ENVIRONMENTAL PROTECTION

NRA

National Rivers Authority
South West Region

REDUCTION IN ALDRIN AND DIELDRIN CONCENTRATIONS IN THE NEWLYN RIVER

May 1991

FWI/90/025

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EXTER

SUMMARY

High levels of aldrin and dieldrin were found in river water and fish in the Newlyn River during 1988. These were linked to the use of aldrin as a pesticide for the control of the large narcissus fly in daffodil growing areas within the catchment.

A reduction in pesticide contamination in the Newlyn River Catchment was expected following the ban on the use of aldrin in May 1989 and agreements with the land owner to change farming practises and to minimise run-off of contaminated sediment.

There has been a reduction in aldrin and dieldrin concentrations in river water, river sediments and freshwater fish since the initial work in 1988. Aldrin and dieldrin concentrations in the Newlyn River have remained within the Environmental Quality Standard (EQS) at all times during 1990. However aldrin and dieldrin concentrations in the Trereife Stream tributary still exceeded the EQS during 1990.

Aquatic invertebrate communities previously affected by aldrin and dieldrin pollution have increased in diversity.

It is recommended that further work is carried out to determine the risk of further aldrin and dieldrin contamination of the Newlyn River Catchment from soil erosion. The Chief Environmental Health Officer of Penwith District Council, DoE and MAFF should be kept informed of the reduction of aldrin and dieldrin concentrations within the catchment.

AERIAL PHOTOGRAPH OF THE NEWLYN RIVER SHOWING POSITION OF BULB FIELDS

CONTENTS

REDUCTION IN ALDRIN & DIELDRIN CONCENTRATIONS IN THE NEWLYN RIVER.

1. INTRODUCTION.

A monitoring programme was set up to determine aldrin and dieldrin concentrations in the Newlyn River Catchment. This followed the identification of high pesticide residues in eels and trout in the catchment in 1988 (Ref. 1).

Dieldrin is a break-down product of aldrin which is a persistent organochlorine insecticide and was used to control the large narcissus fly on daffodils within the catchment.

Intensive studies identified movement of aldrin & dieldrin during heavy rainfall (Ref. 2 & 3). Both compounds adhere to soil particles which are flushed into the river from bulb fields bordering the Trereife Stream.

MAFF imposed a ban on the use of aldrin in May 1989 as a result of these investigations. Agreement was also reached with the landowner to change farming practises to minimise run-off of contaminated sediment. A reduction in pesticide contamination in the Newlyn River catchment was therefore expected.

This report presents the findings of aldrin & dieldrin concentrations monitored in river water, trout and eels in the Newlyn River catchment in 1989 & 1990 (see Fig. 1). Aquatic invertebrate communities have also been sampled during this period to determine their condition.

2. RESULTS.

2.1. Pesticide concentrations in river water (see Appendix).

Highest concentrations of aldrin & dieldrin were found downstream of bulb fields in the Tereife Stream. Concentrations of aldrin and dieldrin exceeded the Environmental Quality Standard (EQS) during 1989 and 1990 in the Trereife Stream (EQS = 30 ng/l combined aldrin & dieldrin, see Ref. 4). However, concentrations were slightly lower in 1990 compared to 1989.

Concentrations of dieldrin were higher during the summer compared to winter months in 1989 and 1990 (see Fig. 2). It is possible that during the warmer summer temperatures dieldrin is more soluble in water and is desorbed from the river sediment. Aldrin is more insoluble in water and does not increase during the summer. Smaller volumes of water at low flows would also lead to an apparent increase in dieldrin concentration although absolute amounts may only slightly vary. It is also possible that greater biological and chemical breakdown of aldrin to dieldrin occurs during warmer temperatures.

Peaks of aldrin & dieldrin concentrations were found in river water which occurred during rainfall events (see Fig. 2). An exceptionally high concentration of aldrin (=200 ng/l) was found on 29 January 1990. Aldrin was probably bound with suspended solids during turbid run-off from land. It seems likely that other peaks of aldrin and dieldrin have not been recorded during rainfall because sampling did not coincide with the precise time of turbid run-off. These occasions are likely to be sudden and of short duration.

Aldrin and dieldrin concentrations in the Newlyn River downstream of the Trereife Stream at Stable Hobba and Newlyn Bridge, were much lower than those detected in the Trereife Stream. Concentrations were much lower during 1990 compared to 1989 and were below the EQS in 1990.

2.2. Pesticide concentrations in river sediments.

There has been a marked decrease (approx. 10 fold) in aldrin concentrations in river sediments at both sites on the Trereife Stream since the initial survey in 1988 (see Fig. 3).

Dieldrin concentrations in river sediments have not decreased at both sites in the Trereife Stream; concentrations at the site immediately prior to the confluence with the Newlyn River were similar during 1988 and 1990.

Concentrations of aldrin and dieldrin in river sediments from the Newlyn River downstream of the Trereife Stream have decreased to levels similar to those upstream at the control sites.

River sediments may become recontaminated with aldrin and dieldrin during deposition of silt following turbid run-off from land. Aldrin will in turn will be broken-down into dieldrin which is then slowly released into the water column.

2.3. Pesticide concentrations in freshwater fish.

The Department of Health have advised Environmental Health Officers of local authorities that where eels are caught regularly and eaten frequently with dieldrin concentrations in excess of 100 ug/kg wet wt., regular consumers should restrict their intake of eels.

Aldrin and dieldrin concentrations present in trout and eels in the Newlyn River at Stable Hobba Bridge have decreased since the initial survey in 1988 (see Fig. 4). However, concentrations of dieldrin in eels exceeded the recommended standard (= 100 ug/kg wet wt. - see Ref. 5). Dieldrin concentrations in trout have generally remained below the recommended standard since the initial survey.

