This paper not to be cited without prior reference to the authors.

International Council for the Exploration of the Sea

C.M. 1977/M:39
Anadromous and Catadromous Fish Committee

Monitoring Salmon Runs in Icelandic Streams using a Resistivity Counter. A Preliminary Report.

by

Maríanna Alexandersdóttir[1] and Björn Kristinsson[2]

Abstract

The Institute of Freshwater Fisheries has been involved in the testing of a resistivity counter. The counter sensor is a mat which can be placed directly on the river bed, needing no supporting structures. Calibration tests, which have been conducted during the last two seasons, have not yet been satisfactorily concluded. Data obtained on diurnal activity using the counter showed that the salmon migrated during the hours between sunset and sunrise.

Introduction

One of the objectives of the UNDP-supported program at the Institute of Freshwater Fisheries was to establish a rational salmon management program in Iceland. A detailed study was made of the Elliða River and a stock-recruitment curve developed for that river (Eiriksdottir, 1974, Mundy, 1975). This was possible as records on catch and escapement are available for the Elliða River for the last 40 years. However for all other Icelandic rivers few records exist for escapement, although catch records have been collected by the Institute for up to 30 years. In an effort to close this gap in our data base the Institute has been involved in the testing and calibration of a resistivity fish counter designed by an electronics firm in Reykjavík, Rafagnatækni

1) Institute of Freshwater Fisheries, Reykjavík, Iceland.
2) Rafagnatækni (Electronic) sf., Reykjavík, Iceland.

(Electronics) sf. This counter has already been installed in several salmon streams in Iceland. Although lack of calibration has decreased the value of the data obtained so far, some interesting data on diurnal activity of salmon have been obtained.

Methods and Results

A. The Counter.

The counter sensor is of a linear resistive type consisting of a submerged "mat" of wires stretched across the river bed. The wires are supported and kept apart by plastic pipes (Fig. 1). Each sensor unit is 10 m wide and about 1.5 m long (the dimensions refer to the river). Several units can be connected to cover a river of over 10 m in width. This simple type of sensor is most suitable for rivers without a fishladder or weir, where tube-sensors cannot be used.

Optimal water velocity has been considered 0.5-1.5 m/s and optimal water depth between o.4 and 0.8 m.

The counter can be energized from a conventional 12 V storage battery that will last up to one month between recharging. The electronic circuits contain a compensating feature for surface wave-motion in addition to automatic balancing to compensate for stream conductivity changes.

The output from the counter is printed on paper strip and the recorded data have the following form:
Hourly printout:
Day of month - Hour - Total count - =
Printout upon activation:
Minute - Second - Period - Signal strength -"Mark".

The counter is an up-down counter and the hourly printout shows the difference between the recorded up and down counts. Period is the passage of time in units of 0.5 s. Signal strength is an arbitrary number. The "mark" printout can be of four differen types i.e. in addition to plus and minus, which indicate an upstream or downstream count, it is possible to distinguish an approach either to the upstream or downstream electrode, although both electrodes are not crossed.

B. Calibration.

The counter was placed in the Elliða River, which is situated within the Reykjavík City Limits. This river has a mechanical counter against which the electronic counter was to be tested. During the 1975 season the counter was placed 400-500 m below the weir. At this time the counter did not include the printer, and a pen recorder was used. It was impossible to distinguish the direction of movement on the record. The results are represented as weekly cumulative run (Fig.2) and show how the electronic counter registered a higher count at all times. This trend increased as the summer wore on.

At the start of the 1976 season the counter mat was moved up above the weir, within 20 m of it. The printing unit was in use through-out the summer. The run was not monitored continuously until after August 10. After this time, until the end of the angling season on September 9, the weir trap was closed four days a week. While the weir was closed all the fish were counted daily and most released above the weir. The electronic count compared favorably with the number of fish released above the weir on these days (Table 1). However, during the periods when the trap was open, the comparison was not as good between the two counters. Comparison of the number of fish in the trap during the days it was closed, with the number shown on the mechanical counter, indicated that the mechanical counter was faulty.

