Mészáros Ferenc

GROUP OF MONITORING AND WATER MANATEMENT EXPERTS FOR THE GABCIKOVO SYSTEM OF LOCKS

DATA REPORT OF HUNGARIAN PARTY

Prepared by

Gábor Vida
Sándor Bolla
Károly Baross
Adrienne Hajósy
Lajos Horváth
Pál Liebe
Ferenc Mészáros
Zoltán Nagy
Jenő Sass
János Szekeres
György Tóth

Budapest, 21 October, 1993

DAILY DISCHARGE AND SURFACE WATER LEVEL DATA
JANUARY, 1991 - AUGUST, 1993

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Tables and figures

1. Index map showing location of stations
2. Hydrographs:

a)	**Rajka**	Discharge - Water Level
b)	**Dunaremete**	Discharge - Water level
c)	**Mosoni Danube at Rajka**	Discharge
d)	**Mosoni Danube at Mecsér**	Water Level
e)	**Komárom**	Discharge

3. Monthly and yearly average

Reliability of the water-level data and the water discharge values

Among the possible sources of errors in estimating the water level values the effect of the waviness is the biggest, ± 2-5 cm on the fluviometers at the Danube.

Along this reach of the river discharge values are estimated from the velocity - area function. The uncertainties of this estimation can usually produce 15% error, but it could even be bigger if the weather or the watercourse is unfavourable. Since these discharge estimations were infrequently repeated, the so called QH curves are themselves not very reliable.

Summary

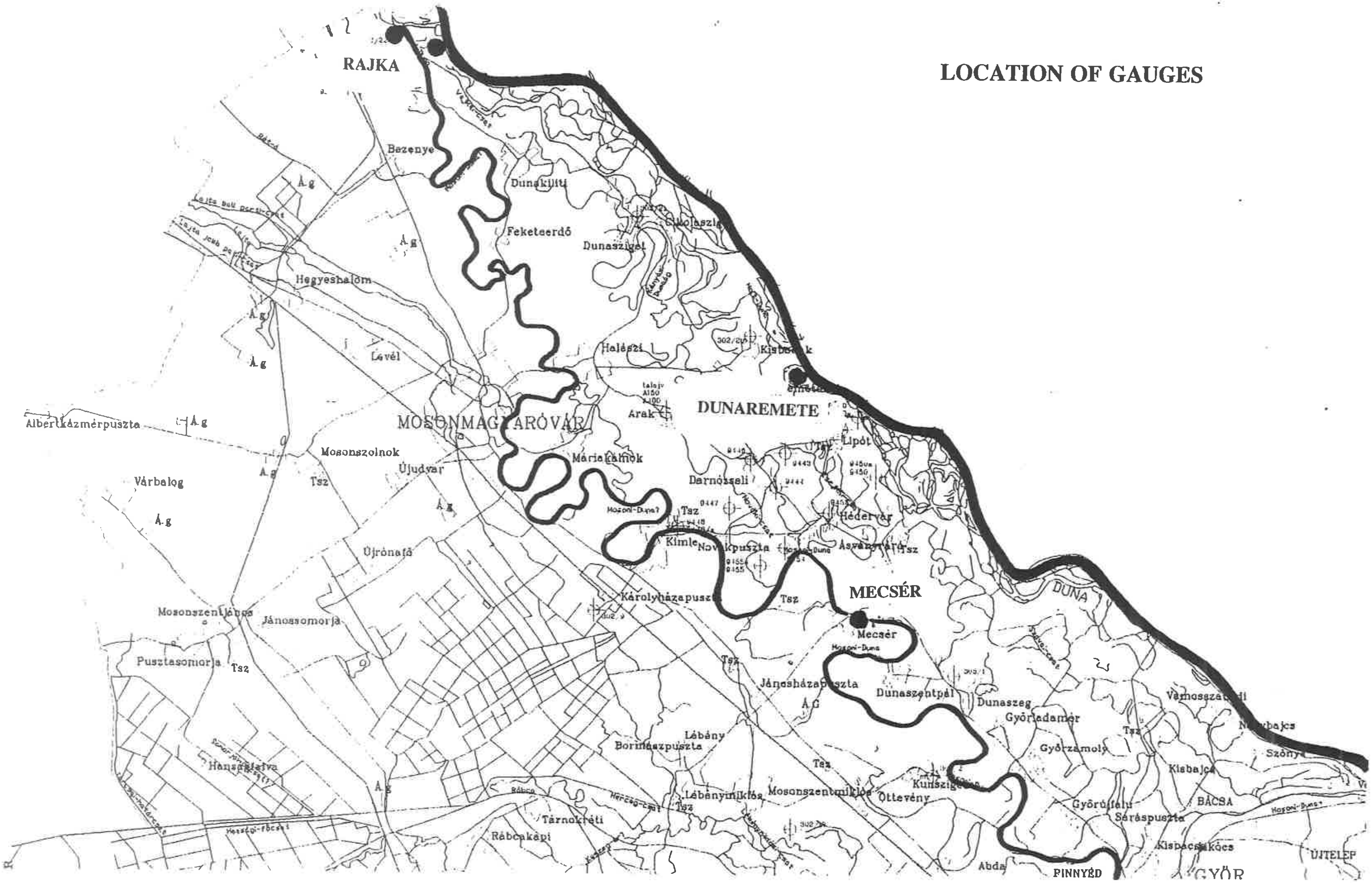
After the closure of Danube at Cunovo, the minimum surface water level values decreased by 240 and 200 cm at Rajka and Dunaremete respectively. An important additional change is the usually rapid water level fluctuation due to opening and closing of the various gates at Cunovo.

This causes sudden inundation or draining of the branches making local navigation difficult or impossible. Isles and holms of the river-branch system are now risky to access.In the last 12 months the flood waves often created 3-4 meter water level increase within a couple of hours.

Downstream Sap the most important feature is the occurance of artificial floods made by the Gabcikovo Power Plant. Rapid change in turbine operation causes large floodwaves in the downstream canal, the effect of which can be observed in some ten kilometer distance downstream the river. Upstream Sap in the old river bed the water often flows backwards several kilometer long.

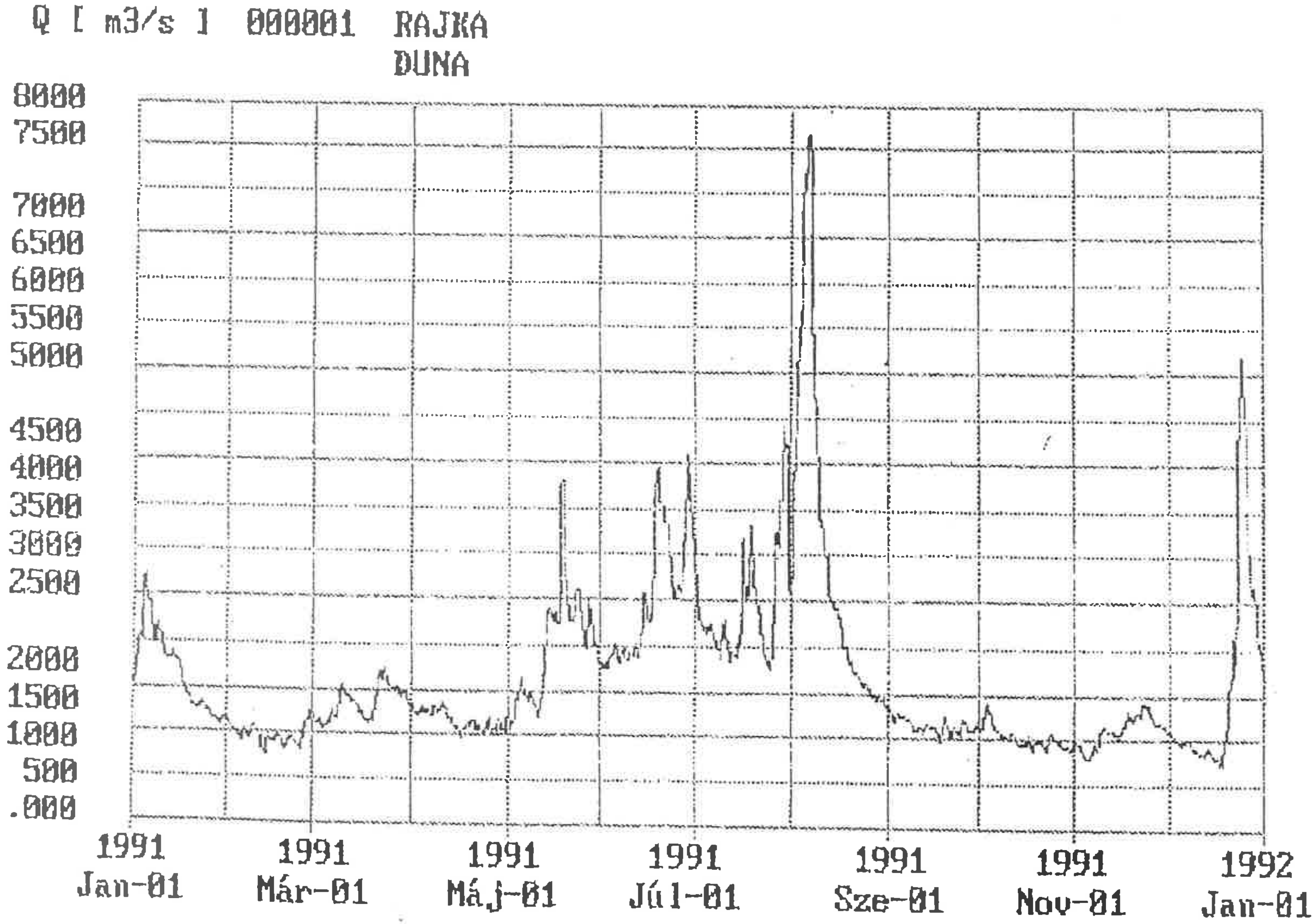
For the most part of the year the river in the Szigetköz receives unusually low water discharge (200-300 m^3/sec). In case of flood however, within a period of a half day it can switch to 2000-3000 m^3/sec. This rapid change deformates the river bed, while the long lasting dry parts of the river bed is getting covered with weedy vegetation. This in turn can influence the flow velocities, thus changing the dynamic character of the river at certain places.

LOCATION OF GAUGES



MONTHLY AND YEARLY AVERAGE OF DISCHARGE

		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	
RAJKA KÖQ (m^3/s)	1991.	1670	992	1350	1150	1990	2540	2520	3060	1140	1030	1110	1680	1690
	1992.	1370	1500	2200	2380	2620	2160	1660	1220	1160	866	555	743	1540
	1993.		225	420	294	354	347	731	314					
DUNAREMETE KÖQ (m^3/s)	1991.	1670	978	1320	1140	1980	2520	2530	3080	1130	1010	1080	1590	1680
	1992.	1420	1530	2190	2410	2630	2180	1720	1260	1180	890	604	788	1570
	1993.	298	238	467	319	370	382	789	362					
KOMÁROM KÖQ (m^3/s)	1991.	1830	1050	1450	1220	2120	2640	2660	3260	1140	1030	1280	1670	1790
	1992.	1580	1690	2450	2660	2860	2340	1750	1200	1150	1110	2270	2470	1960
	1993.	1760	1480	2100	2270	1950	1950	2660	2140					
MOSONI-DUNA I. zsilip	1991.													
	1992.											27,7	12,9	
	1993.	11,1	8,98	13,2	12,1	19,9	20,9	22,8	22,6					