The difference in pesticide levels detected in fish by different analytical techniques was investigated. Fish collected in Jan 1991 were divided in two halves and sent to different laboratories.

Generally, aldrin and dieldrin results from the different laboratories were similar. However, there was a marked difference in dieldrin concentrations found in one eel (cf. 4,000 ug/kg wet wt. and 645 ug/kg wet wt. - see Fig. 4). It seems unlikely that the differences are due to an uneven distribution of dieldrin in the fish since both techniques analysed fish tissue from the shoulder area. However, this requires further investigation. It is concluded that there is scope for analytical bias depending on the technique used.

It is questionable whether results should be compared to the recommended standard since they are dependent upon the analytical technique used.

2.4. Aquatic invertebrates.

The diversity of aquatic invertebrate communities has increased at Stable Hobba in the Newlyn River (see Fig. 5). Communities present in the Trereife Stream remain impoverished downstream of the bulb fields. At this site certain invertebrate families were very abundant and others which would be expected were absent. Abundant families were those known to be more tolerant of aldrin and dieldrin.

A restricted invertebrate fauna was found to be present on the Trereife Stream at the control site Dennis Place. This was considered to be due to natural habitat constraints.

3. CONCLUSION.

1. Since initial work in 1988 there has been a reduction in aldrin and dieldrin concentrations in the Newlyn catchment during 1989 and 1990. Concentrations of aldrin and dieldrin have decreased in river water, river sediments and freshwater fish. Aquatic invertebrate communities previously affected by aldrin/dieldrin pollution have increased in diversity.

2. Reductions in aldrin and dieldrin concentrations in river water and sediments have been greater in the Newlyn River compared to the Trereife Stream tributary.

3. Aldrin and dieldrin concentrations in the Newlyn River have remained within the EQS at all times during 1990. However, concentrations in the Trereife Stream still exceeded the EQS during 1990.

4. There is an increase in dieldrin concentrations in river water during the summer. It is thought that warmer temperatures produce greater solubility of dieldrin and also lead to faster chemical/bacterial breakdown of aldrin to dieldrin.

5. Analysis of aldrin and dieldrin in fish tissue by different techniques can produce different results.

4. RECOMMENDATIONS.

1. An investigation should be carried out to determine the risk of further aldrin and dieldrin contamination from soil erosion and the progress of aldrin/dieldrin decay in soils.

   The work should involve:-
   (i) Chemical monitoring of soils in bulb fields.
   (ii) A risk assessment to determine the likelihood of soil erosion, and access of soil to watercourses.

   - Action by Catchment Scientist.

2. The Chief Environmental Health Officer of Penwith District Council, DoE and MAFF should be kept informed of reduction of aldrin and dieldrin concentrations.

   - Action by Pollution Controller.

3. An evaluation is required to assess the variability of aldrin and dieldrin concentrations in contaminated fish tissue.

   - Action by Catchment Scientist.

5. REFERENCES.

1. MILFORD, B.L. (1989). Organo-chlorine pesticide residues in freshwater eels.

2. MILFORD, B.L. (1989). Water quality investigations in the Newlyn River Catchment.

3. HARROD, T.R. (1989). Pesticide pathways and land use practises in the Newlyn River Catchment, Cornwall. Report commissioned by the NRA South West Region.

4. List I and list II families and groups of substances - Dangerous Substances Directive (76/464/EEC).

5. Environmental Protection Agency (1973). Ecological Research Series, Water Quality Criteria 1972 Washington D.C., pp. xix +594.