Therefore, at the end of two seasons, although favorable data had been obtained during 1976, the resistivity counter had not yet been satisfactorily tested.

C. Diurnal Activity.

The counter records the time of each signal, making it possible to study the diurnal activity of the fish in the river. During the 1975 season the migration in the Elliða River was monitored continuously from July 1 to September 8. The counts were summarized over each weekly period (Fig.3). The salmon moved mainly at night with maximum activity occurring just after sunset. In July, the peak month, when there are no darkness hours in Reykjavík, there was some activity during the day, with a maximum at midnight. During August and September the fish were hardly active at all except between sunset and sunrise. Although continuous monitoring was not achieved in Elliða River in 1976, a similar diurnal pattern was evident (Fig. 4), as it was in another Icelandic stream monitored, Grímsá.

The diurnal activity is related to light intensity. Huntsman (1948) reported that in the Margaree River salmon ran chiefly for an hour after dusk in shallow water. Stewart (1973) found salmon activity was greater during darkness hours in rivers monitored in Lancashire.

Discussion

Resistivity counters have been in use in the U.K. since the 1950's (Vibert, 1967, Hellawell, 1973). Hellawell (1973) tested an open channel resistivity counter using photoghraphic recording and estimated that salmon caused 95% of the counts.

Most Icelandic streams have low conductivity (Table 2) making them suitable for use of a resistivity counter. The mat counter has already been installed in six Icelandic streams in West Iceland as well as several tube-counters in fishladders. The mat counter has the advantage of not needing a supporting structure. Two years experience with the Icelandic mat counter have indicated some of the problems involved in the use of this type of counter:

1. The effect of dense runs of salmon. Hellawell (1973) found no photographic evidence of simultaneous passage of salmon over the counter electrodes. However, data gathered in the last two years show that the salmon in the Elliða River, and probably most Icelandic streams, migrate in dense runs during the night (Fig.3). Up to 100 signals have been recorded in one hour. The sensor mat can be up to 10 m in width and it cannot be ignored that a number of fish may pass over at short intervals. There is a "dead" time following each count, the counter will distunguish between fish that pass over 1-2 seconds apart.

2. Swimming behavior. False counts may arise if the fish do not swim straight over the mat, but hesitate or swim in a zig-zag pattern. This seems to occur especially where stream flow is very slow.

3. Wandering. In late summar and autumn there is the problem of wandering within the stream. The data from the Elliða River show that there is an increase in the total activity recorded by the counter, although migration of fish into the stream is decreasing. This increases considerably the chance of false counts and the error in the summed total.

References

Eiriksdóttir, G. 1974. The Elliða River. 3. Detailed Analysis of the Run Characteristics. Inst. Freshwat. Fisher. Reykjavík. Manuscript. 67 pp.

Hellawell, J.M. 1973. Automatic Methods of Monitoring Salmon Populations. IASF Spec. Publ. Ser. 4(1): 317-337.

Huntsman, A.G. 1948. Freshets and Fish. Trans. Amer. Fish. Soc. 75(1945): 257-266

Mundy, P. 1975. Stock-recruitmnet Relation for the Atlantic Salmon Stock of the Elliða River. Inst. Freshw. Fisher. Reykjavík. Manuscript. 21 pp.

Stewart, L. 1973. Environmental Engineering and Monitoring in Relation to Salmon Management. IASF Spec. Publ. Ser. 4(1): 297-316.

Vibert, R. 1967. Ed. Fishing with Electricity - its Applications to Biology and Management. Fishing News Books Ltd. 278 pp.

Table one. Results of calibration experiments in Elliða River 1976.