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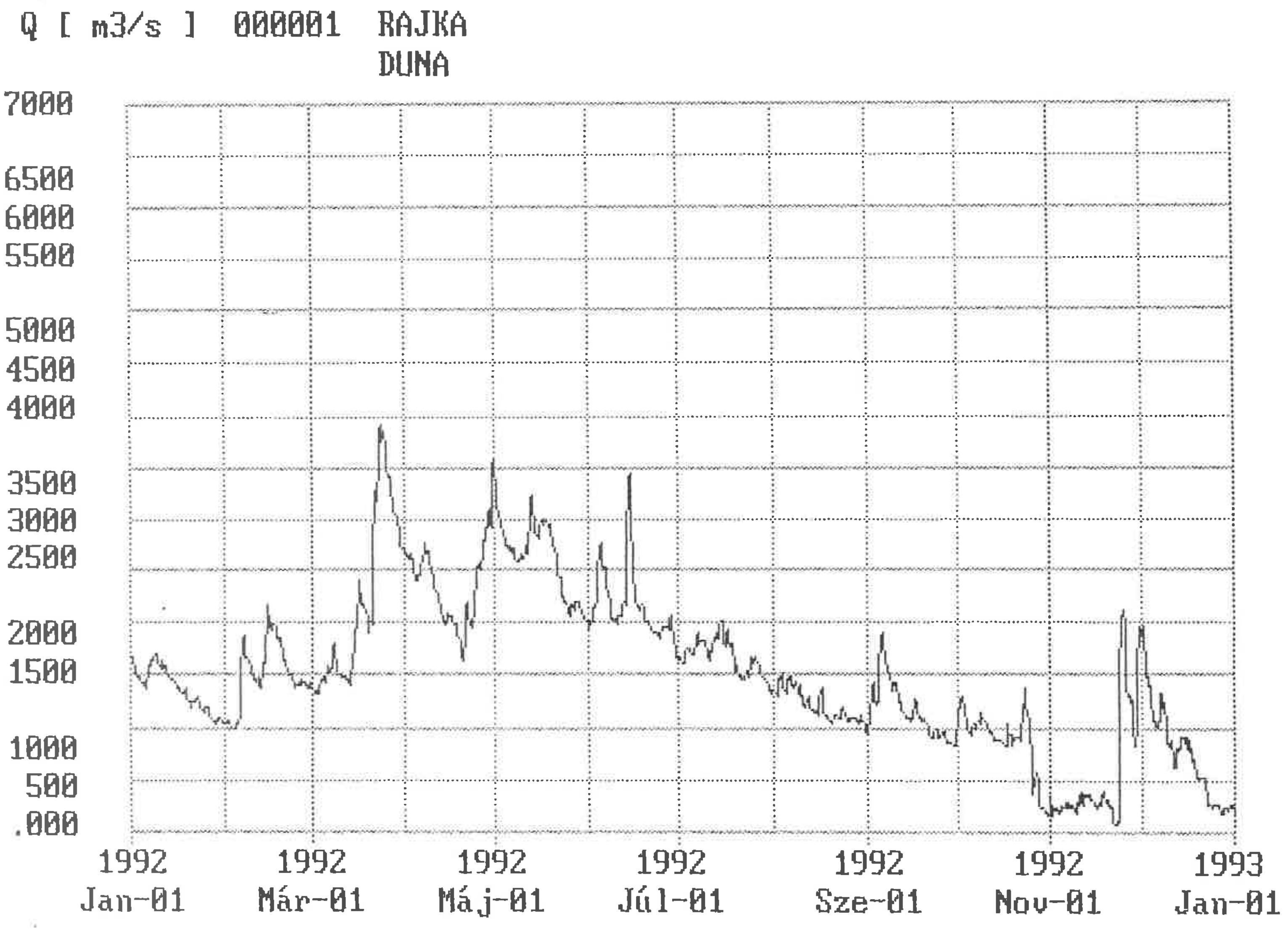
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
.000
1991 Jan-01
1991 Már-01
1991 Máj-01
1991 Júl-01
1991 Sze-01
1991 Nov-01
1992 Jan-01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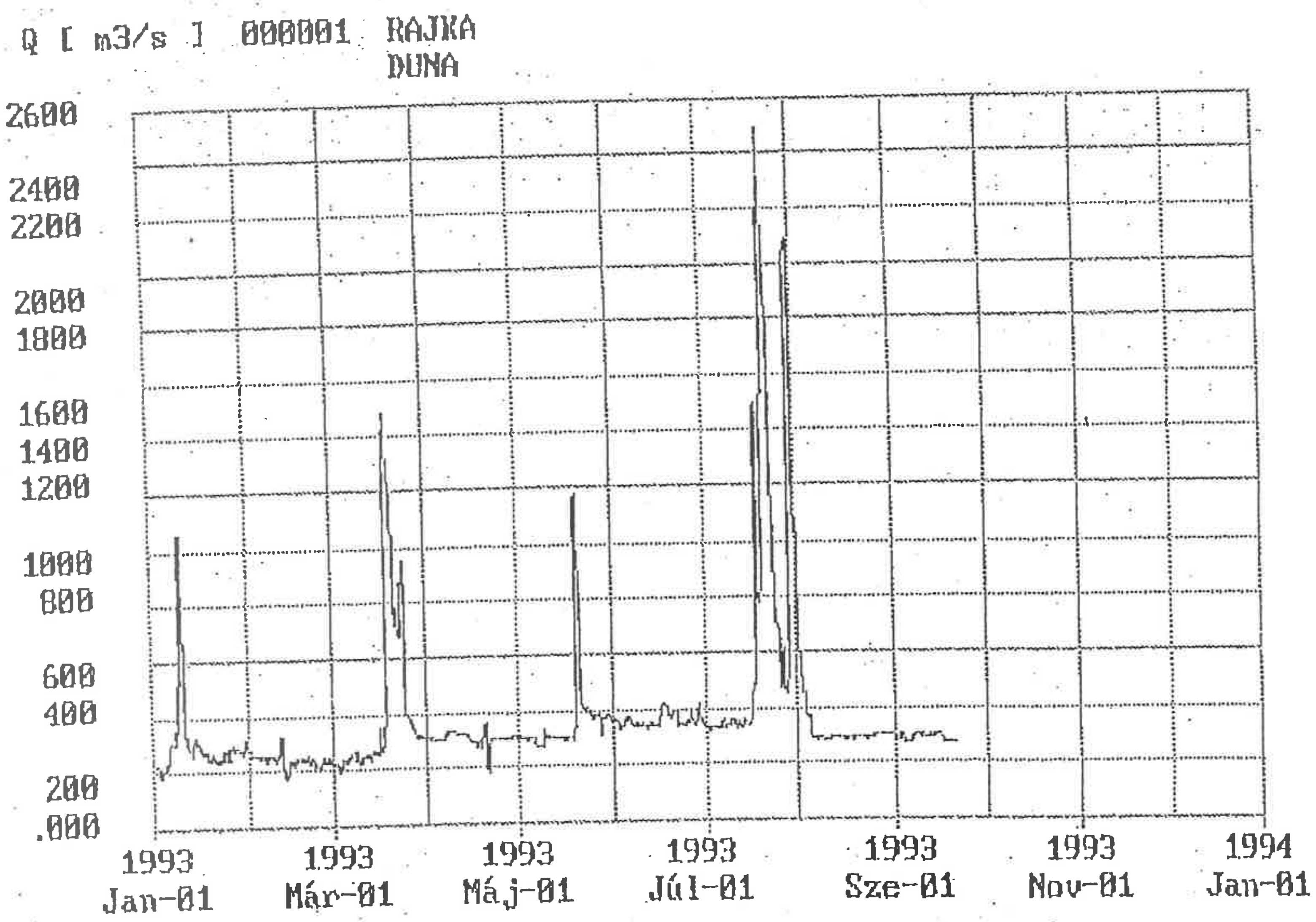
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
.000
1992 Jan-01
1992 Már-01
1992 Máj-01
1992 Júl-01
1992 Sze-01
1992 Nov-01
1993 Jan-01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2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
.000
1993
Jan-01
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Már-01
1993
Máj-01
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Júl-01
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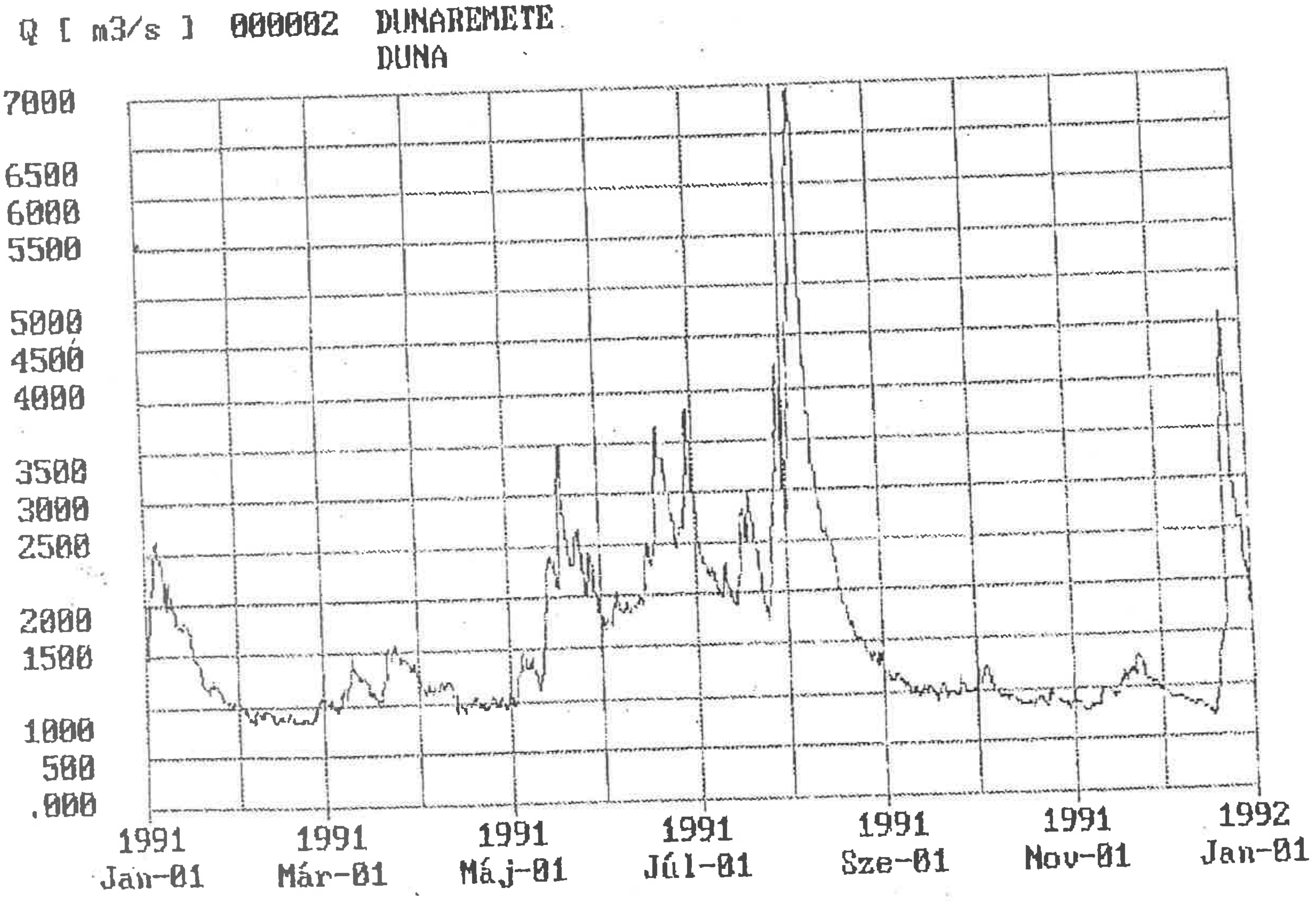
Sze-01
1993
Nov-01
1994
Jan-01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1991 Jan-01
1991 Már-01
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1991 Júl-01
1991 Sze-01
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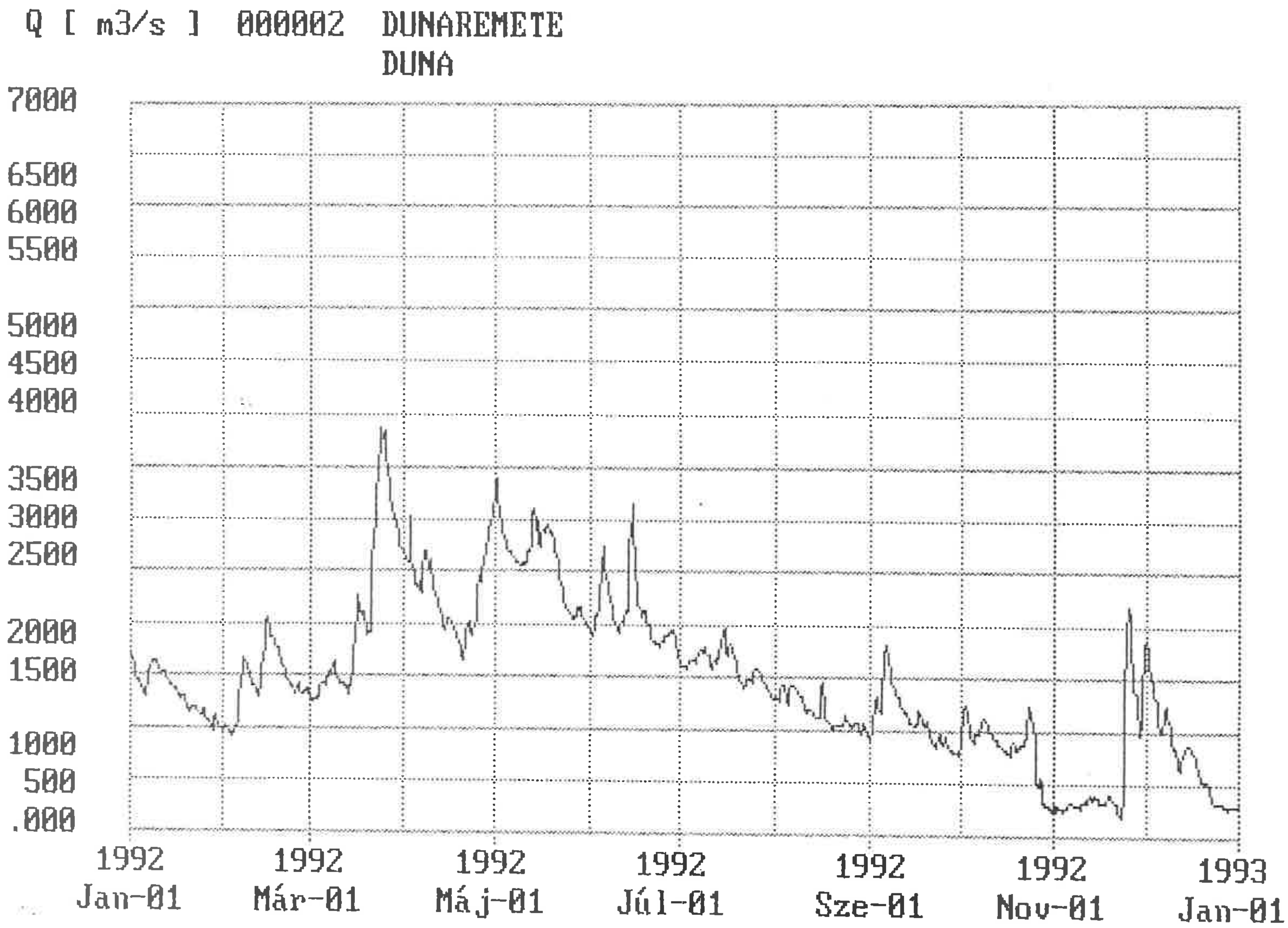
1992 Jan-01



Q [m3/s] 000002 DUNAREMETE
DUNA
7000
6500
6000
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3500
3000
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2000
1500
1000
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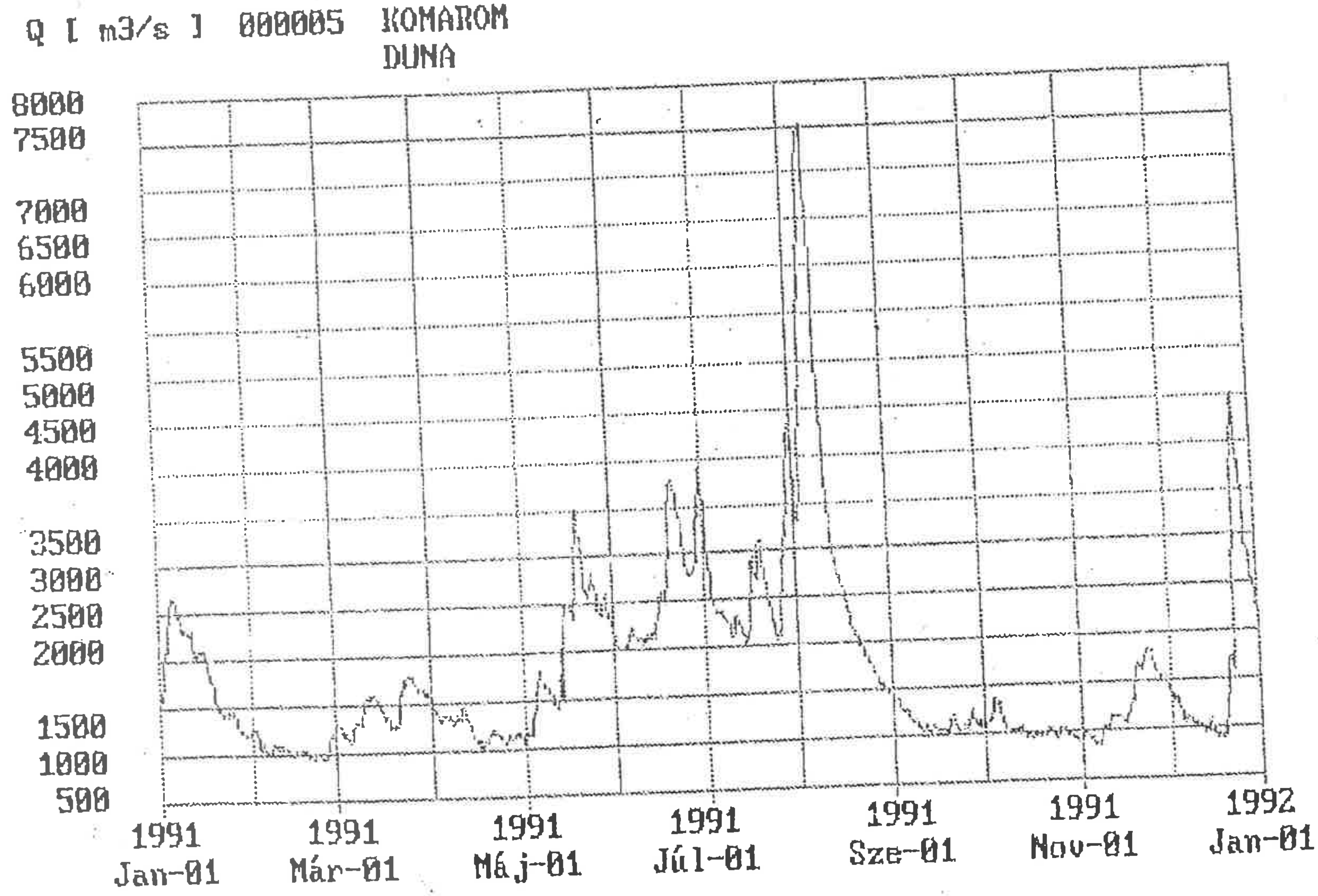
1992 Jan-01
1992 Már-01
1992 Máj-01
1992 Júl-01
1992 Sze-01
1992 Nov-01
1993 Jan-01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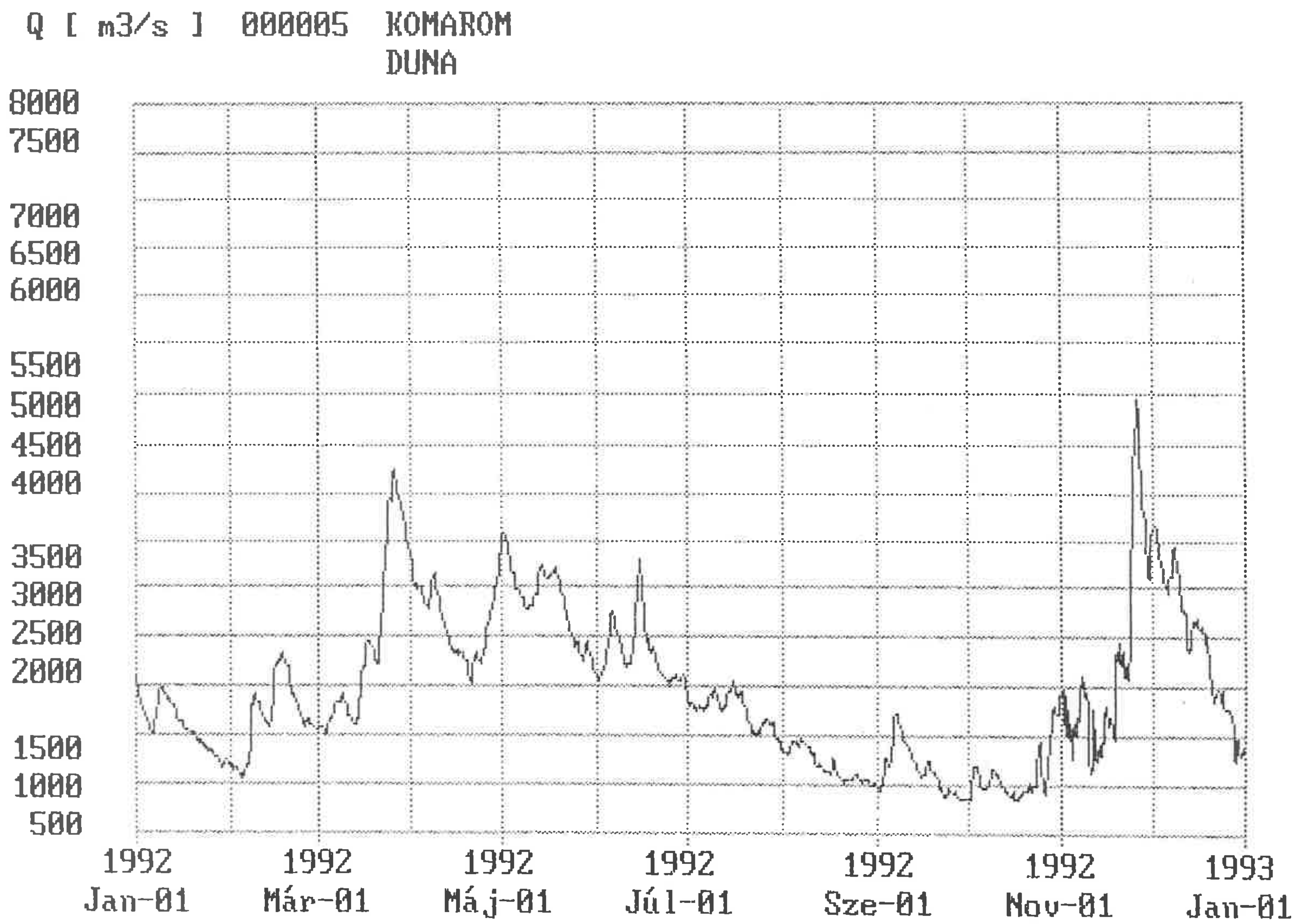
1991 Sze-01
1991 Nov-01
1992 Jan-01