Fig. 1

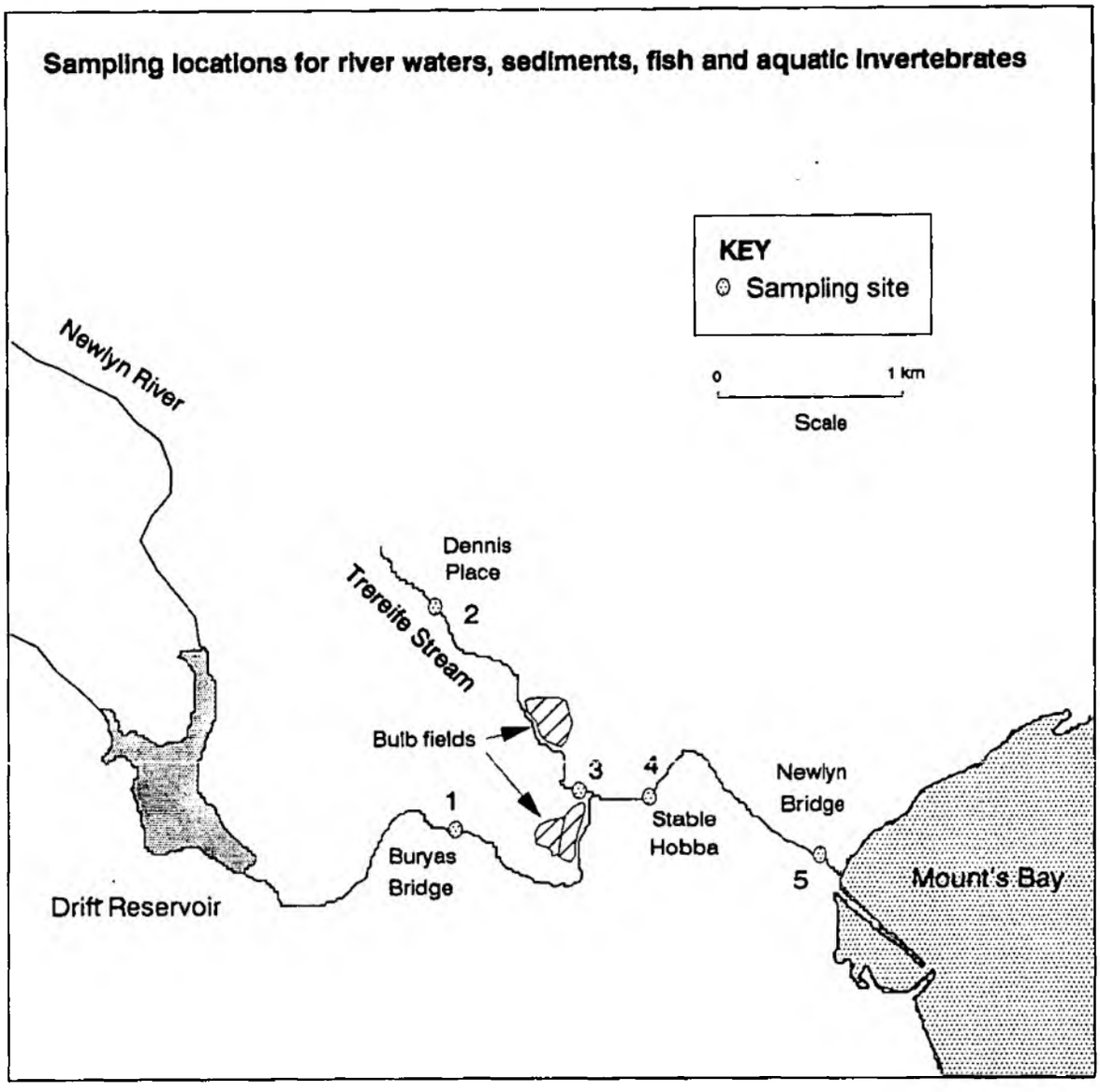

Sampling locations for river waters, sediments, fish and aquatic invertebrates
KEY
Sampling site
0
1 km
Scale
Newlyn River
Dennis
Place
2
Trereife Stream
Bulb fields
3
4
Newlyn
Bridge
1
Buryas
Bridge
Stable
Hobba
5
Mount's Bay
Drift Reservoir

Fig. 2

Aldrin and dieldrin concentrations in the Trereife Stream compared to river temperature and rainfall at Drift Reservoir during 1989.

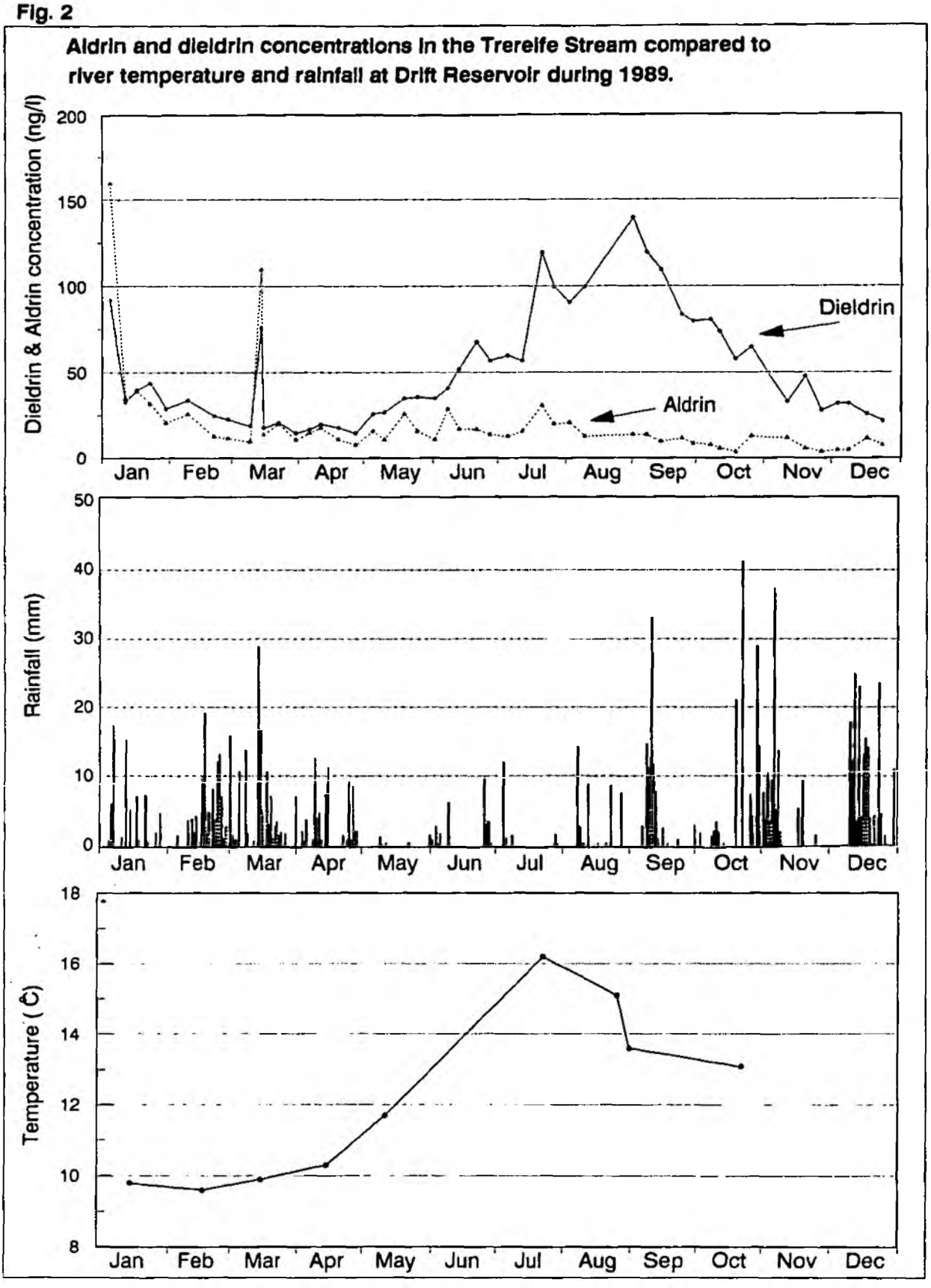


Fig. 3

Aldrin & Dieldrin concentrations in river sediments collected during 1988 & 1990 at different sites on the Newlyn River

