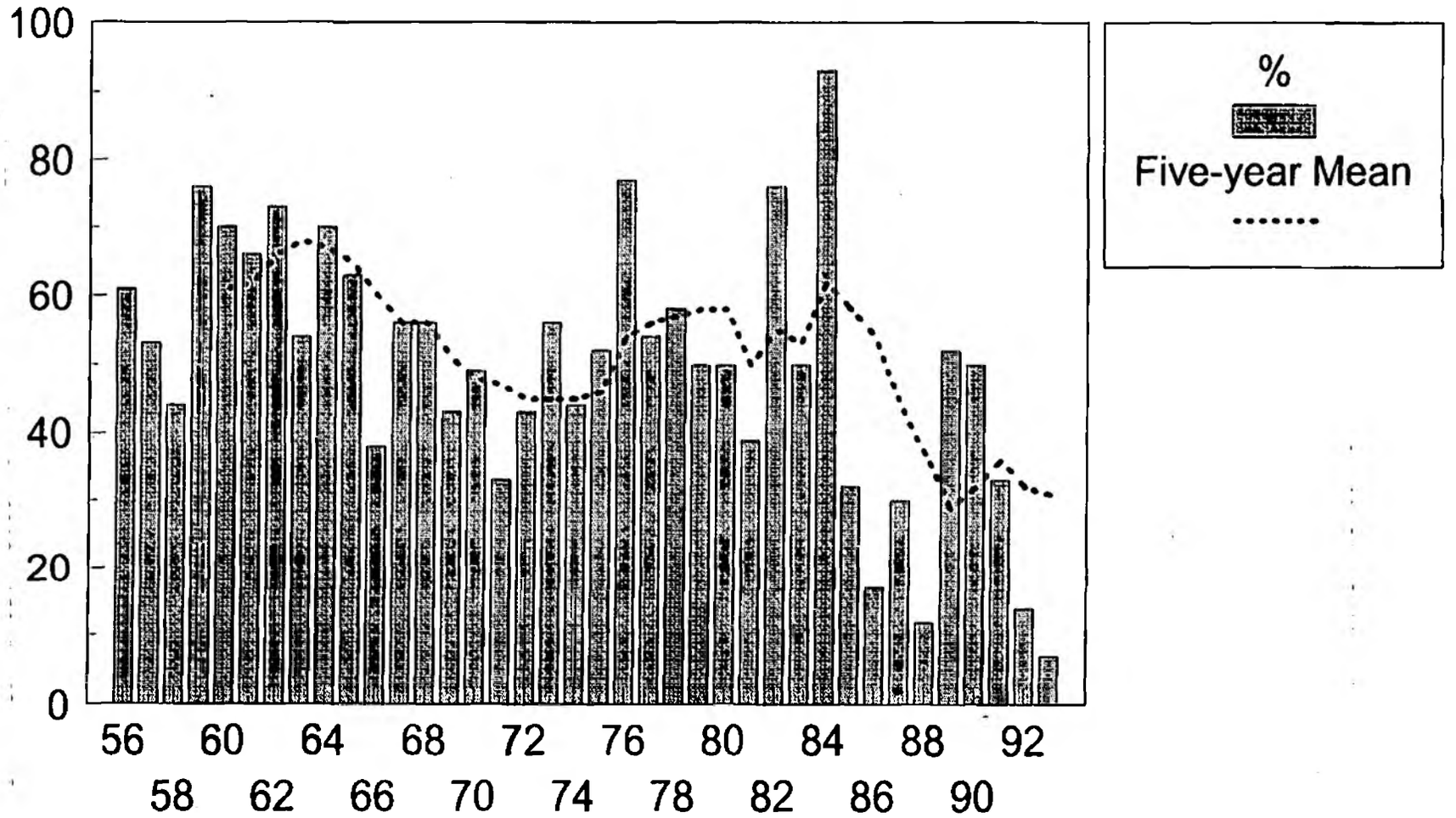


Figure 17 - River Taw Salmon Rod Catch, August - September, as % of Season Total, 1956 - 93