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DUNA
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7000
6500
6000
5500
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4500
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3500
3000
2500
2000
1500
1000
500
1992 Jan-01
1992 Már-01
1992 Máj-01
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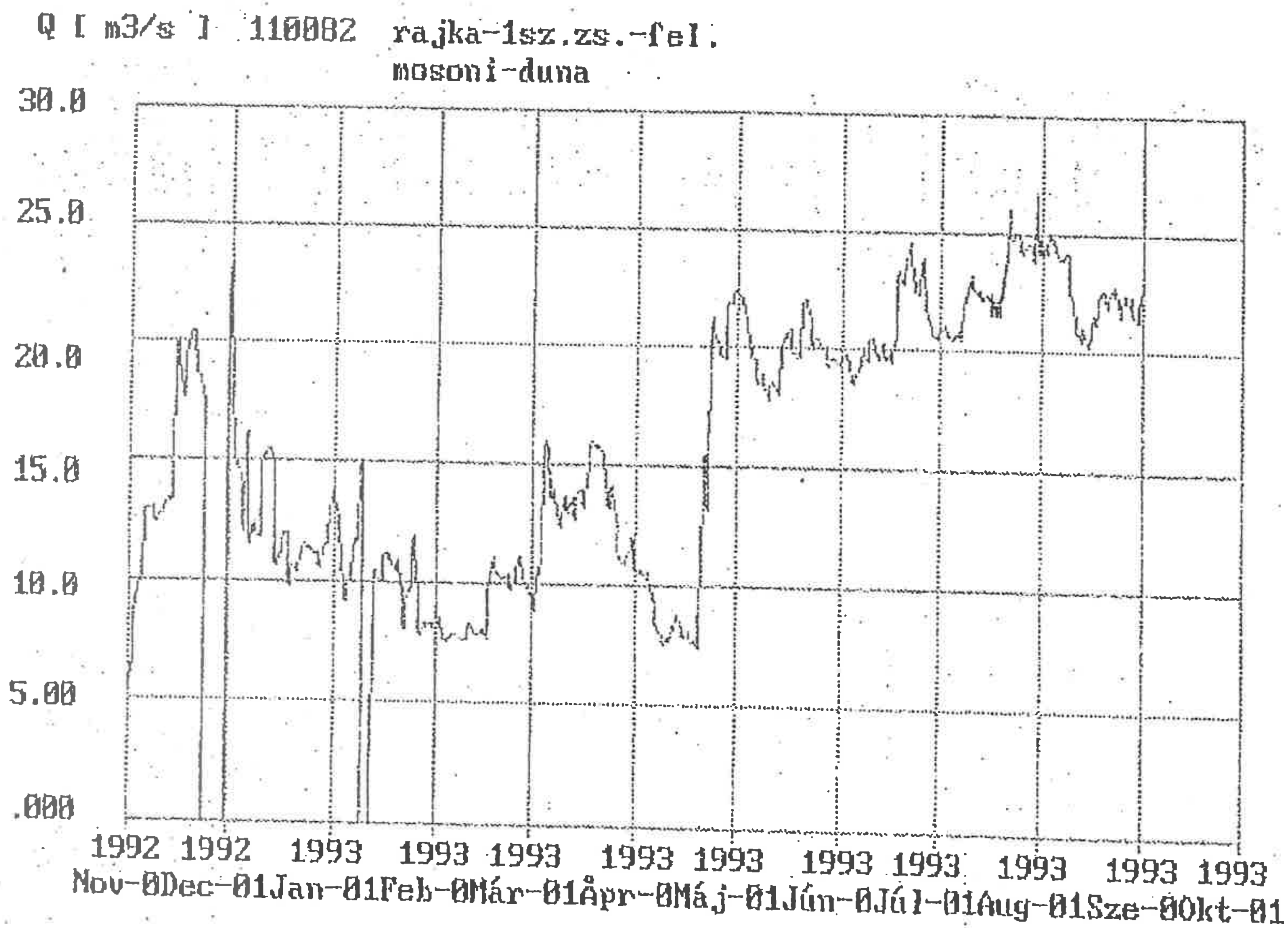
1992 Sze-01
1992 Nov-01
1993 Jan-01

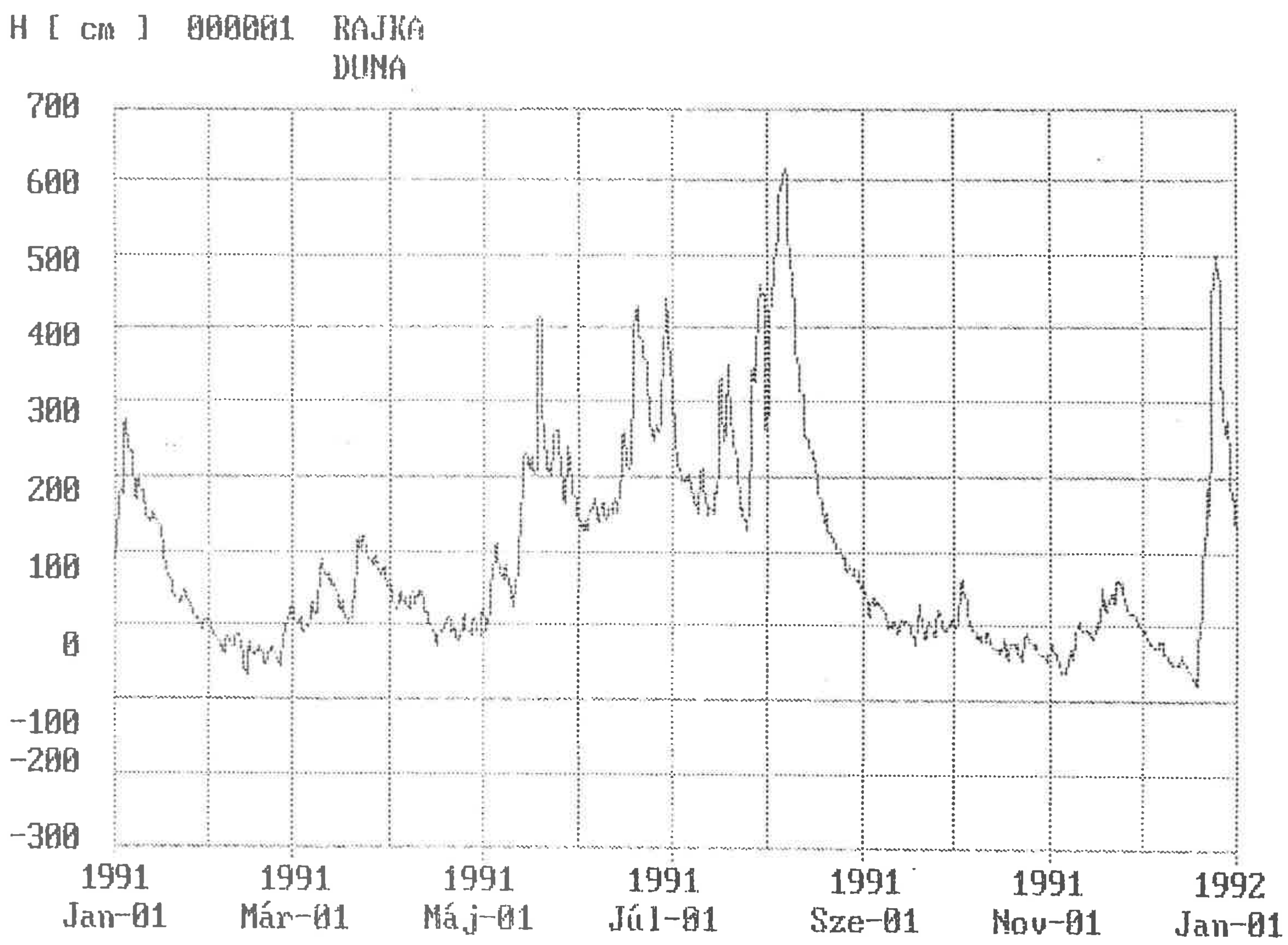


Q [m3/s] 110082 rajka-1sz.zs.-fel.
mosoni-duna
30.0
25.0
20.0
15.0
10.0
5.00
.000
1992 1992 1993 1993 1993 1993 1993 1993 1993 1993 1993 1993
Nov-0Dec-01Jan-01Feb-0Már-01Ápr-0Máj-01Jún-0Júl-01Aug-01Sze-0Okt-01

MONTHLY AND YEARLY AVERAGE OF WATER LEVEL

			I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	
RAJKA	1991.	KV.	- 4	- 65	- 8	- 28	- 10	128	130	48	- 25	- 46	-62	- 75	- 75
		KÖV	105	- 27	49	9	157	239	237	256	7	- 18	0	77	92
		NV.	275	25	122	49	415	442	462	616	54	62	63	503	616
	1992.	KV.	-14	- 30	44	105	168	108	48	-28	- 69	- 268	-314	-253	-314
		KÖV	54	77	186	223	259	191	110	23	9	- 63	-162	-103	67
		NV.	116	196	412	381	358	366	170	80	150	58	158	130	412
	1993.	LV.	-269	-273	-262	-268	-235	-214	-216	-230					
		KÖV.	-226	-247	-189	-222	-201	-204	-116	-216					
		NV.	- 18	-217	58	-202	223	-184	220	- 24					
DUNAREMETE	1991.	KV.	238	192	223	213	230	364	370	235	216	189	179	161	161
		KÖV.	340	212	284	247	378	439	444	451	245	219	233	233	316
		NV.	466	255	346	236	528	547	571	720	289	285	302	592	720
	1992.	KV.	220	211	279	353	394	352	286	217	177	19	- 1	34	- 1
		KÖV	291	309	390	432	455	410	342	263	247	187	112	161	
		NV.	359	408	534	505	511	497	397	318	376	280	424	385	534
	1993.	KV.	20	15	19	48	45	67	60	51					
		KÖV.	49	32	88	58	71	76	157	69					
		NV.	227	47	302	89	238	106	458	258					
MECSÉR MOSONI-DUNA	1991.	KV.	35	30	32	22	25	92	105	72	42	39	37	45	22
		KÖV.	77	33	47	31	85	136	137	193	57	44	49	72	81
		NV.	115	40	72	44	152	154	218	403	80	60	72	158	403
	1992.	KV.	56	54	46	70	94	100	54	31	25	25	61	70	
		KÖV	75	72	65	88	103	128	84	41	33	32	151	87	
		NV.	126	107	102	114	123	178	106	52	51	37	26	111	
	1993.	KV.	55	41	45	52	89	91	88						
		KÖV	66	55	68	72	96	100	115						
		NV.	76	64	113	103	101	115	153						

KEY 'KV.' : min, 'KÖV' : mean, 'NV' : max


H [cm]
000001
RAJKA
DUNA
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600
500
400
300
200
100
0
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-200
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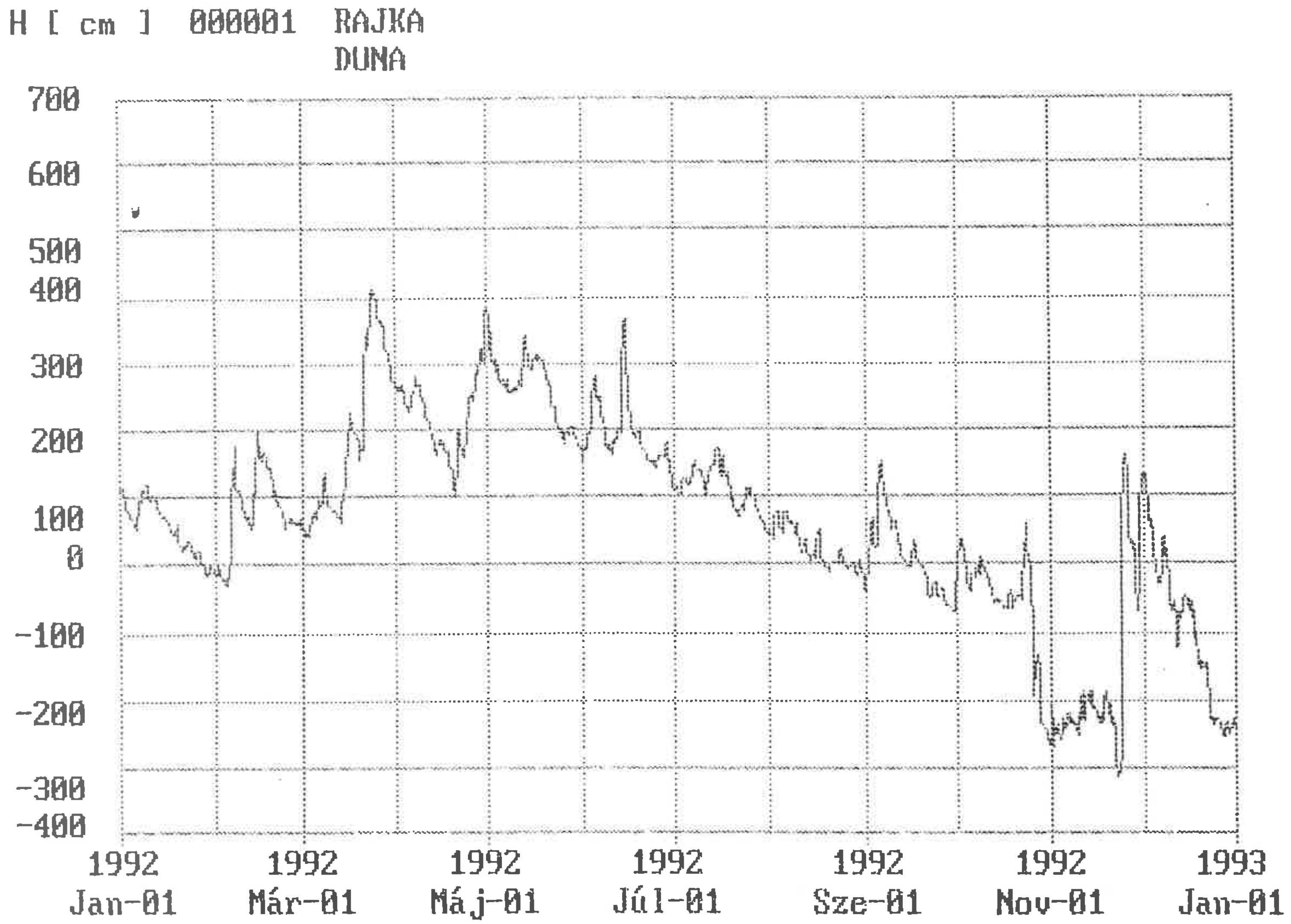
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1992 Júl-01
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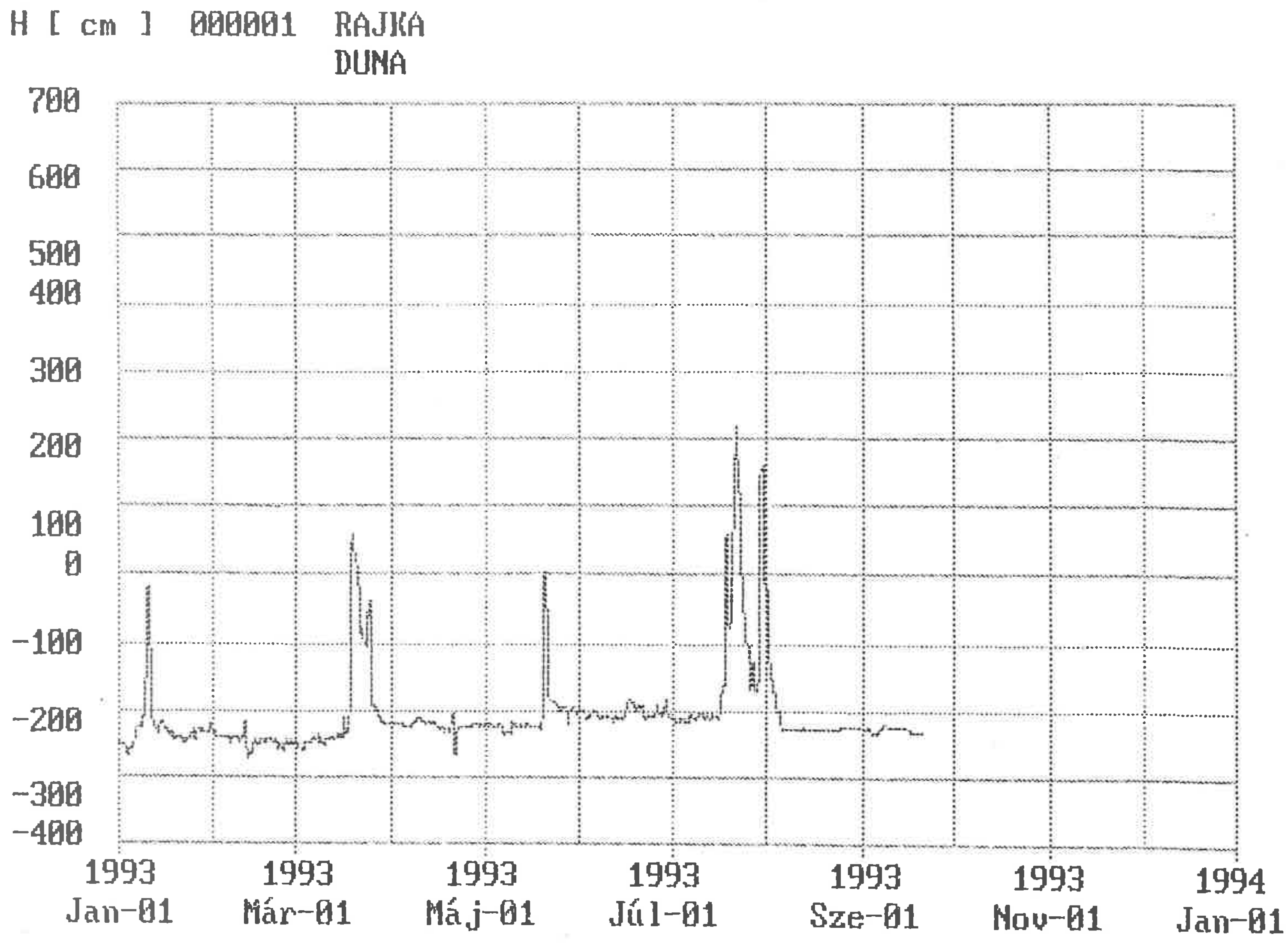
1993 Jan-01