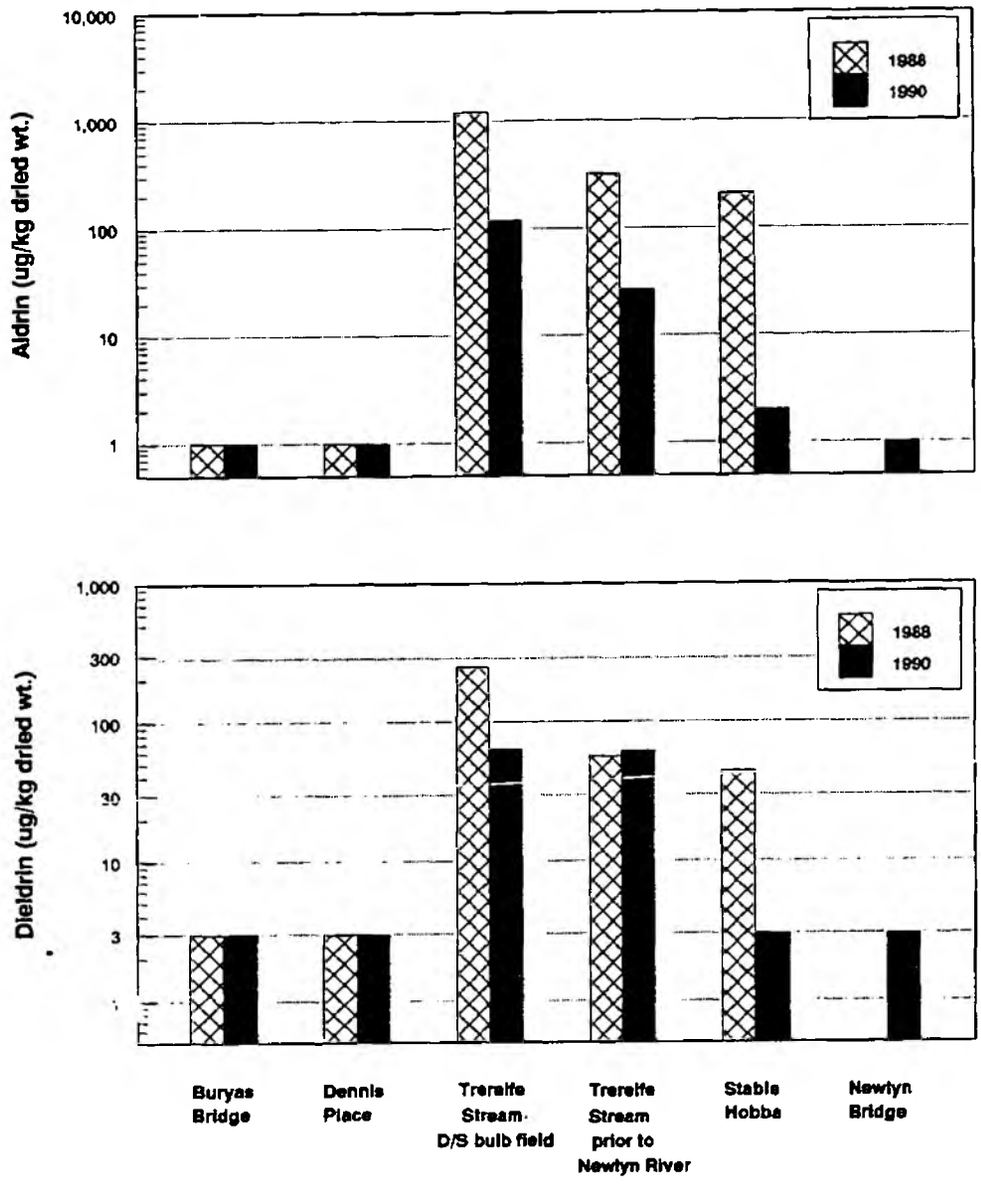
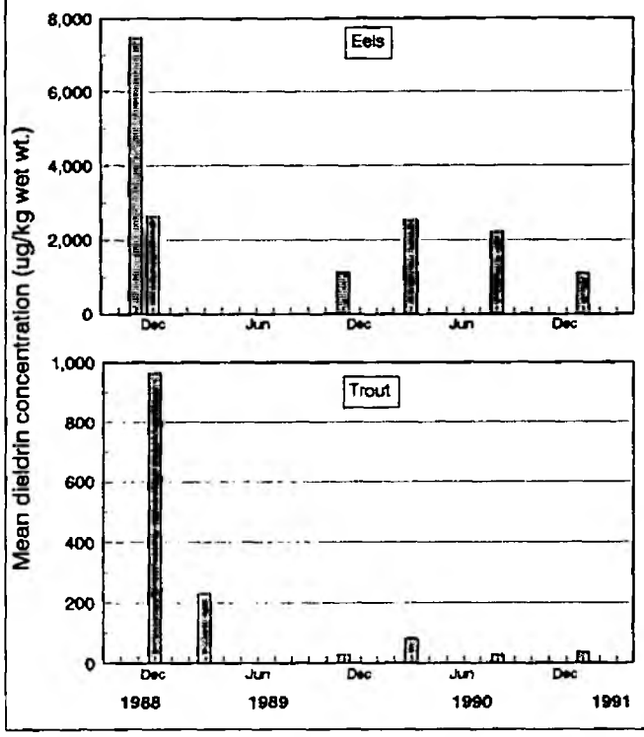