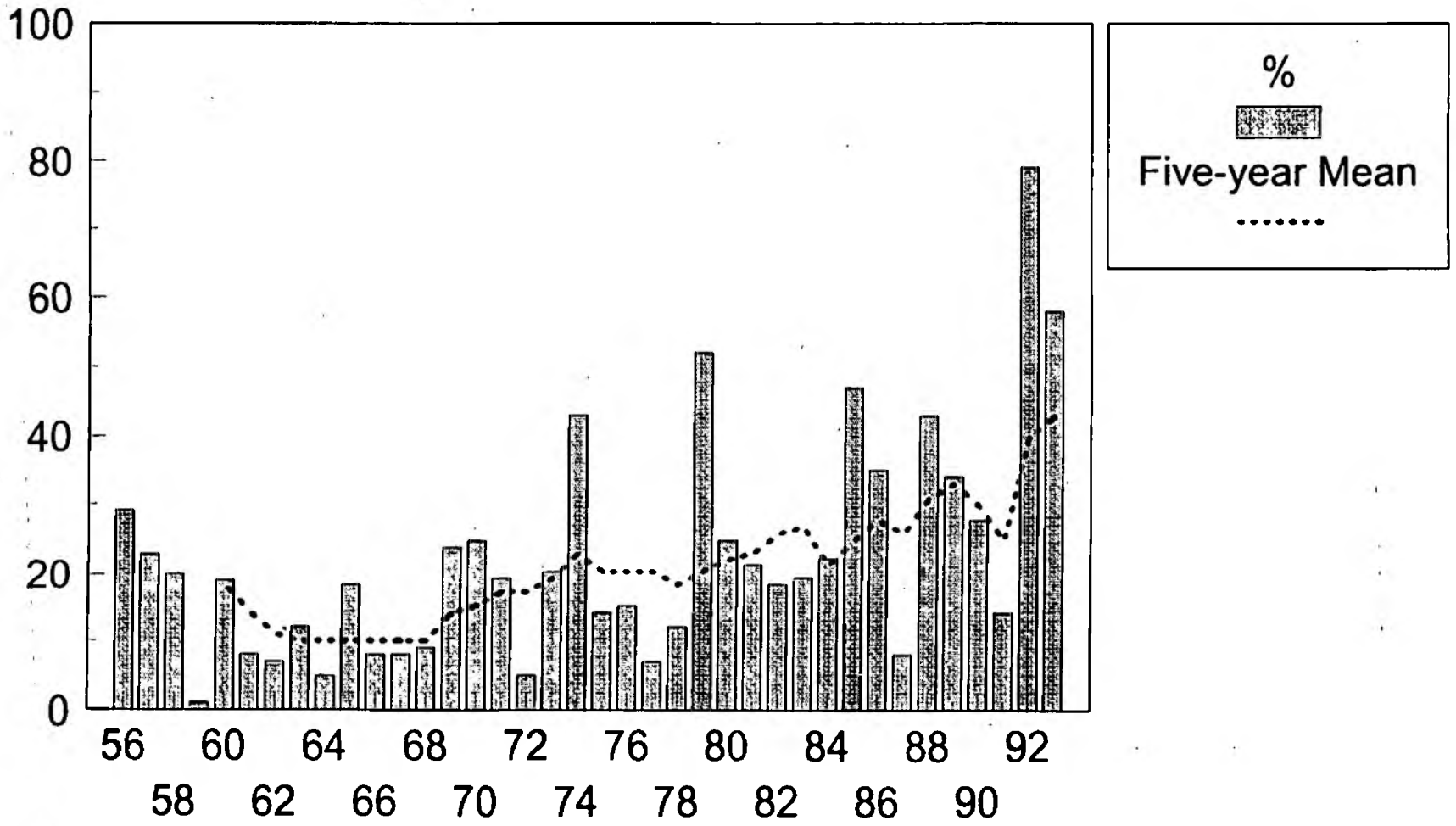


Figure 18 - River Torridge Salmon Rod Catch, August - September, as % of Season Total, 1956 - 93