H [cm] 000001 RAJKA
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200
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1993 Jan-01
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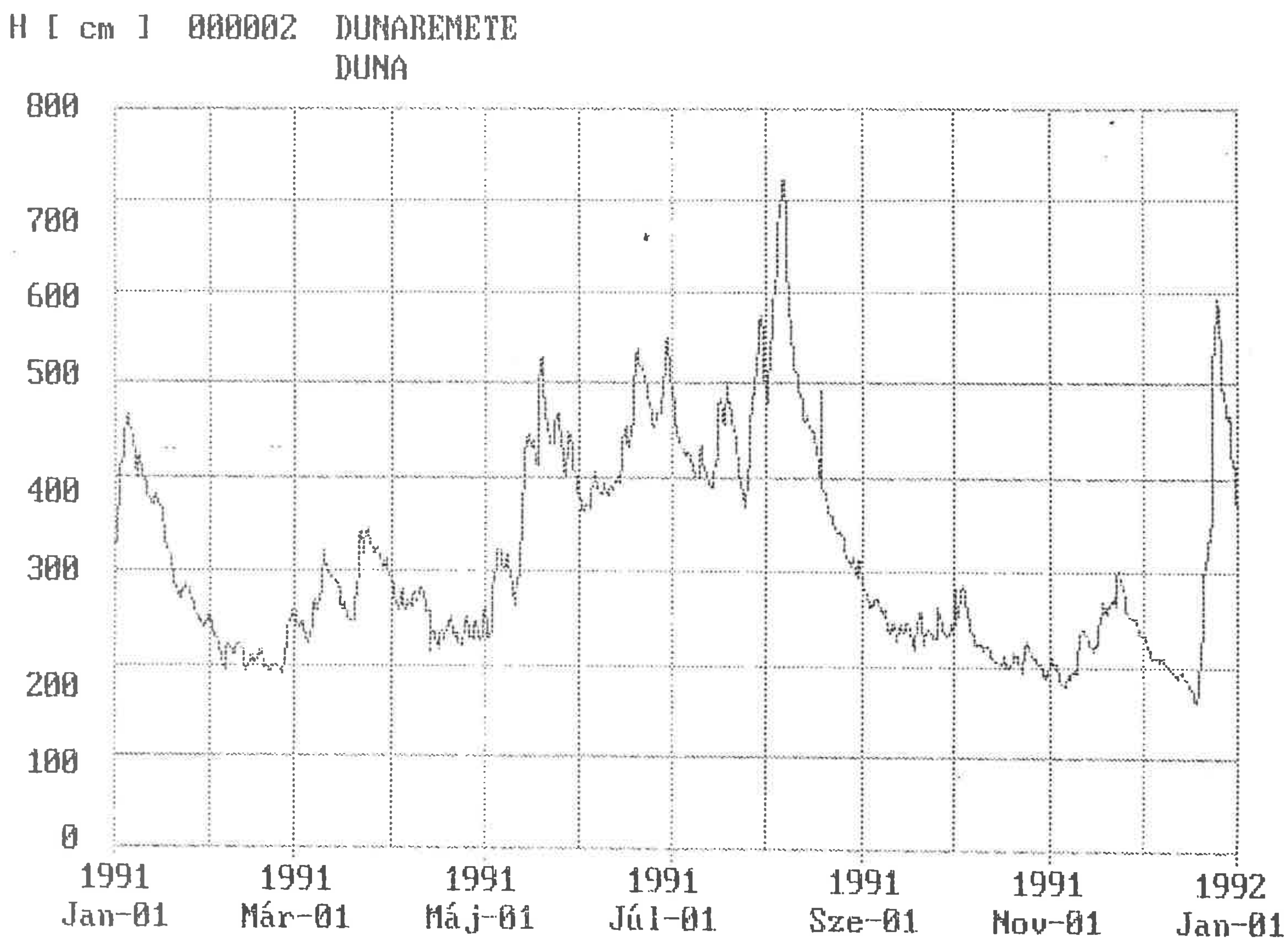
1993 Máj-01
1993 Júl-01
1993 Sze-01
1993 Nov-01
1994 Jan-01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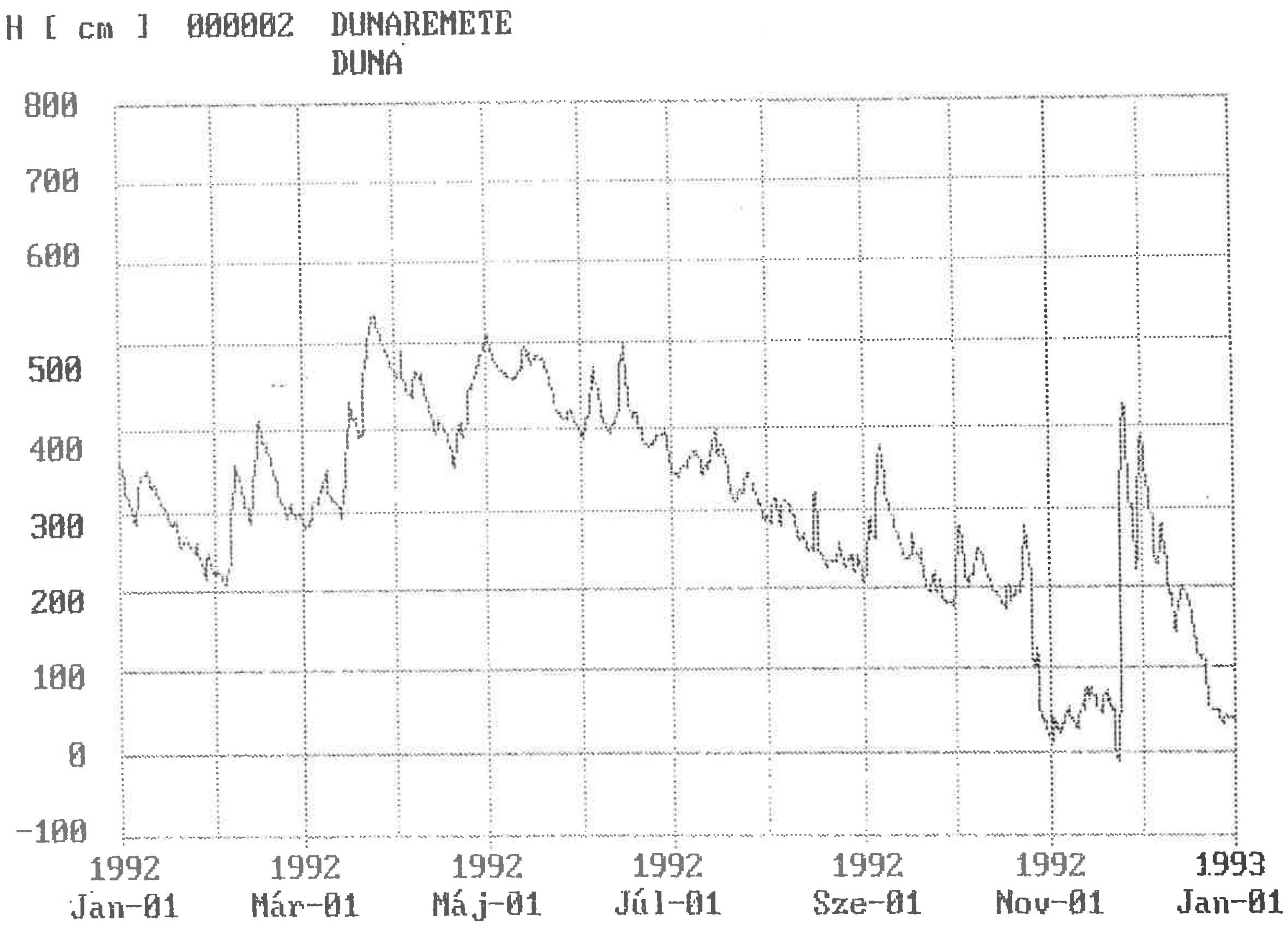
1992 Jan-01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1992 Már-01
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1992 Júl-01
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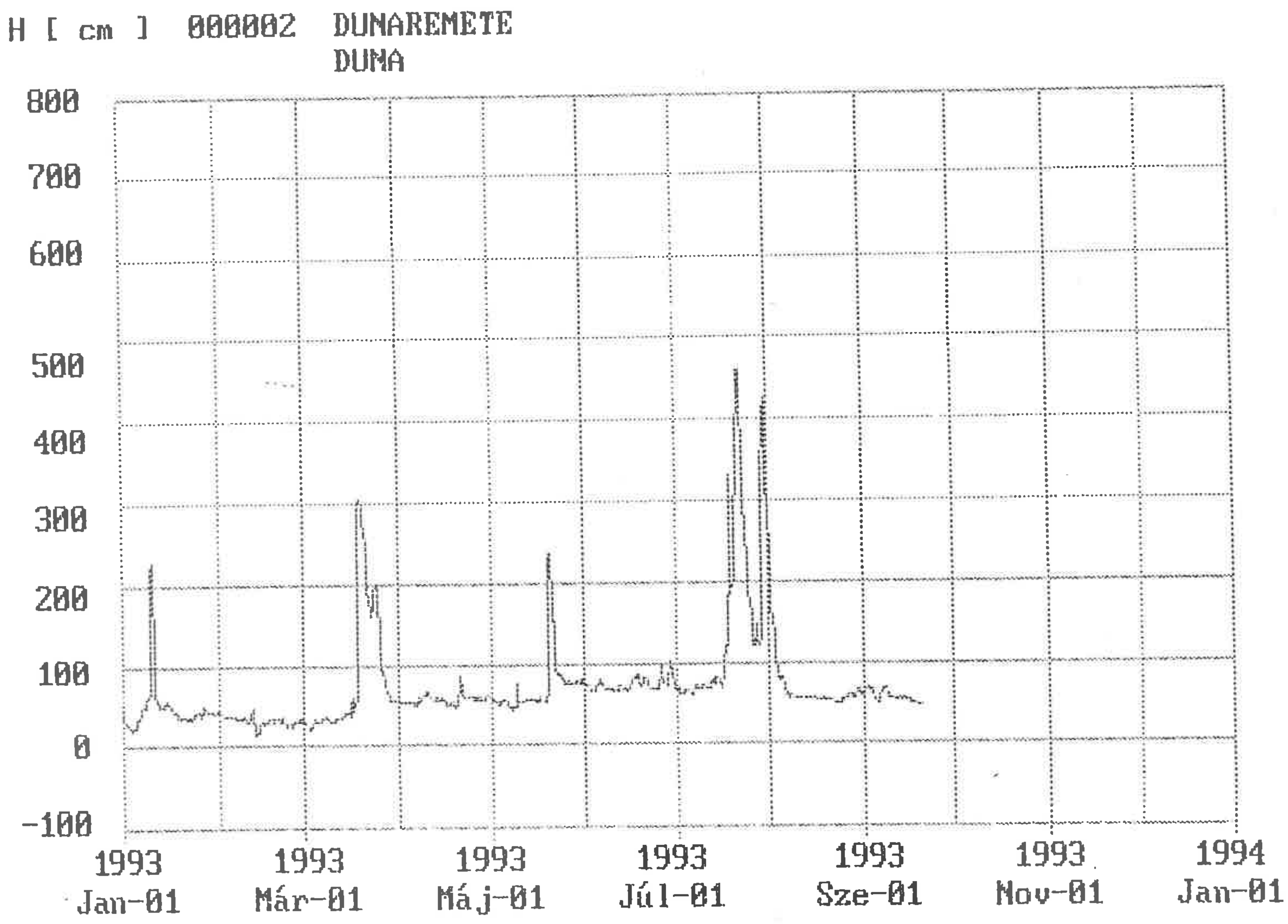
1992 Nov-01
1993 Jan-01