Date	Trap	Hand counted	Mech. counter	Released	Electr. counter	Difference Diff.	Diff./No.count
6-9.8	Open		47		78	-31	.66
10-13.8	Closed	87	134	60	57	+3	.05
14-16.8	Open		158		77	+81	.51
17-20.8	Closed	89	93	59	71	-12	.20
21-13.8	Open		40		55	-15	.38
24-27.8	Closed	182	132	126	115	+11	.09
31.8-3.9	Closed	45	38	29	63	-34	1.17
4.-6.9	Open		42		87	-42	1.00
7-9.9	Closed	3	2	1	14	-13	13.00

Table two. Conductivity (microsiemens/cm V.25°C) of a few Icelandic Rivers.

River	Conductivity	Range-over 12 months sampled
Elliða River 1	78.9	
2	91.5	
Varmá	214.2*	178.0-278.5
Sog	78.7	74.4- 83.6
Brúará	67.6	63.8- 72.0
Tungufljót	53.6	47.7- 61.3
Fossá	84.5	68.2-111.1
Hvítá (Gullfoss)	70.6	63.6- 79.5
Stóra-Laxá	71.3	56.6- 96.4
Þjórsá (Urriðafoss)	88.7	75.0-108.4
Ölfusá (Selfoss)	75.6	69.1- 83.4

* Varmá is a river fed by a hot-spring.