Fig. 4

Dieldrin concentrations in trout and eels at Stable Hobba Bridge



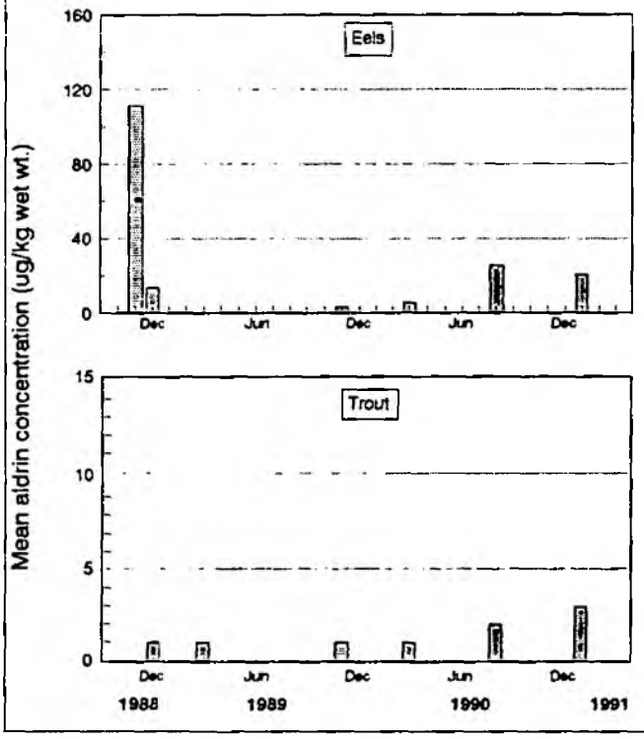
Eels

Lab A	Lab A	Lab A	Lab A	Lab B	Lab A	Lab B
Nov 88	Dec 88	Nov 89	Mar 90	Aug 90	Jan 91	Jan 91
10,000	1,100	16	96	52	4,000	645
420	900	1,500	890	1,760	240	96
3,300	1,000	300	200	250	190	142
900	820	89	2,000	5,950	52	34
3,000	4,300	87	9,800	3,160		
22,000	3,900	240				
9,300	2,900	120				
13,000	2,100	4,100				
1,000	9,000	3,900				
12,000	490					

Trout

Dec 88	Mar 89	Nov 89	Mar 90	Aug 90	Jan 91	Jan 91
600	370	75	14	20	10	123
430	300	26	160	30	68	87
1,200	210	30	97	30	28	13
100	160	15	65	40	38	96
2,500	340	42	83	20	10	30
	160	19			34	71
	130	14				
	260	7				
	240	26				
	120	12				