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700
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500
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300
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1993 Jan-01
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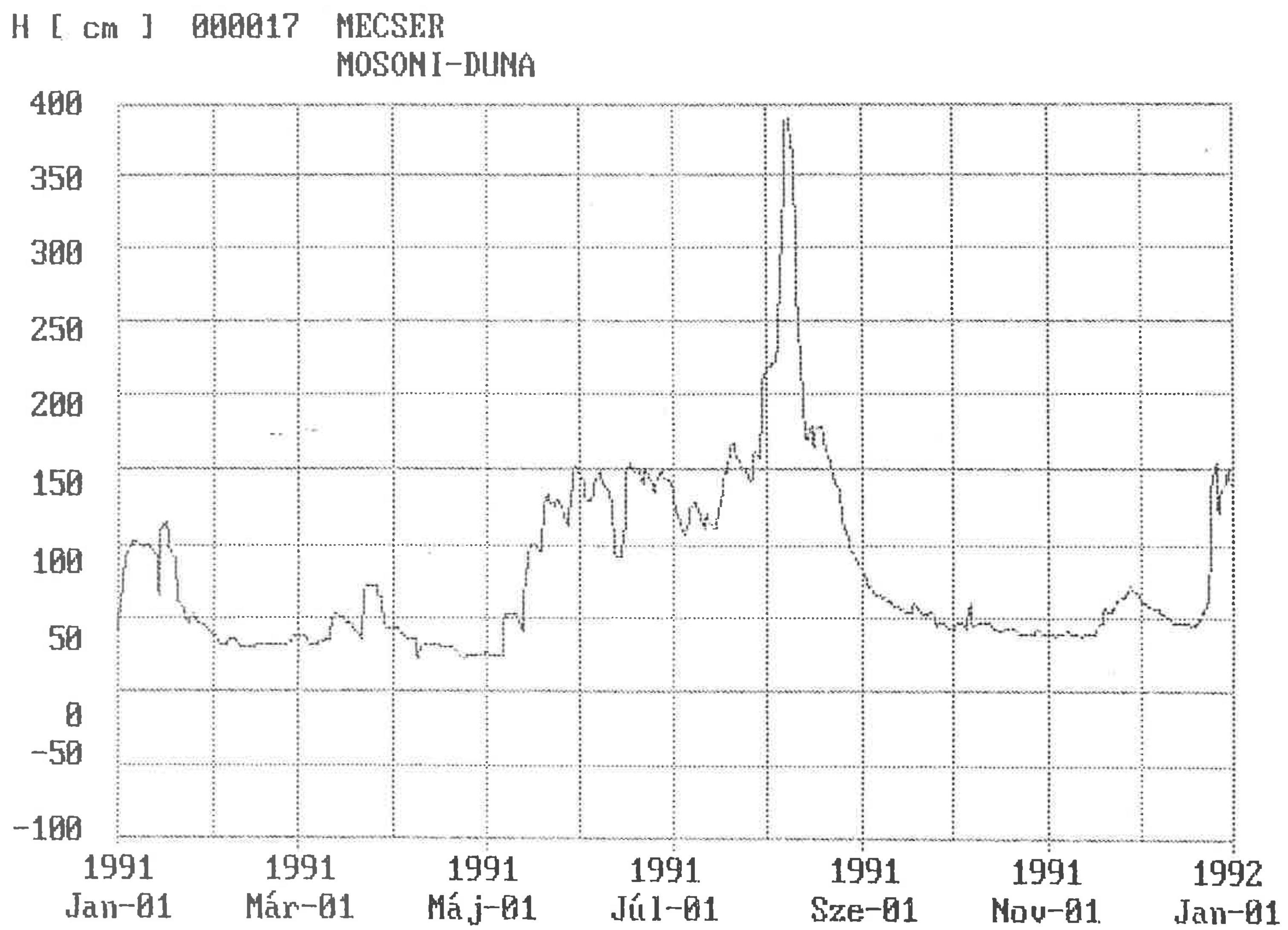
1993 Nov-01
1994 Jan-01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200
150
100
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0
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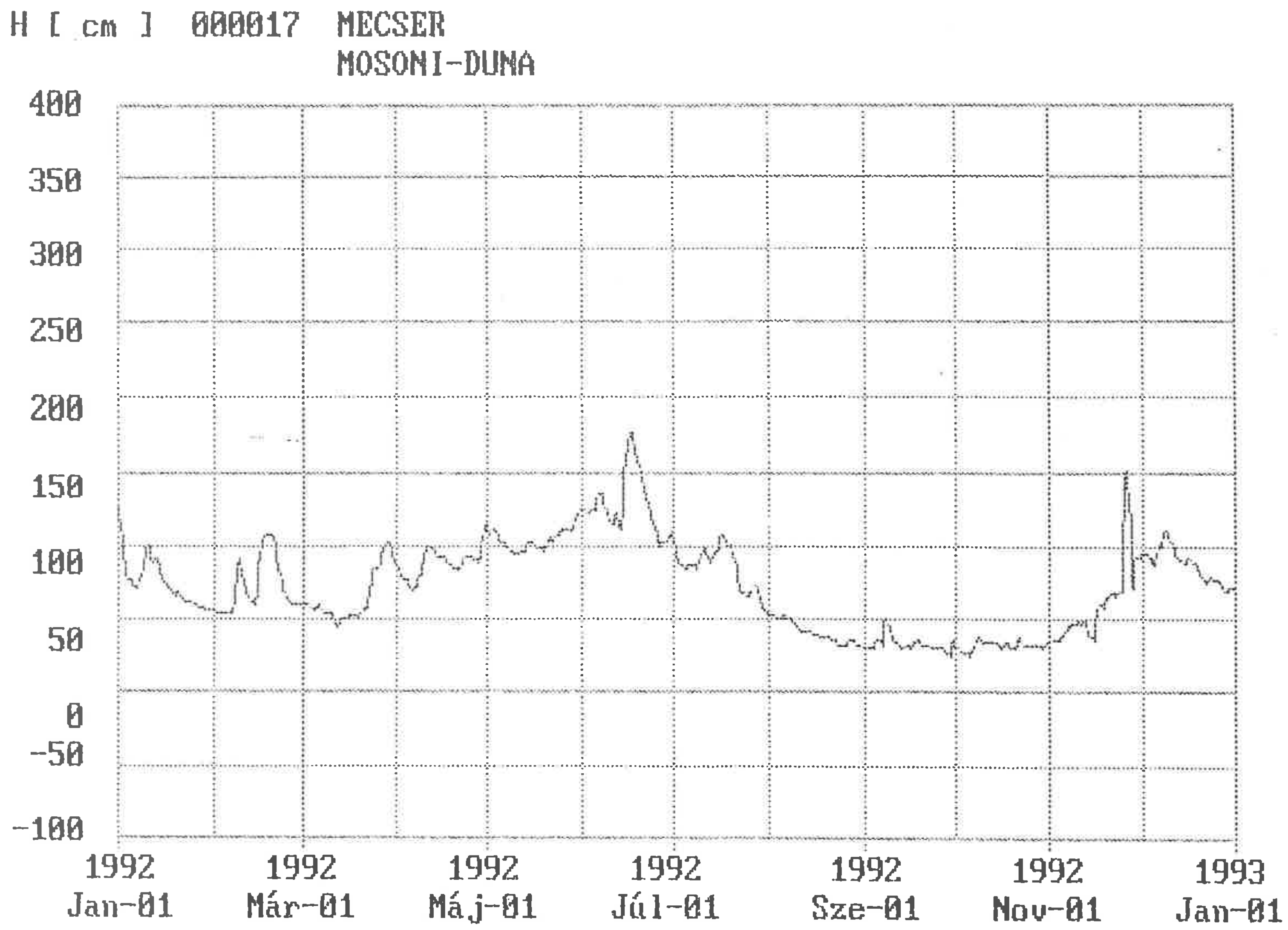
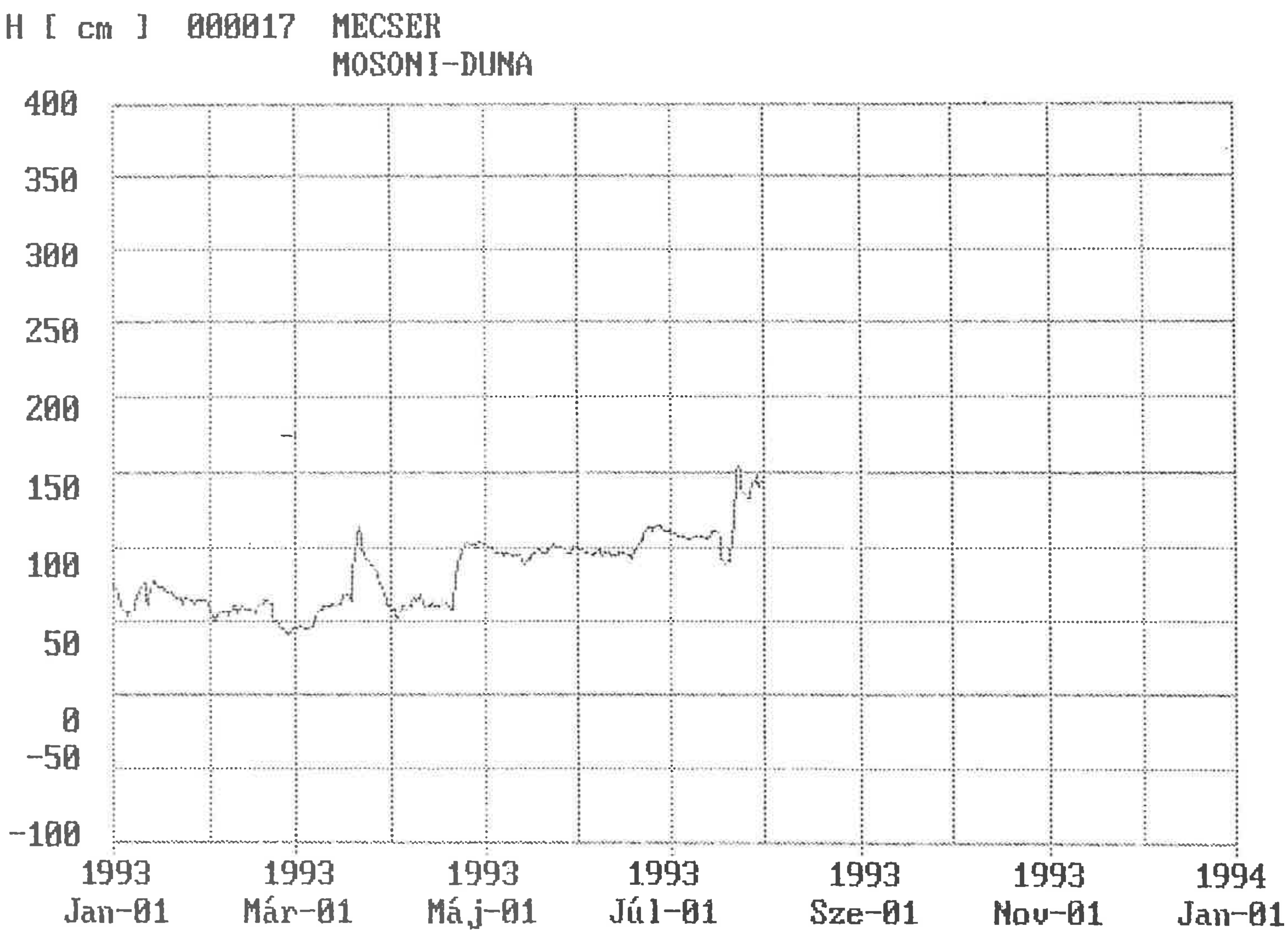
1991 Jan-01
1991 Már-01
1991 Máj-01
1991 Júl-01
1991 Sze-01
1991 Nov-01
1992 Jan-01


H [cm] 000017 MECSER
MOSONI-DUNA
400
350
300
250
200
150
100
50
0
-50
-100
1992 Jan-01
1992 Már-01
1992 Máj-01
1992 Júl-01
1992 Sze-01
1992 Nov-01
1993 Jan-01


H [cm]   000017   MECSER
MOSONI-DUNA
400
350
300
250
200
150
100
50
0
-50
-100
1993 Jan-01
1993 Már-01
1993 Máj-01
1993 Júl-01
1993 Sze-01
1993 Nov-01
1994 Jan-01

GROUND WATER LEVEL

GROUND WATER LEVEL

The graphs presented illustrate the drastic reduction of the ground water levels. Only in the vicinity of the reservoir is the situation different. Particularly important feature is the absence of long lasting high values in the summer period. In the middle part of Szigetköz the summer maximum of the ground water level decreased by 1,5-2 m. This is the main source of decline in agricultural and forestry productivity.

Evaluation of the ground water changes

Characterization of ground water level changes for longer period (weeks, months) can be demonstrated by the Danube - ground water level function. The so called standardized water level - time correlation in the case of the Danube and in the wells shows linear function. The attached eight figures illustrate the simplicity and reliability of the method.

The standard value is

$$W(t) = [\, w(t) - w_m \,] \,/\, w_s \ ,$$

where

- $w(t)$: the actual water level,
- w_m : the mean of the measurements,
- w_s : estimated standard deviation.

Fig.2 shows how the standard values of the water- levels taken from Fig.1 fit up to the date of damming. In order to get a clearer graph smoothed curves are presented. This has been created by calculating central moving averages from the daily measurements. The effect of smoothing is illustrated by Fig. 3. Fig 4. shows the remarkable matching of the water levels of Danube and that of the ground water. (Each well in Szigetköz shows the same strong correlation. The time lag has been omitted in the calculations, since its effect is negligible on this scale. From April 1993 onwards the Bratislava values were calculated from actual measurements at Devin.)

The above equation can be used to construct models for temporal change of ground water levels in Szigetköz in the supposed absence of variant C. The locations of the three selected wells are illustrated on Fig.5. It can be seen that the three wells continuously exhibit lower ground water levels as compared with the hypothetic non-deviated Danube situation. Close to the main river bed (Lipot and Rajka, Fig.6 and 7), the difference is around 2 m, while in 4 km distance (Darnózseli, Fig.8) it is roughly 0,4 m.