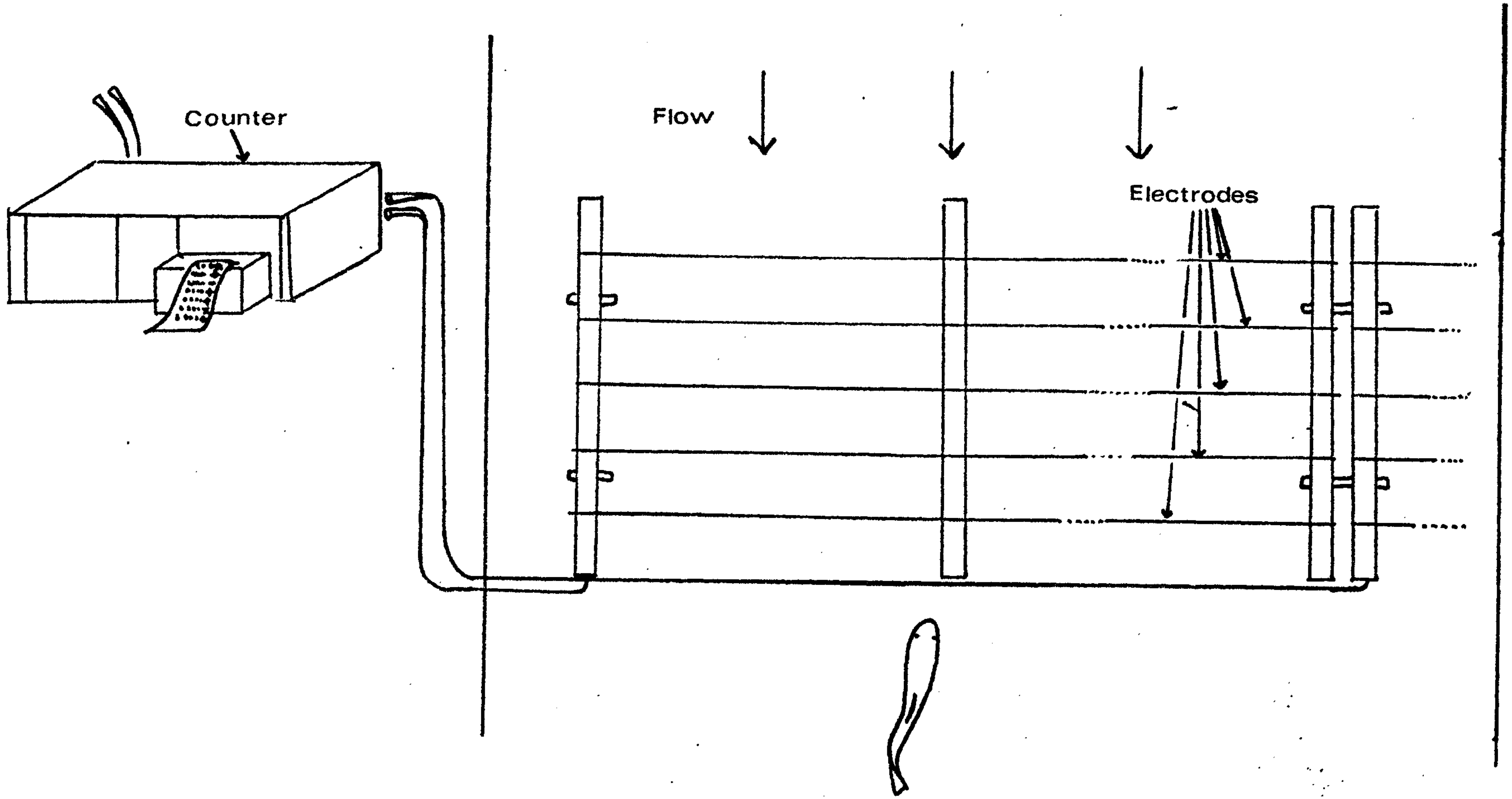

Figure 1. Diagram of counter and mat

(from Kristinsson 1976)