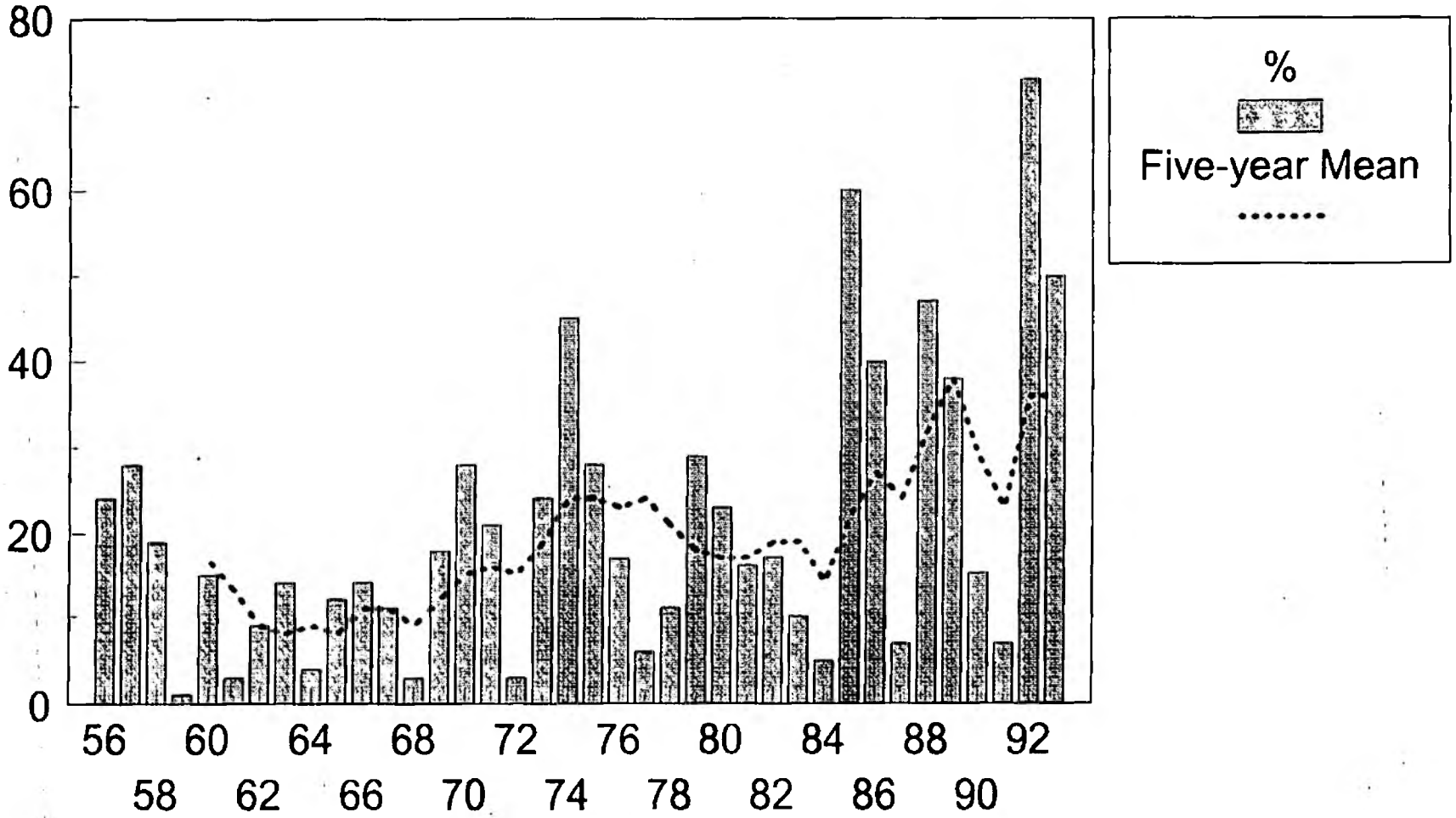


Figure 19 - River Taw Sea Trout Rod Catch, Season Totals, 1953 - 93