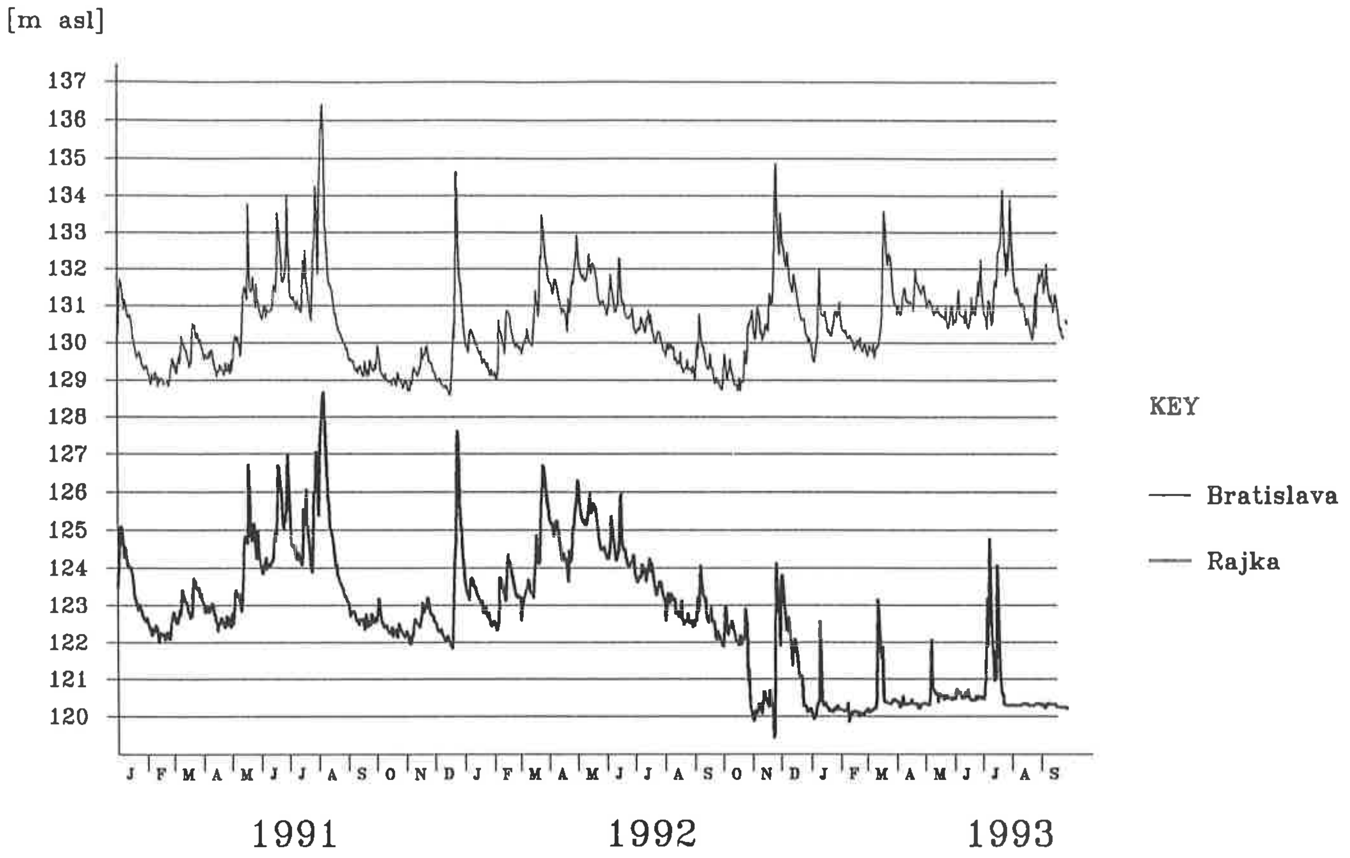


Fig. 1 Water Level of Danube

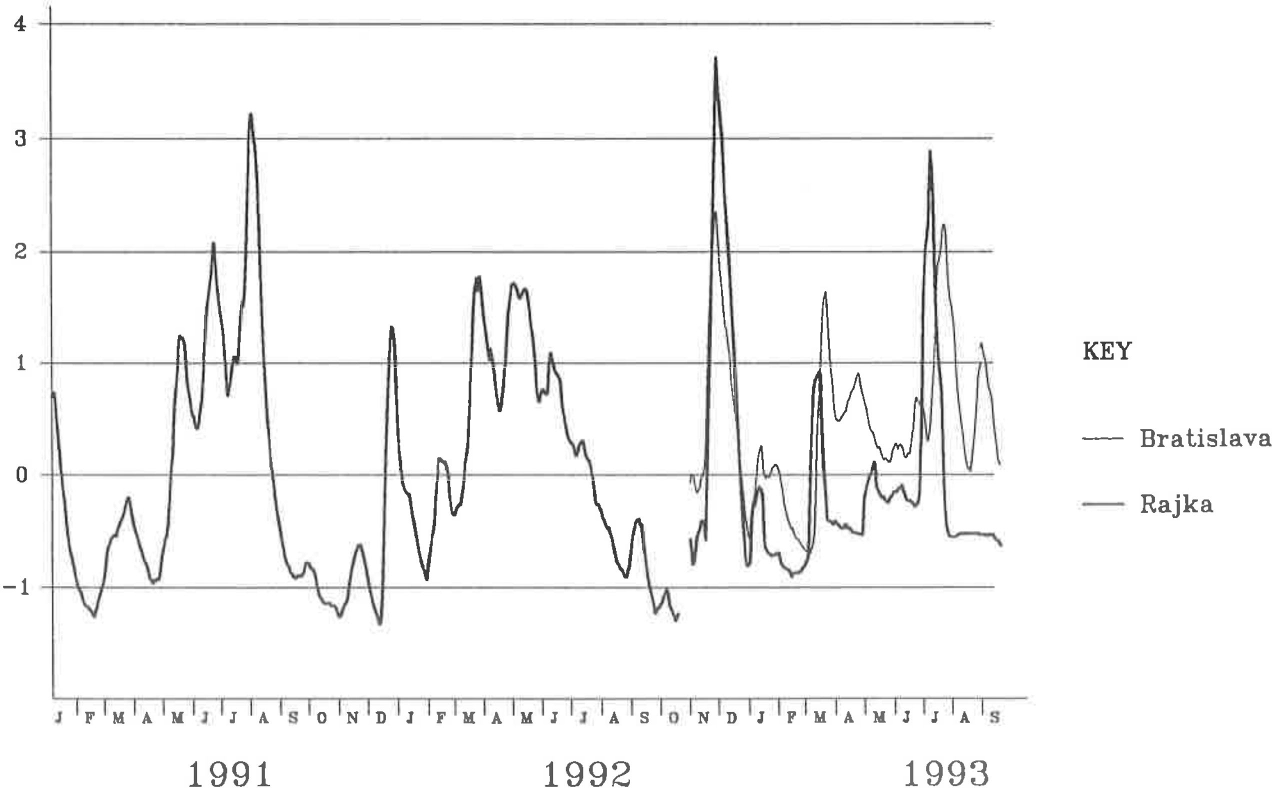


Fig. 2 Standard Values

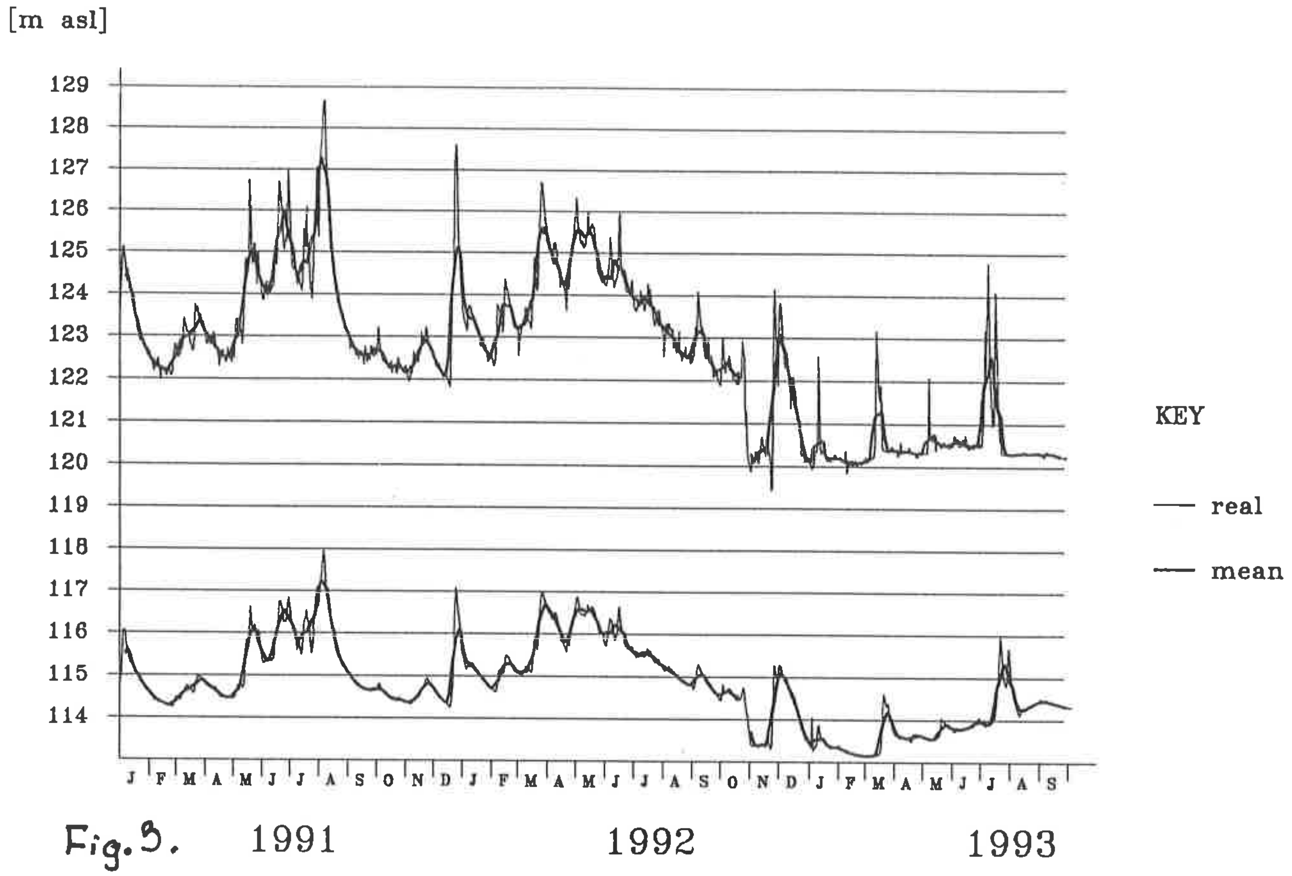


Fig.3.