Aldrin concentrations in trout and eels at Stable Hobba Bridge



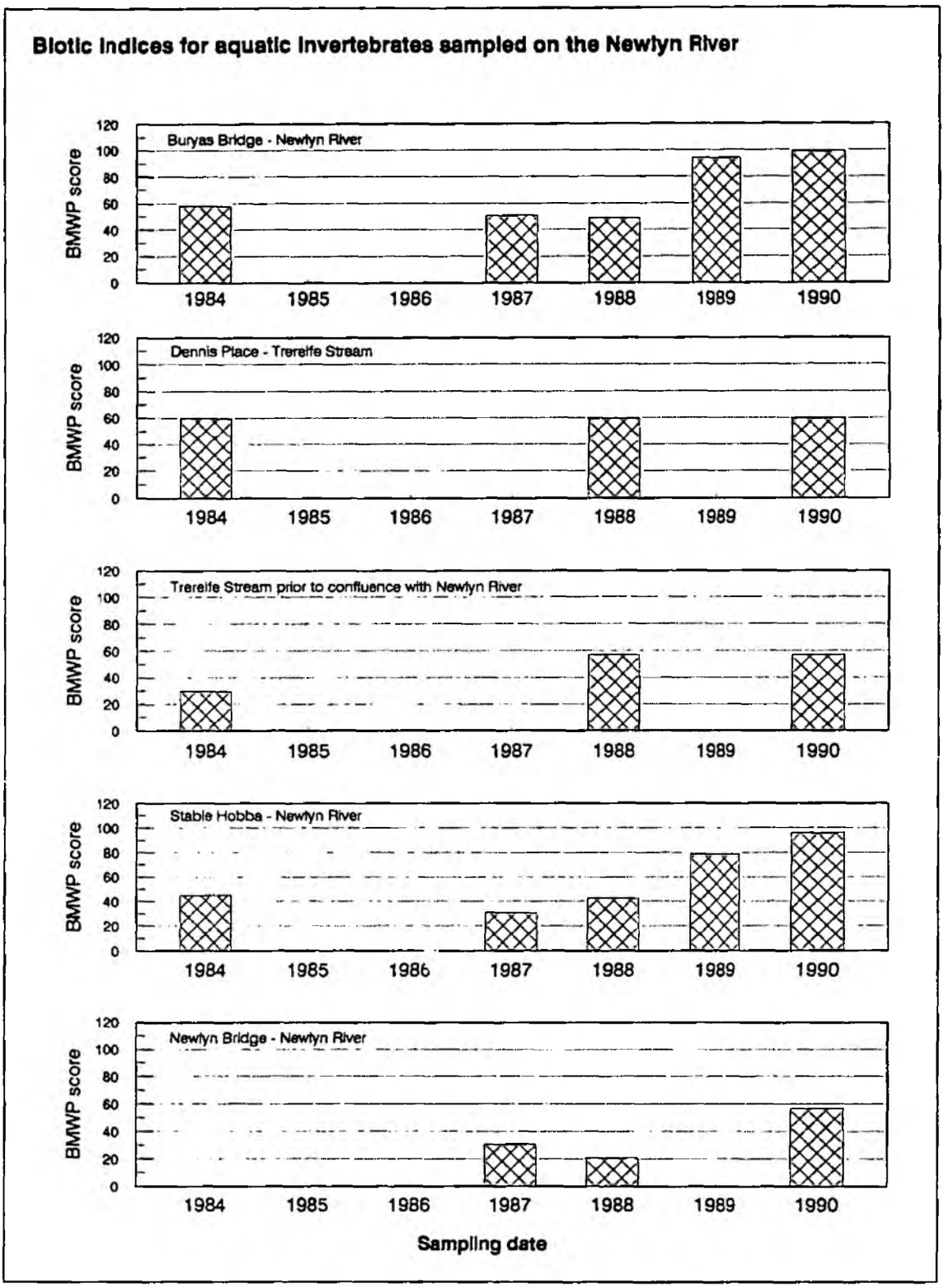
Eels

Lab A	Lab A	Lab A	Lab A	Lab B	Lab A	Lab B
Nov 88	Dec 88	Nov 89	Mar 90	Aug 90	Jan 91	Jan 91
220	<1	<1	<1	<25	<1	31
2	<1	<1	<1	<25	<1	4
81	<1	<1	<1	<25	<1	35
3	<1	<1	3	<25	<1	5
74	24	<1	8	<25		
130	12	<1				
140	24	<1				
230	<1	5				
22	96	<1				
200	<1					

Trout

Dec 88	Mar 89	Nov 89	Mar 90	Aug 90	Jan 91	Jan 91
<1	<1	<1	<1	<2	<1	7
<1	<1	<1	<1	<2	<1	6
<1	<1	<1	<1	<2	<1	<2
<1	<1	<1	<1	<2	<1	5
<1	<1	<1	<1	<2	<1	<2
	<1	<1			<1	<2
	<1	<1				
	<1	<1				
	<1	<1				
	<1	<1				

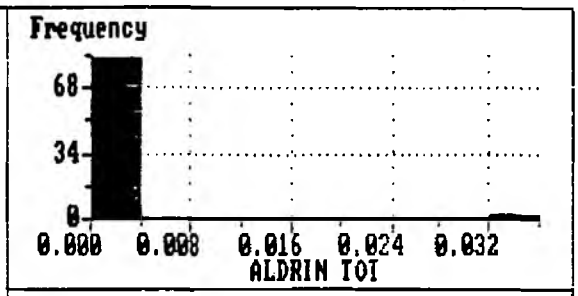
Fig. 5

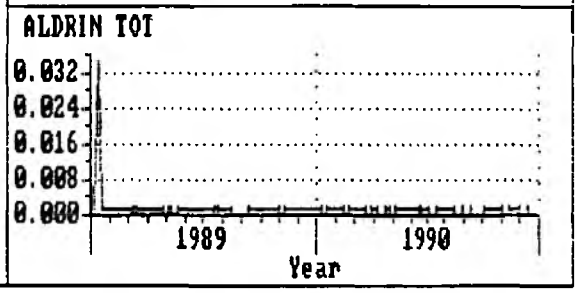

Biotic indices for aquatic invertebrates sampled on the Newlyn River
Buryas Bridge - Newlyn River
Dennis Place - Trerelfe Stream
Trerelfe Stream prior to confluence with Newlyn River
Stable Hobba - Newlyn River
Newlyn Bridge - Newlyn River
BMWP score
0
20
40
60
80
100
120
1984
1985
1986
1987
1988
1989
1990
Sampling date

APPENDIX. Statistics for aldrin and dieldrin concentrations collected in river water at different sites in the Newlyn River catchment.

NEWLYN AT BURYAS BRIDGE ALDRIN TOT 5/ 1/89 to 12/12/90

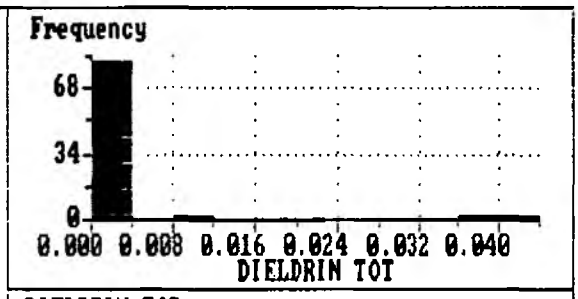
Number of observations	85
Minimum	0.0010
Mean	0.0014
Maximum	0.0350
Standard deviation	0.00369
SDD	0.00422
Non-parametric estimate of:	
5 percentile	0.0010
10 percentile	0.0010
20 percentile	0.0010
Median	0.0010
80 percentile	0.0010
90 percentile	0.0010
95 percentile	0.0010

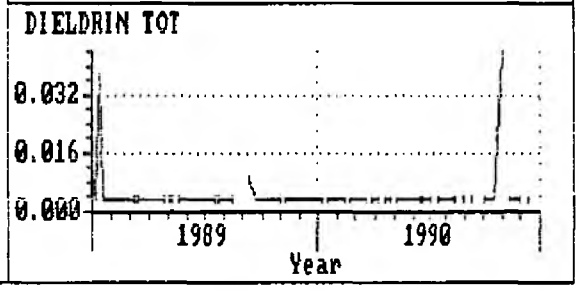




NEWLYN AT BURYAS BRIDGE DIELDRIN TOT 5/ 1/89 to 12/12/90

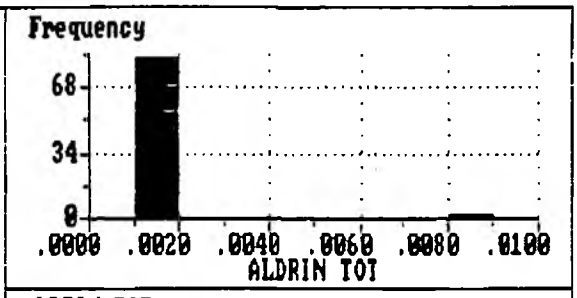
Number of observations	85
Minimum	0.0030
Mean	0.0040
Maximum	0.0430
Standard deviation	0.00576
SDD	0.00561
Non-parametric estimate of:	
5 percentile	0.0030
10 percentile	0.0030
20 percentile	0.0030
Median	0.0030
80 percentile	0.0030
90 percentile	0.0030
95 percentile	0.0030