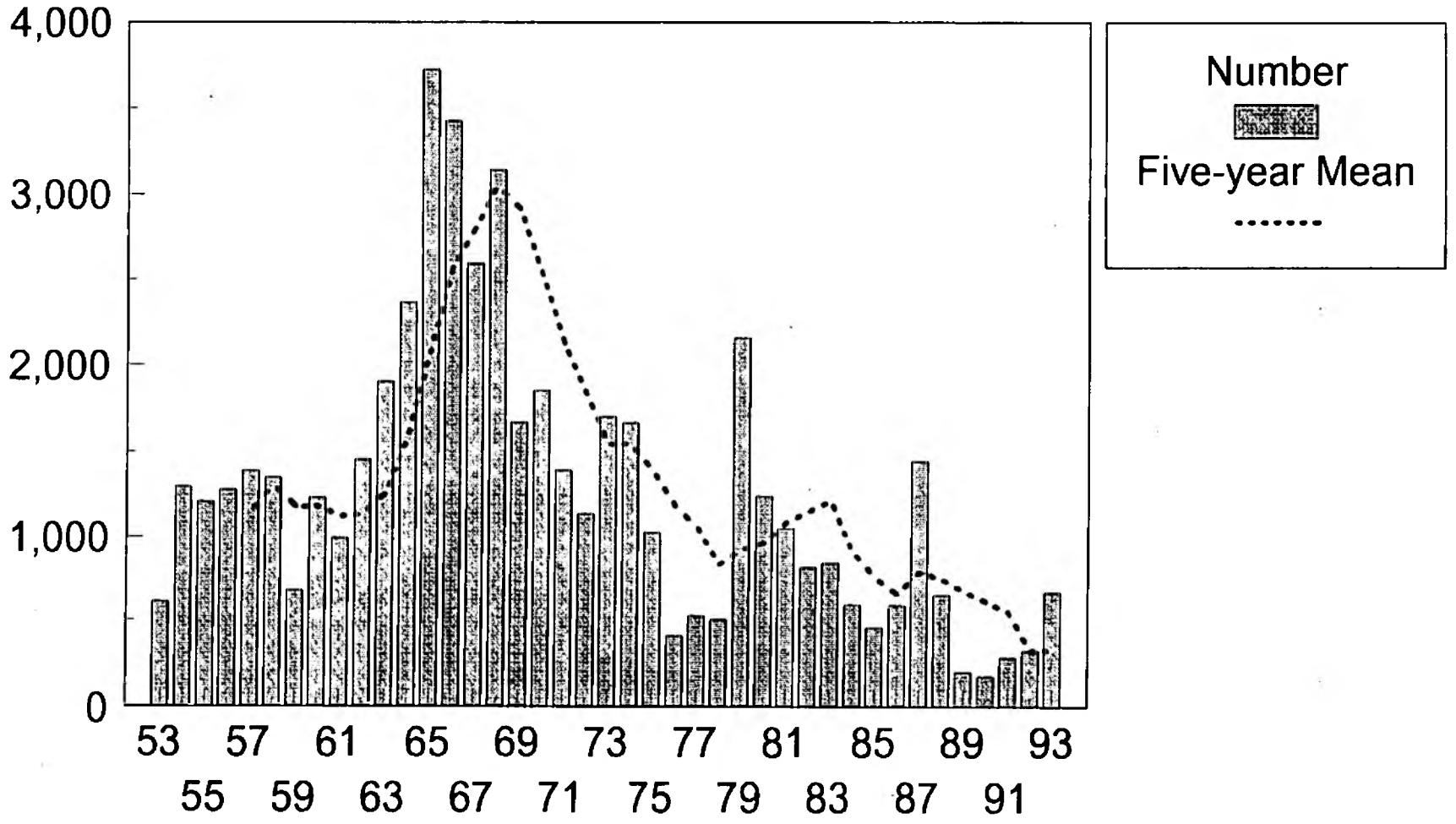
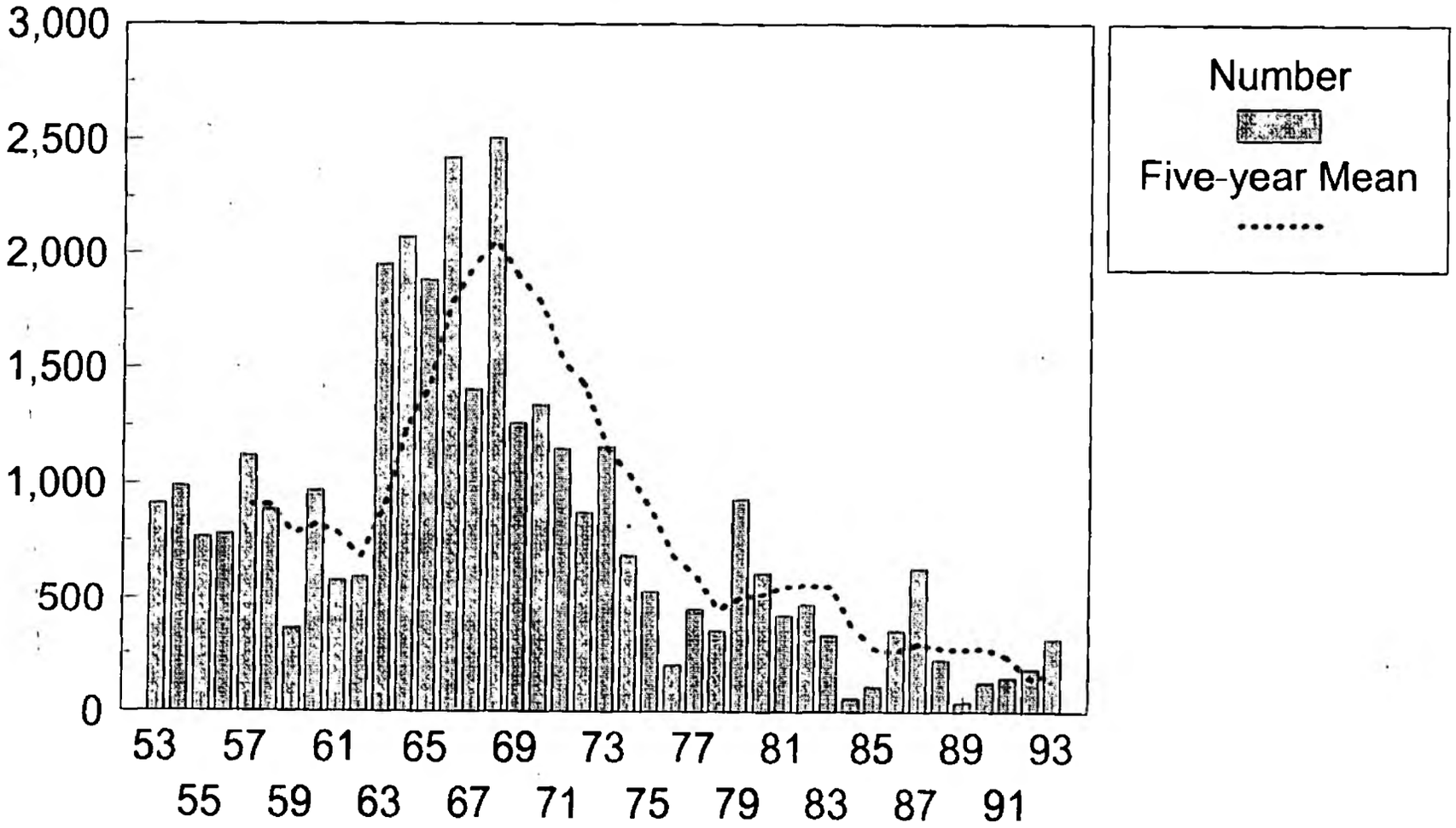