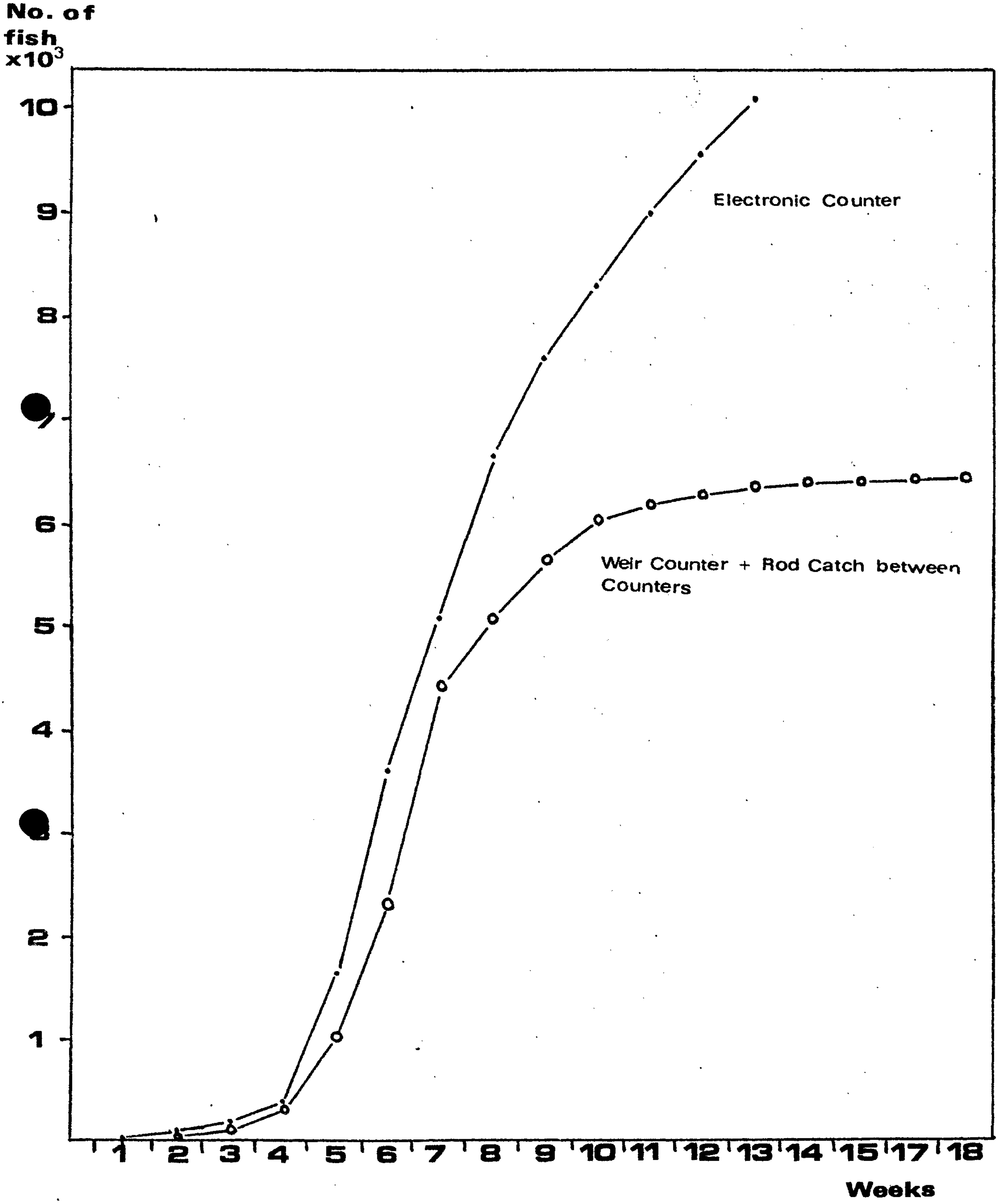

Figure 2. Weekly cumulative run in Ellidaar 1975 June 1 to Sept. 22

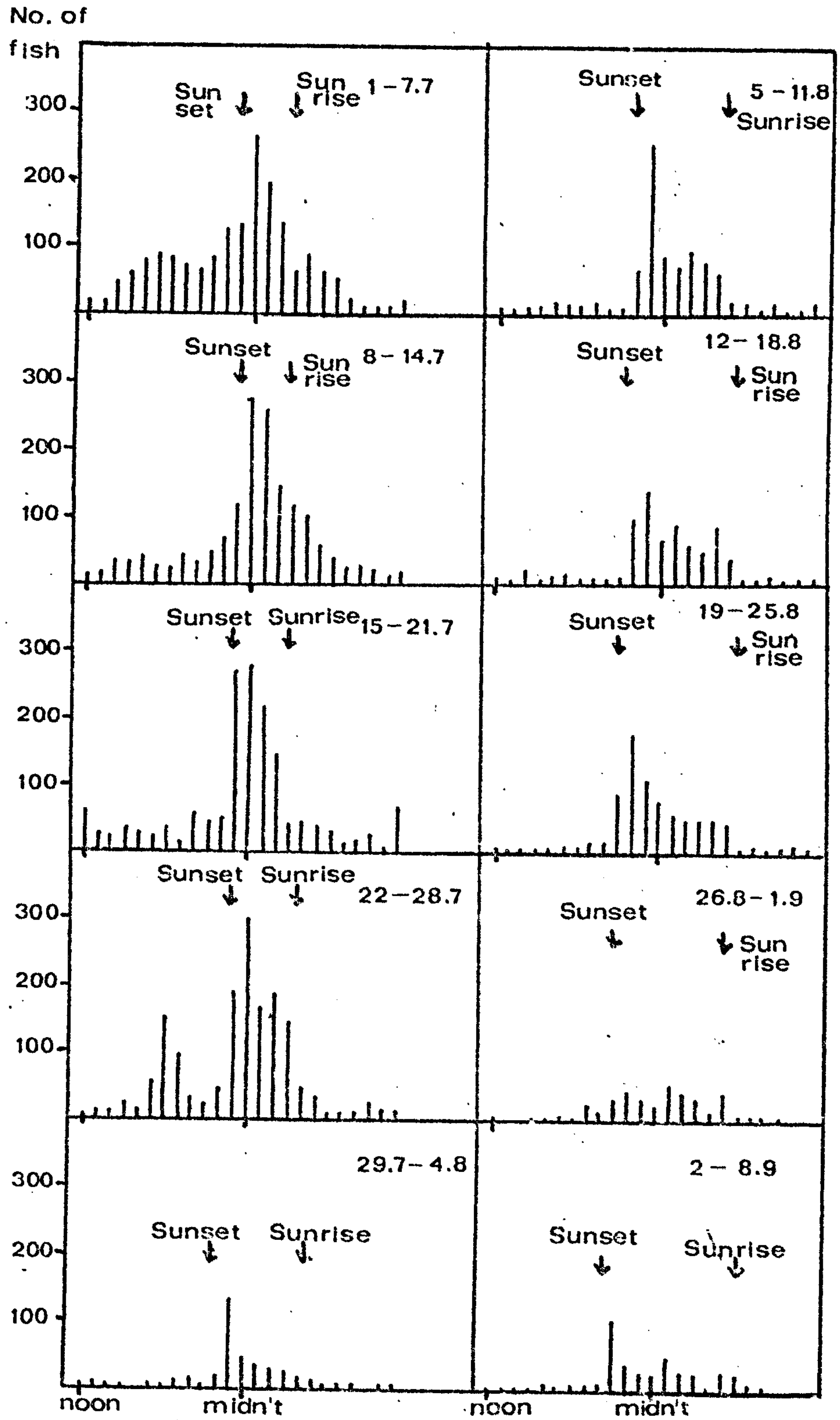