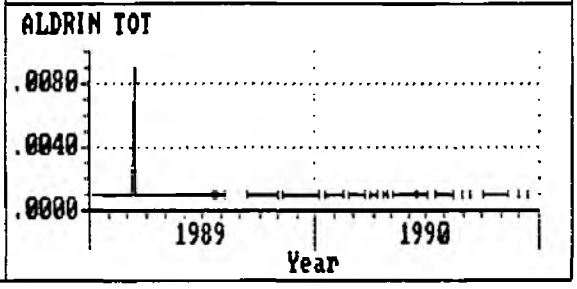




TEREIFE TRIB. AT DENNIS PLACE ALDRIN TOT 5/ 1/89 to 12/12/90

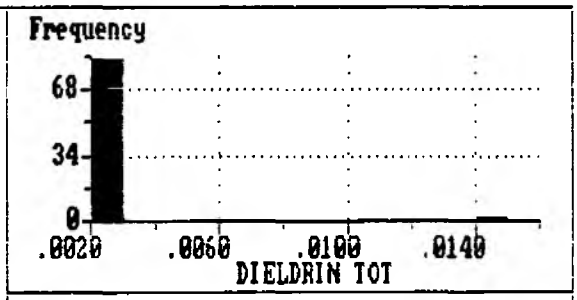
Number of observations	84
Minimum	0.00100
Mean	0.00110
Maximum	0.00900
Standard deviation	0.000873
SDD	0.000977
Non-parametric estimate of:	
5 percentile	0.00100
10 percentile	0.00100
20 percentile	0.00100
Median	0.00100
80 percentile	0.00100
90 percentile	0.00100
95 percentile	0.00100

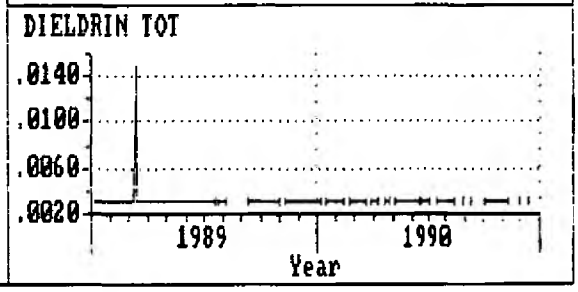




TEREIFE TRIB. AT DENNIS PLACE DIELDRIN TOT 5/ 1/89 to 12/12/90

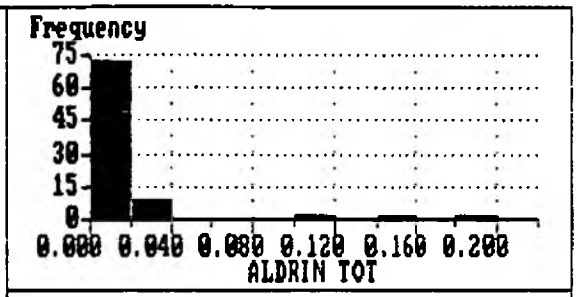
Number of observations	84
Minimum	0.00300
Mean	0.00314
Maximum	0.01500
Standard deviation	0.001309
SDD	0.001466
Non-parametric estimate of:	
5 percentile	0.00300
10 percentile	0.00300
20 percentile	0.00300
Median	0.00300
80 percentile	0.00300
90 percentile	0.00300
95 percentile	0.00300

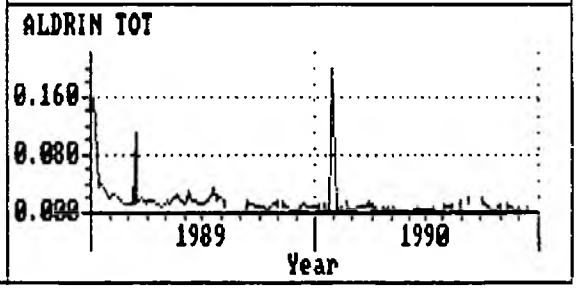




TEREIFE TRIB. AT PRIOR TO CONFL. ALDRIN TOT 5/ 1/89 to 12/12/90

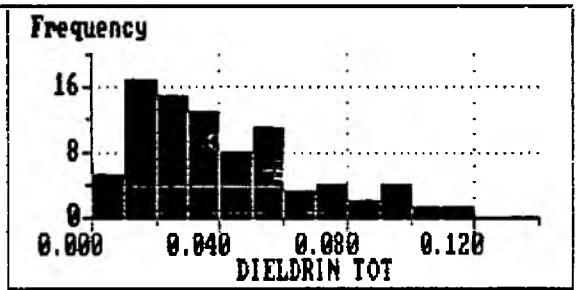
Number of observations	84
Minimum	0.0010
Mean	0.0163
Maximum	0.2000
Standard deviation	0.02918
SDD	0.02927
Non-parametric estimate of:	
5 percentile	0.0020
10 percentile	0.0030
20 percentile	0.0040
Median	0.0100
80 percentile	0.0170
90 percentile	0.0275
95 percentile	0.0380