Figure 20 - River Torridge Sea Trout Rod Catch, Season Totals, 1953 - 93



Appendix A

Calculation of potential egg deposition

Potential egg deposition is calculated from the equations:

$$S = C \cdot (1/U \cdot Ps - 1) \cdot z$$

where
- S = spawning stock
- C = rod catch, the average for the ten year period
- U = exploitation rate. 10% for grilse and 28% for MSW fish. The latter is that adopted by Welsh Region (NRA 1994b). Data from recent radio tagging programme on the Taw and Torridge indicates an overall rate of 12%. The majority of the fish were grilse so a rate of 10% for grilse is assumed.
- Ps = the proportion entering during the season, as adopted by Welsh Region.
- z = survival rate, arbitrarily defined as 95%.

and

$$E = S \cdot Pf \cdot f$$

where
- E = potential egg deposition
- S = spawning stock
- Pf = proportion of females in the stock, 42% for grilse and 68% for MSW fish, as adopted by Welsh Region
- f = average fecundity, obtained by converting the mean weight of Taw and Torridge fish to length using the relationship derived for River Tamar fish

$$\log_n y \text{ (gms)} = 2.911 \log_n x \text{ (mm)} - 10.929$$

and by converting length to fecundity using the general relationship derived for Scottish fish (Pope et al, 1961)

$$\log_{10} N \text{ (number of eggs)} = 2.3345 \log_{10} L \text{ (cms)} - 0.582$$

Values for the Rivers Taw and Torridge for the time periods analysed are shown in Table A1.

Table A1. Assumed and calculated values for potential egg deposition.

	River Taw			River Torridge		
	59-68	71-80	84-93	59-68	71-80	84-93
C_g	38	89.5	127.2	34	45.7	35.5
C_m	486	249.2	112	439	133.8	30.9
U_g	0.1	0.1	0.1	0.1	0.1	0.1
U_m	0.28	0.28	0.28	0.28	0.28	0.28
Ps_g	0.88	0.88	0.88	0.88	0.88	0.88
Ps_m	0.96	0.96	0.96	0.96	0.96	0.96
z	0.95	0.95	0.95	0.95	0.95	0.95
S_g	282	663	943	252	339	263
S_m	1121	575	258	1013	309	71
Pf_g	0.42	0.42	0.42	0.42	0.42	0.42
Pf_m	0.68	0.68	0.68	0.68	0.68	0.68
f_g	4599	4599	4599	4599	4599	4599
f_m	6658	6658	6658	6658	6658	6658
$E . 10^6$	5.6	3.9	3.0	5.1	2.1	0.8
$m^2 . 10^6$	1.4	1.4	1.4	1.2	1.4	1.4
$E/100m^2$	396	274	211	428	148	60

Subscript $_g$ = grilse Subscript $_m$ = multi sea winter fish

References

NRA, 1994b. Review of Net Limitation Orders and Net Fishing Byelaws. NRA Welsh Region report, 12 pp + figs & appendices.

Pope, J.A., Mills, D.H. & Shearer, W.M., 1961. The fecundity of Atlantic salmon (Salmo salar Linn). Freshwat. Salm. Fish. Res., **26**, 1-12.