Water Level - Rajka
Ground Water Level - Lipot

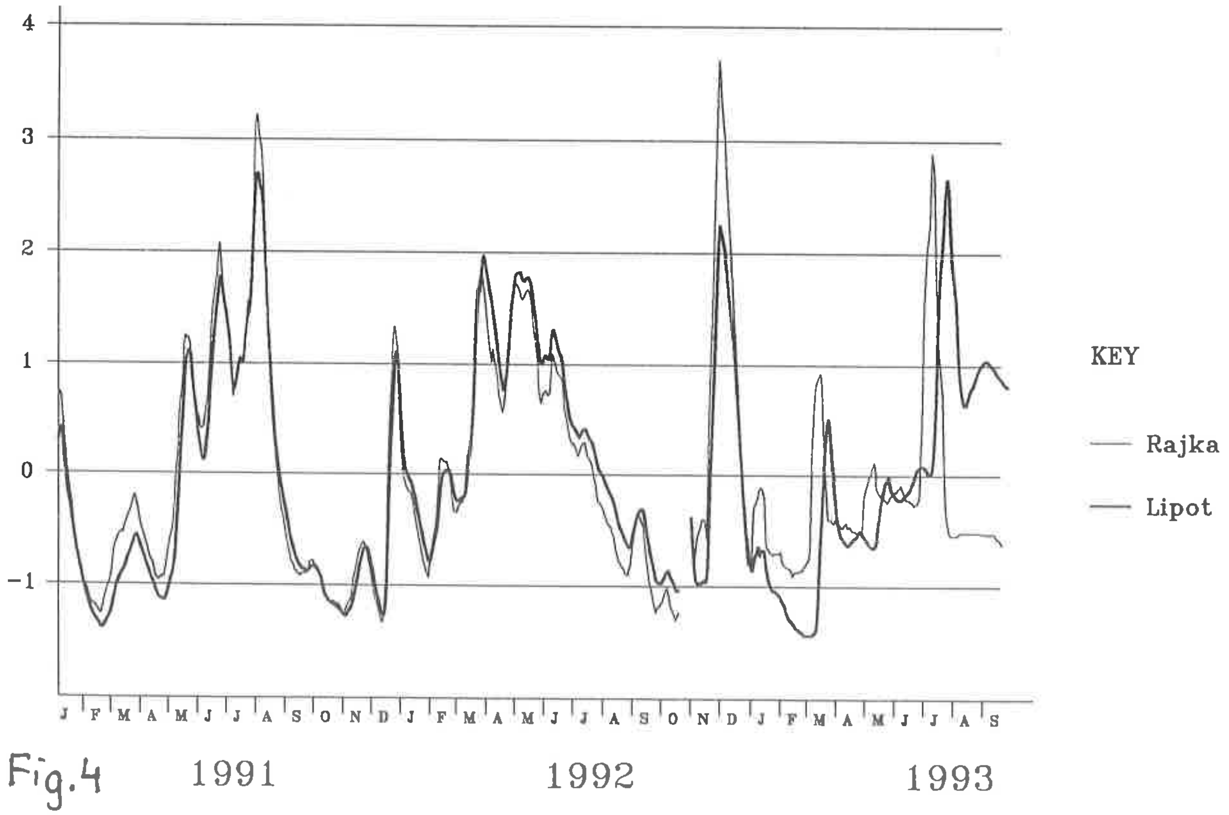


Fig.4

Standard Values

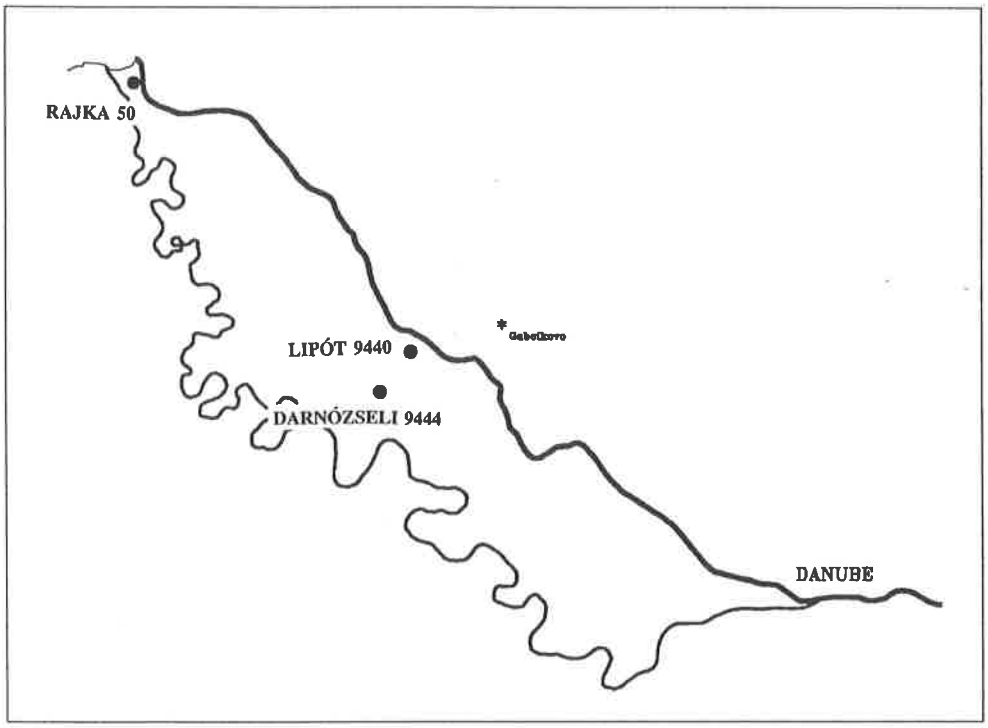


Fig. 5

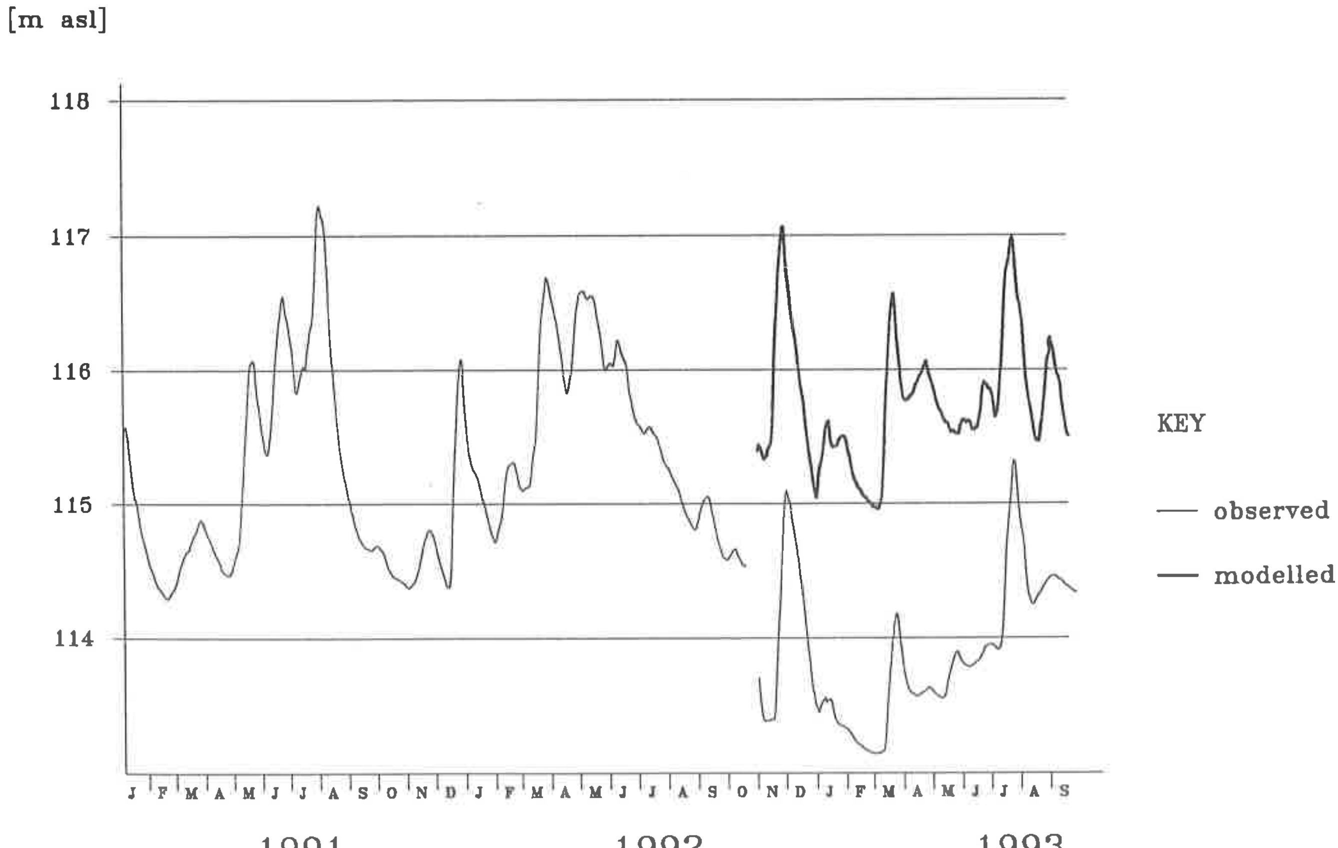


Fig. 6

Ground Water Level – Lipot

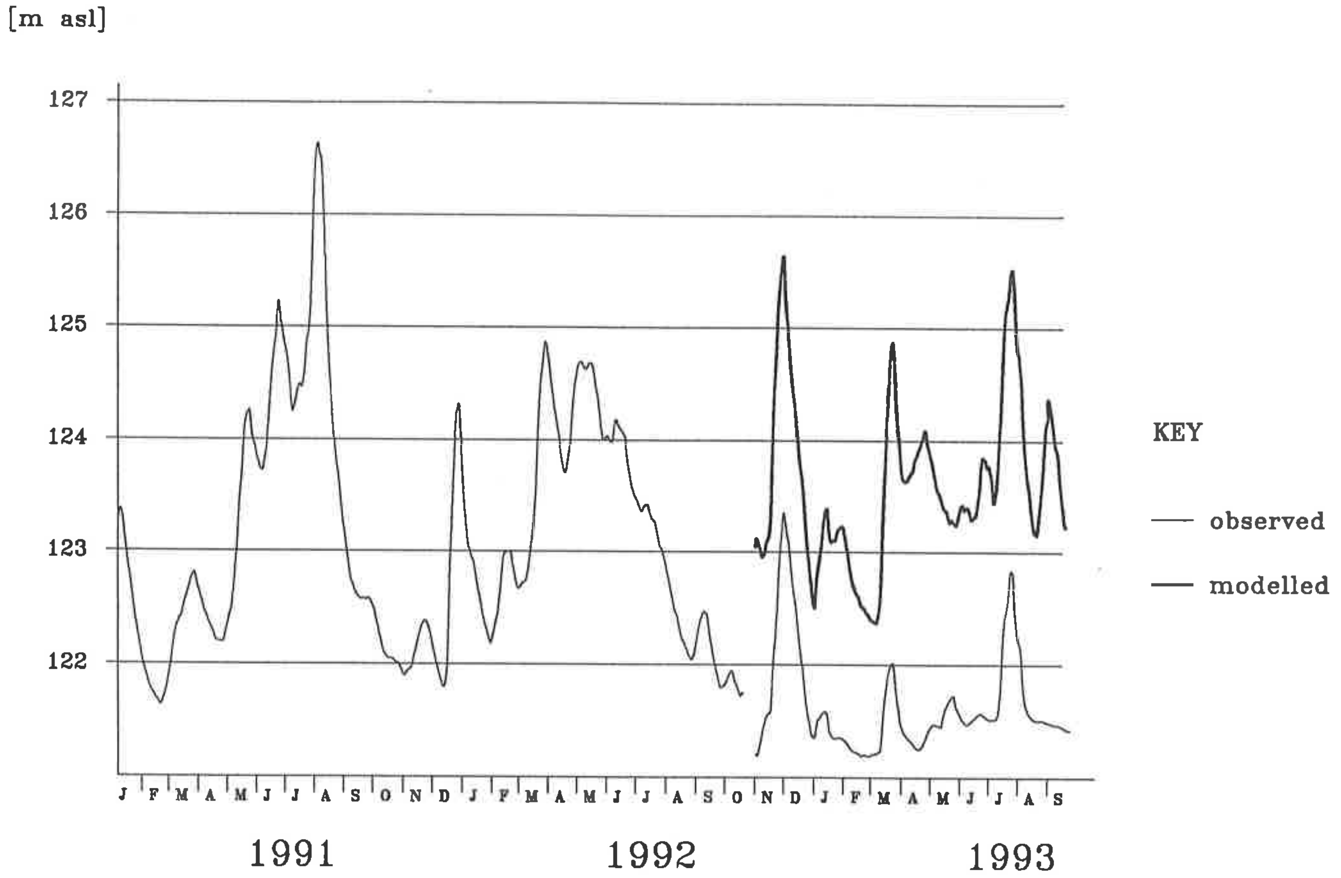


Fig. 7 Ground Water Level - Rajka

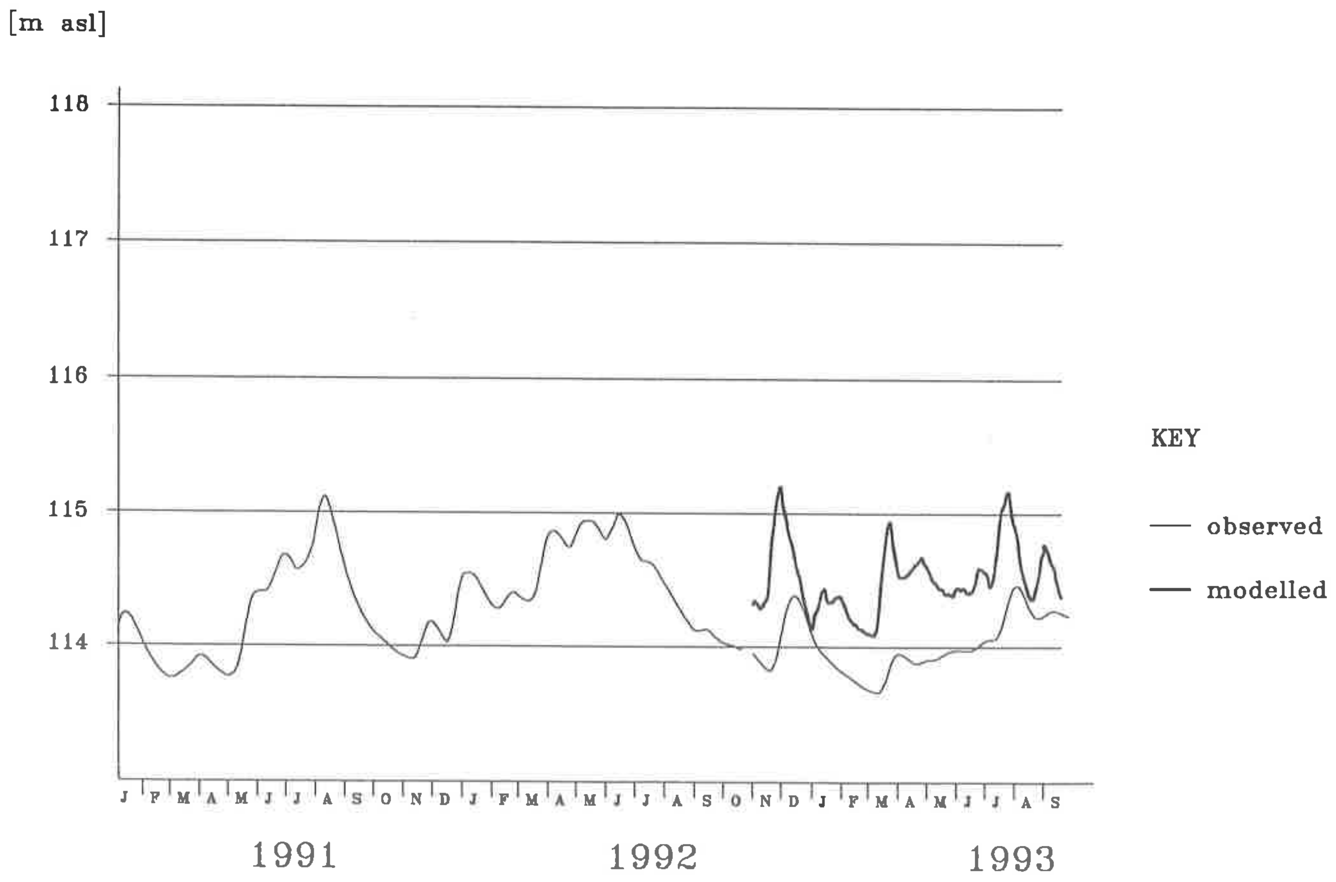
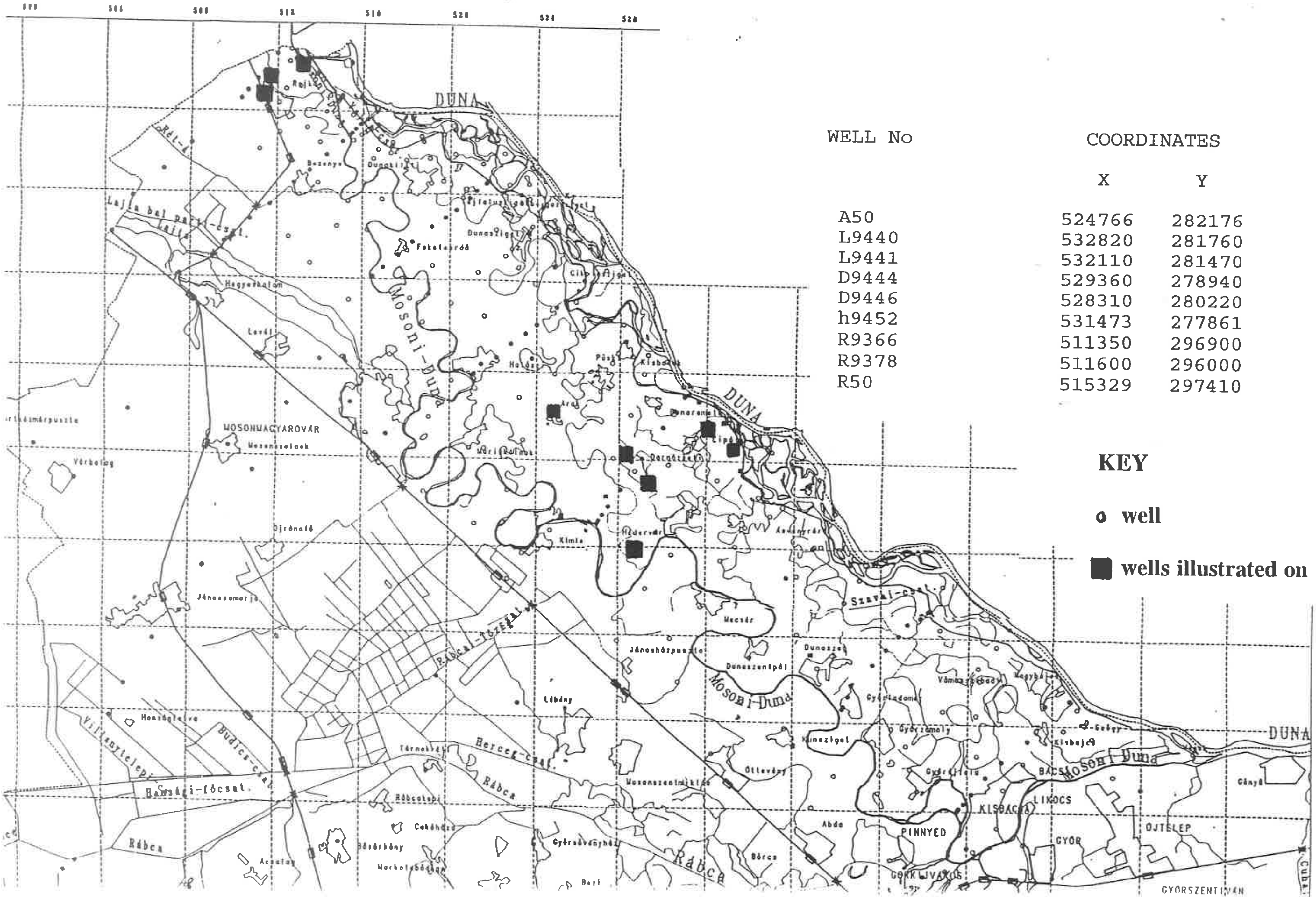


Fig. 8 Ground Water Level - Darnozseli

LOCATION OF WELLS

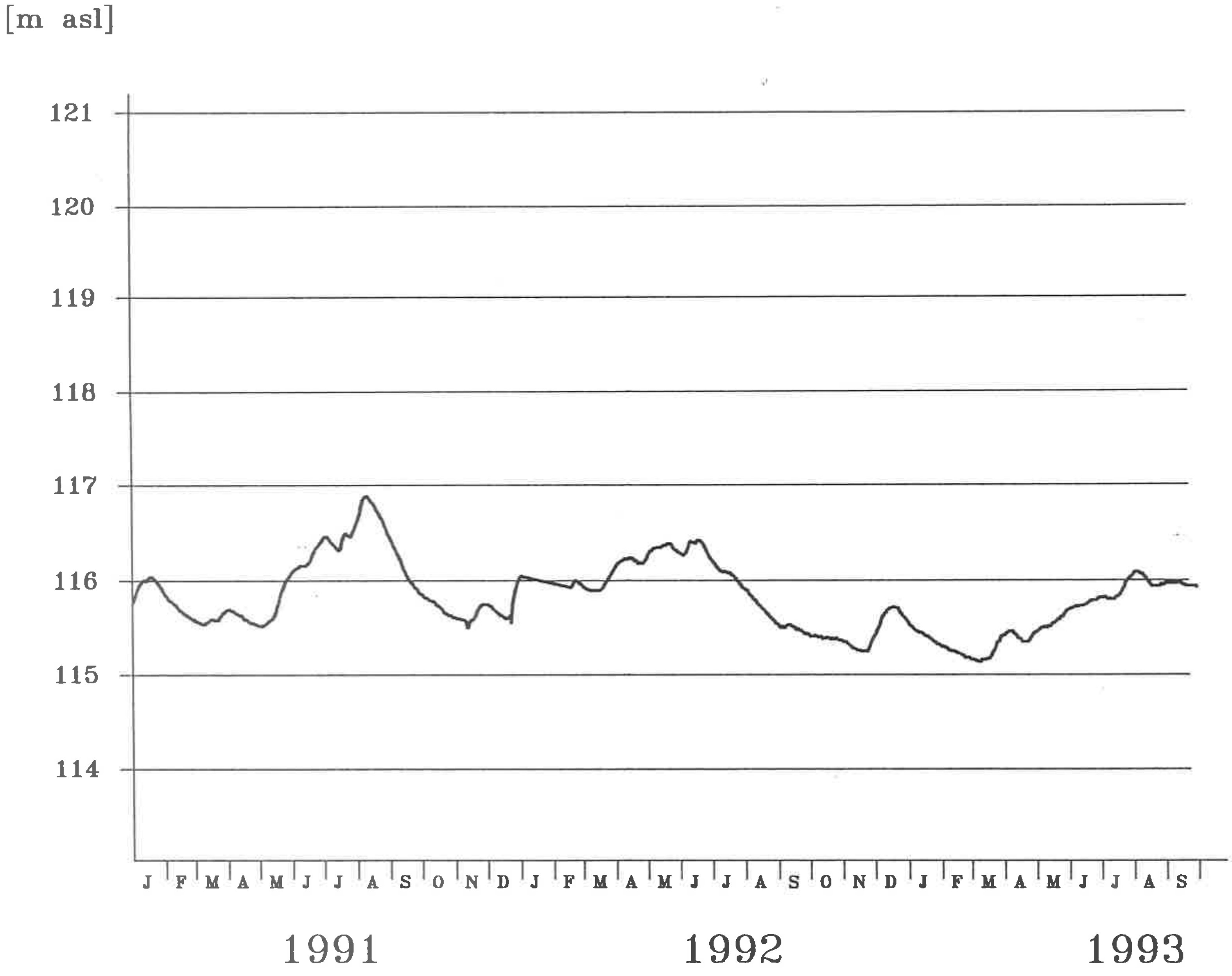


WELL No	COORDINATES X	COORDINATES Y	TIME
A50	524766	282176	1985
L9440	532820	281760	1986
L9441	532110	281470	1986
D9444	529360	278940	1986
D9446	528310	280220	1986
h9452	531473	277861	1986
R9366	511350	296900	1985
R9378	511600	296000	1985
R50	515329	297410	1987