Figure 3. The summated hourly count for each week. Ellida River 1975.

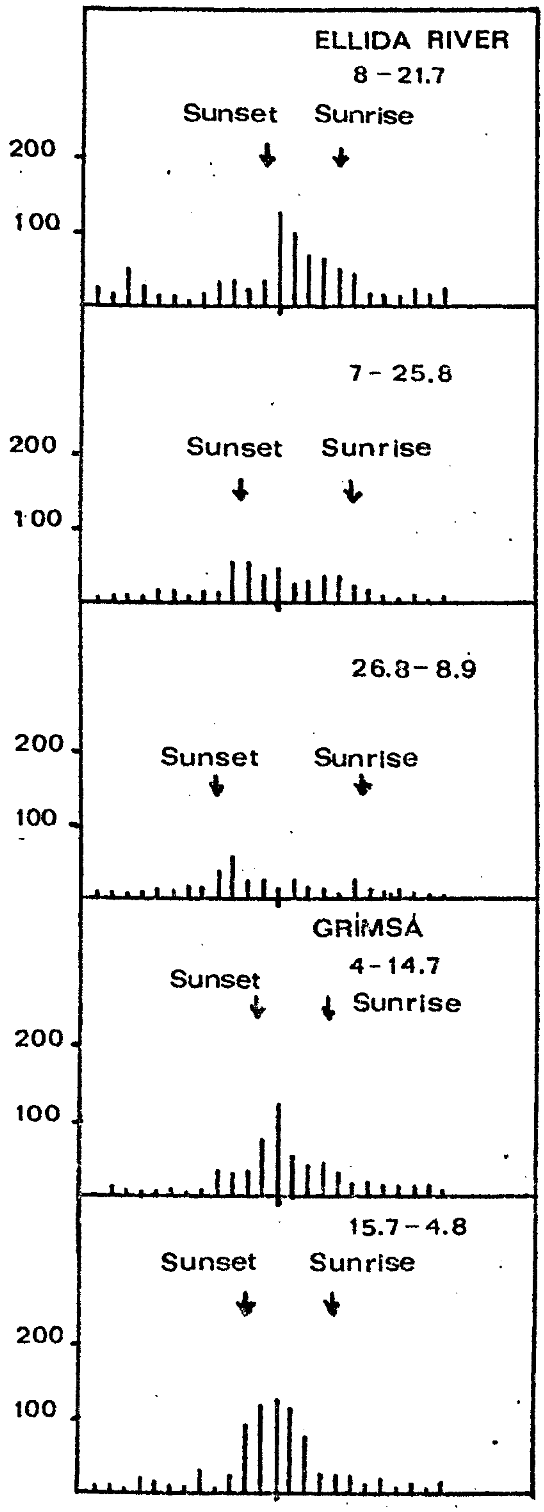

Figure 4. Summated hourly count for Ellida River and Grímsá 1976.