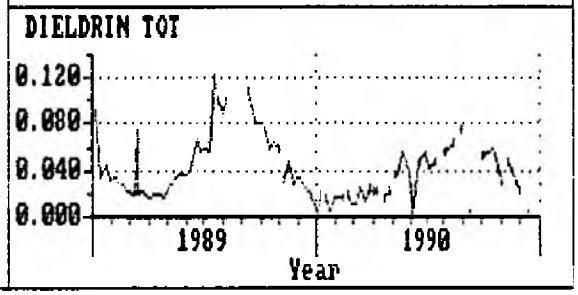




TEREIFE TRIB. AT PRIOR TO CONFL. DIELDRIN TOT 5/ 1/89 to 12/12/90

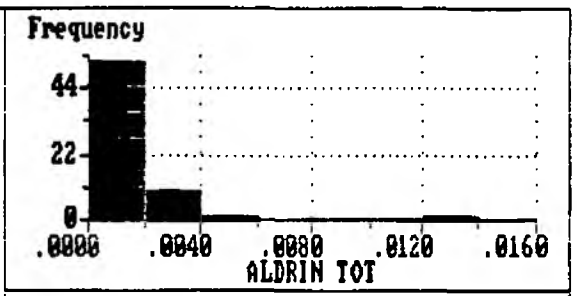
Number of observations	84
Minimum	0.0030
Mean	0.0401
Maximum	0.1200
Standard deviation	0.02666
SDD	0.01343
Non-parametric estimate of:	
5 percentile	0.0030
10 percentile	0.0140
20 percentile	0.0180
Median	0.0335
80 percentile	0.0590
90 percentile	0.0805
95 percentile	0.0980

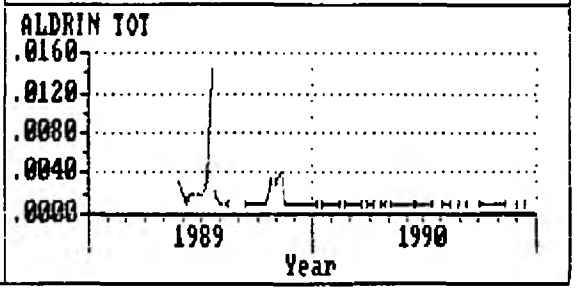




NEWLYN AT STABLE HOBBA ALDRIN TOT 24/ 5/89 to 12/12/90

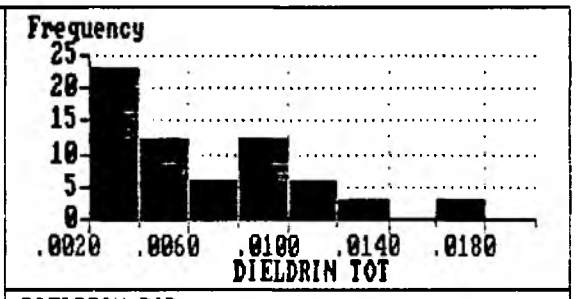
Number of observations	65
Minimum	0.00100
Mean	0.00146
Maximum	0.01400
Standard deviation	0.001705
SDD	0.001208
Non-parametric estimate of:	
5 percentile	0.00100
10 percentile	0.00100
20 percentile	0.00100
Median	0.00100
80 percentile	0.00100
90 percentile	0.00240
95 percentile	0.00300

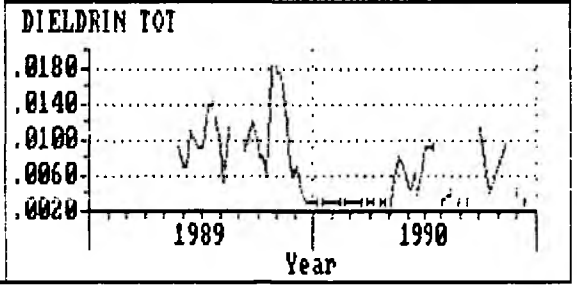




NEWLYN AT STABLE HOBBA DIELDRIN TOT 24/ 5/89 to 12/12/90

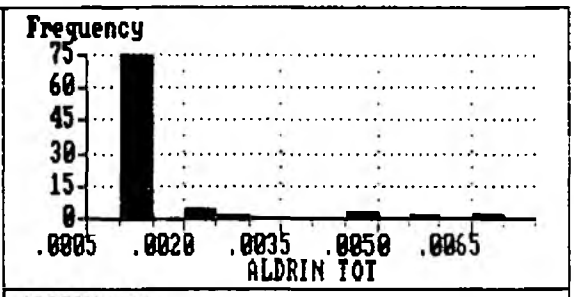
Number of observations	65
Minimum	0.00300
Mean	0.00675
Maximum	0.01800
Standard deviation	0.004097
SDD	0.002158
Non-parametric estimate of:	
5 percentile	0.00300
10 percentile	0.00300
20 percentile	0.00300
Median	0.00600
80 percentile	0.00980
90 percentile	0.01280
95 percentile	0.01610

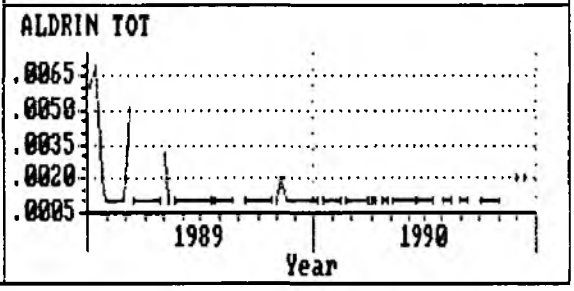




NEWLYN AT NEWLYN BRIDGE ALDRIN TOT 5/ 1/89 to 12/12/90

Number of observations	84
Minimum	0.00100
Mean	0.00130
Maximum	0.00700
Standard deviation	0.001062
SDD	0.000533
Non-parametric estimate of:	
5 percentile	0.00100
10 percentile	0.00100
20 percentile	0.00100
Median	0.00100
80 percentile	0.00100
90 percentile	0.00200
95 percentile	0.00450





NEWLYN AT NEWLYN BRIDGE DIELDRIN TOT 5/ 1/89 to 12/12/90

Number of observations	84
Minimum	0.00300
Mean	0.00661
Maximum	0.01800
Standard deviation	0.004130
SDD	0.002641
Non-parametric estimate of:	
5 percentile	0.00300
10 percentile	0.00300
20 percentile	0.00300
Median	0.00500
80 percentile	0.01100
90 percentile	0.01350
95 percentile	0.01500