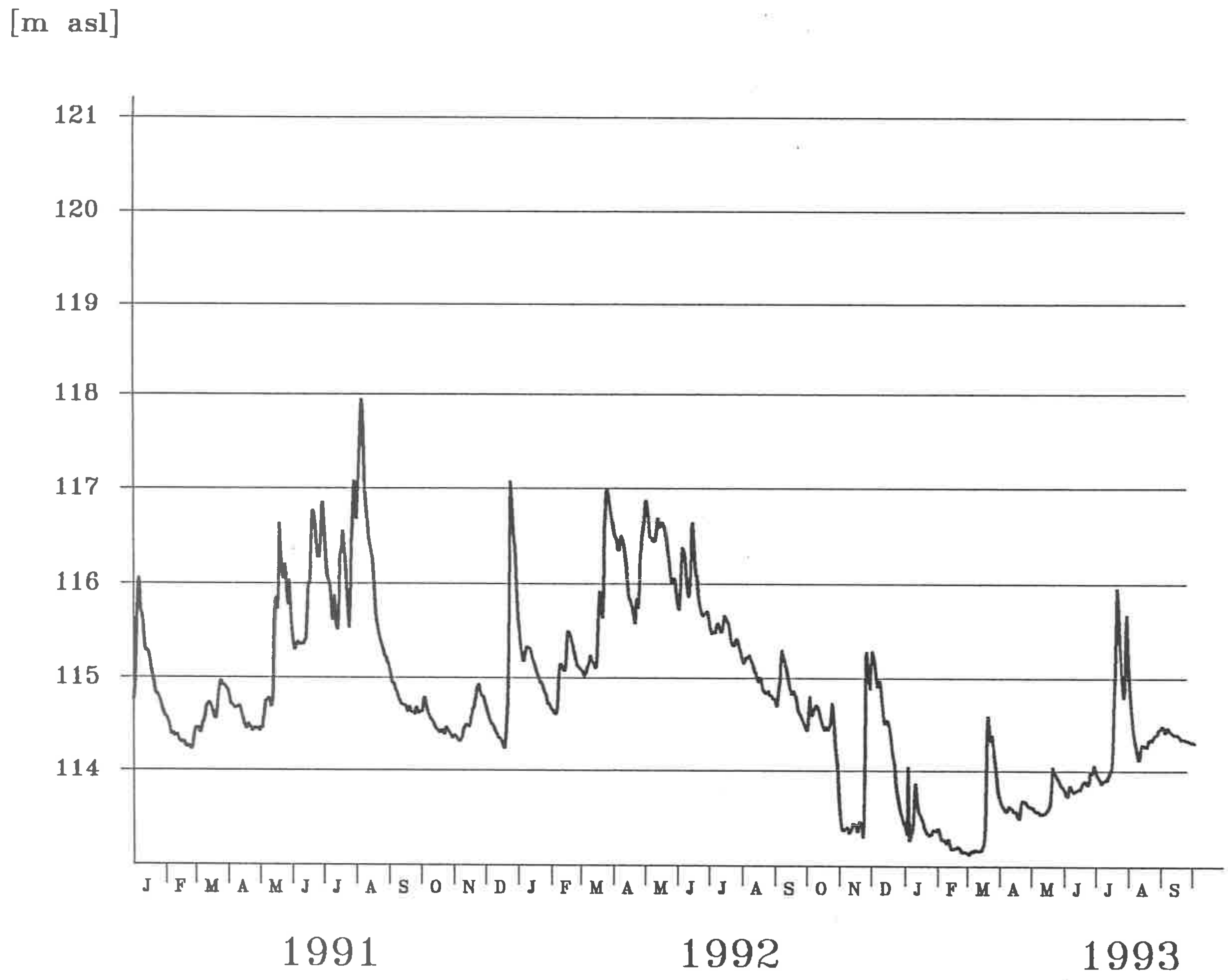
KEY

o well

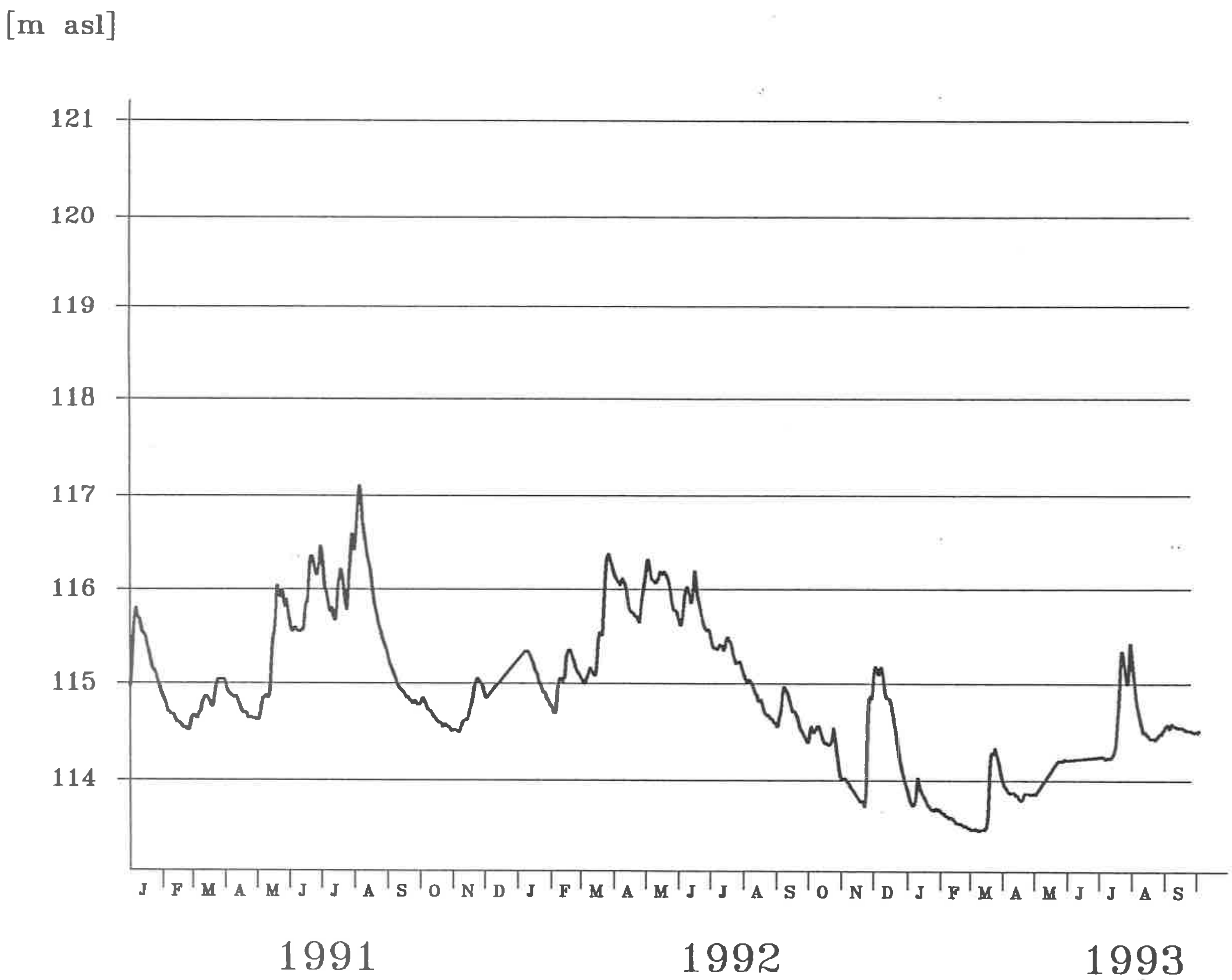
■ wells illustrated on Fig



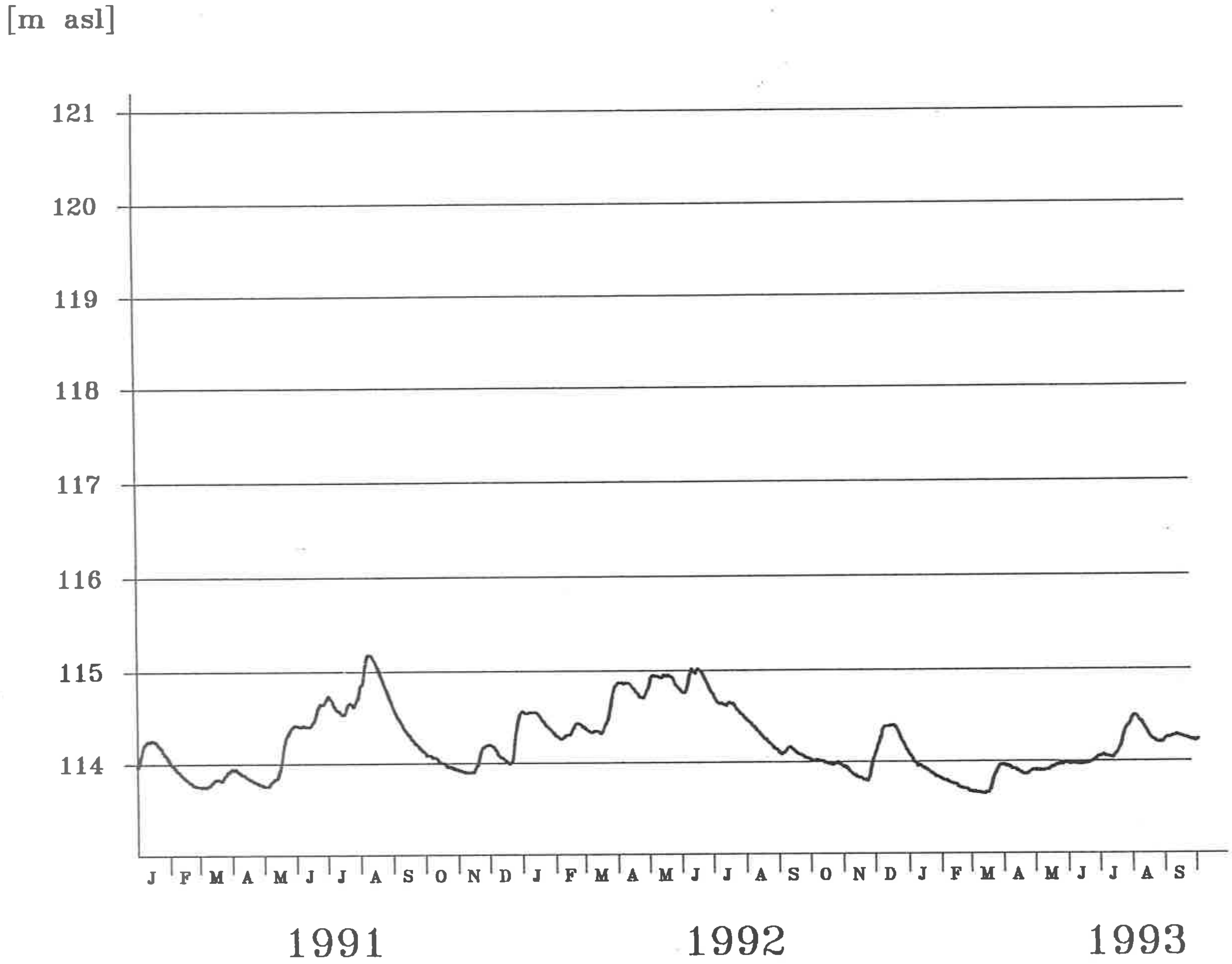
Ground Water Level - ARAK A50



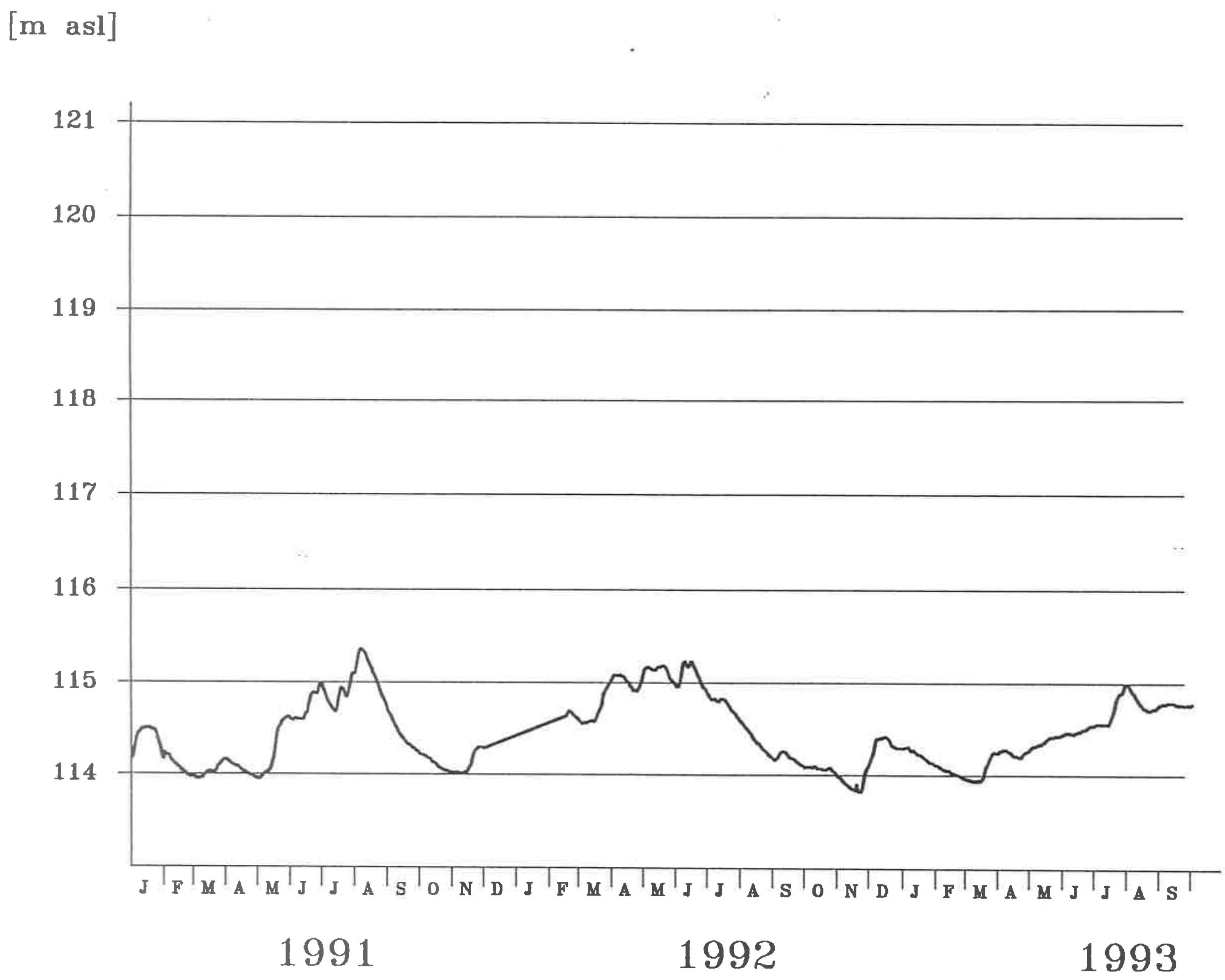
Ground Water Level – L9440



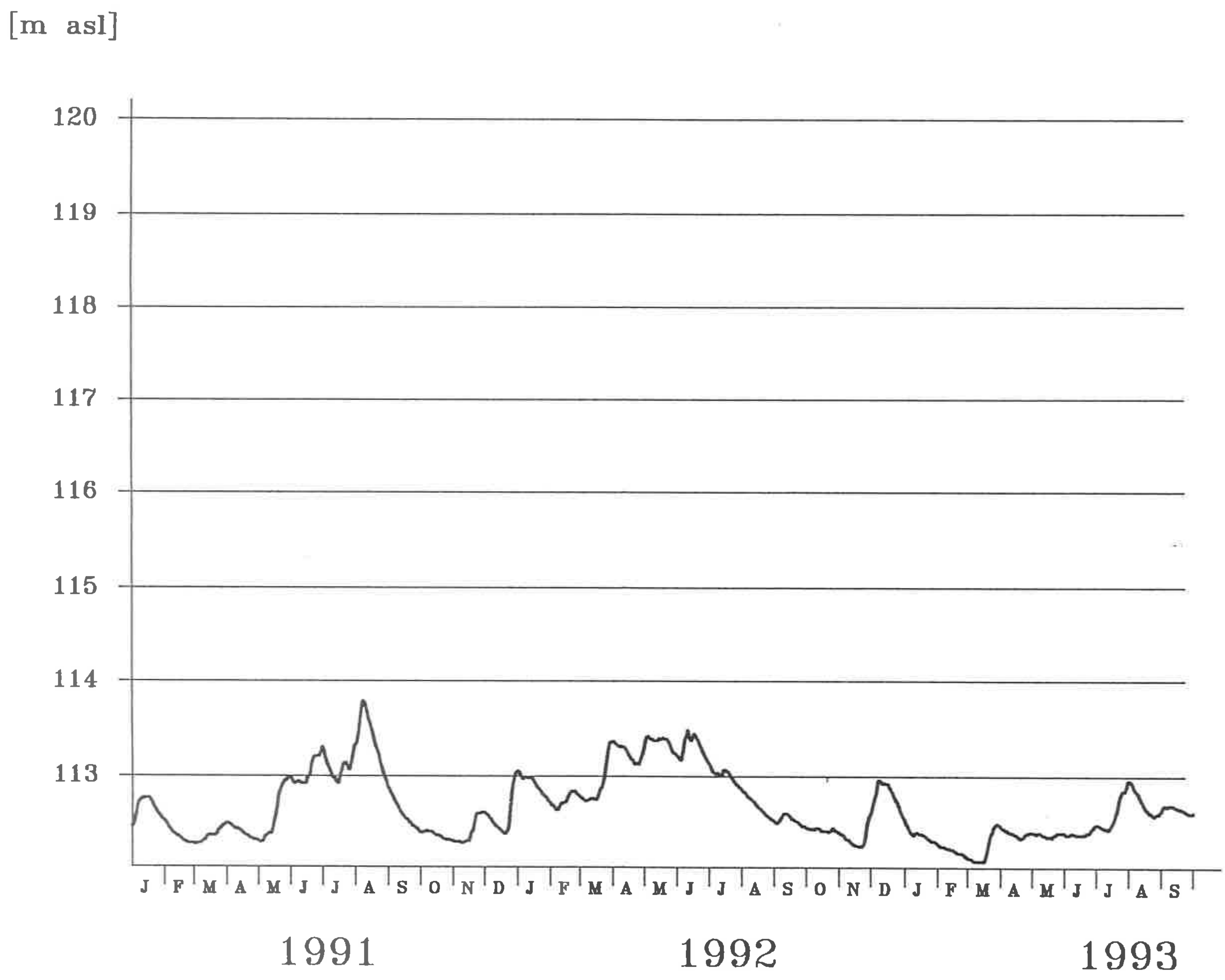
Ground Water Level - L9441



Ground Water Level – D9444

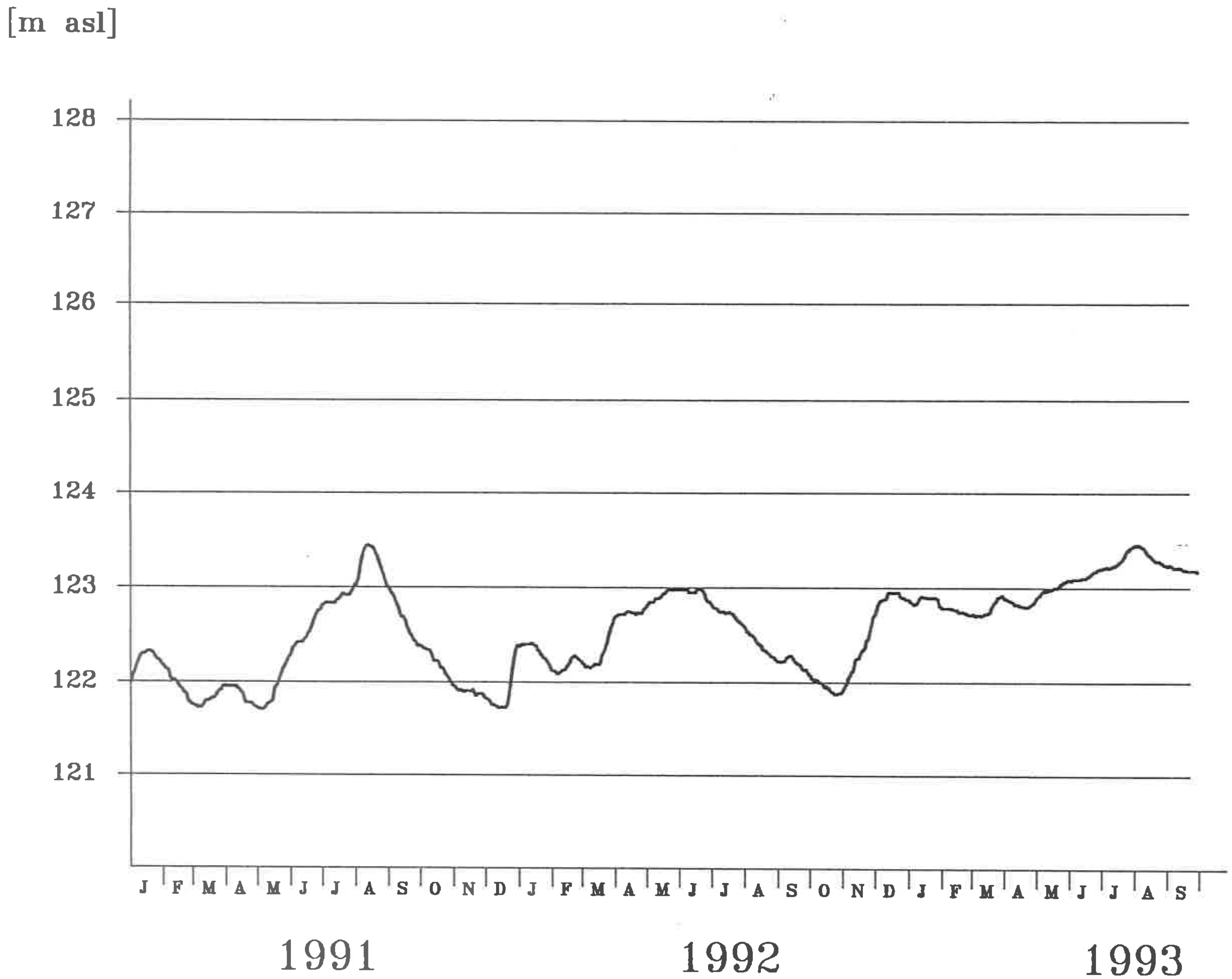


Ground Water Level - D9446

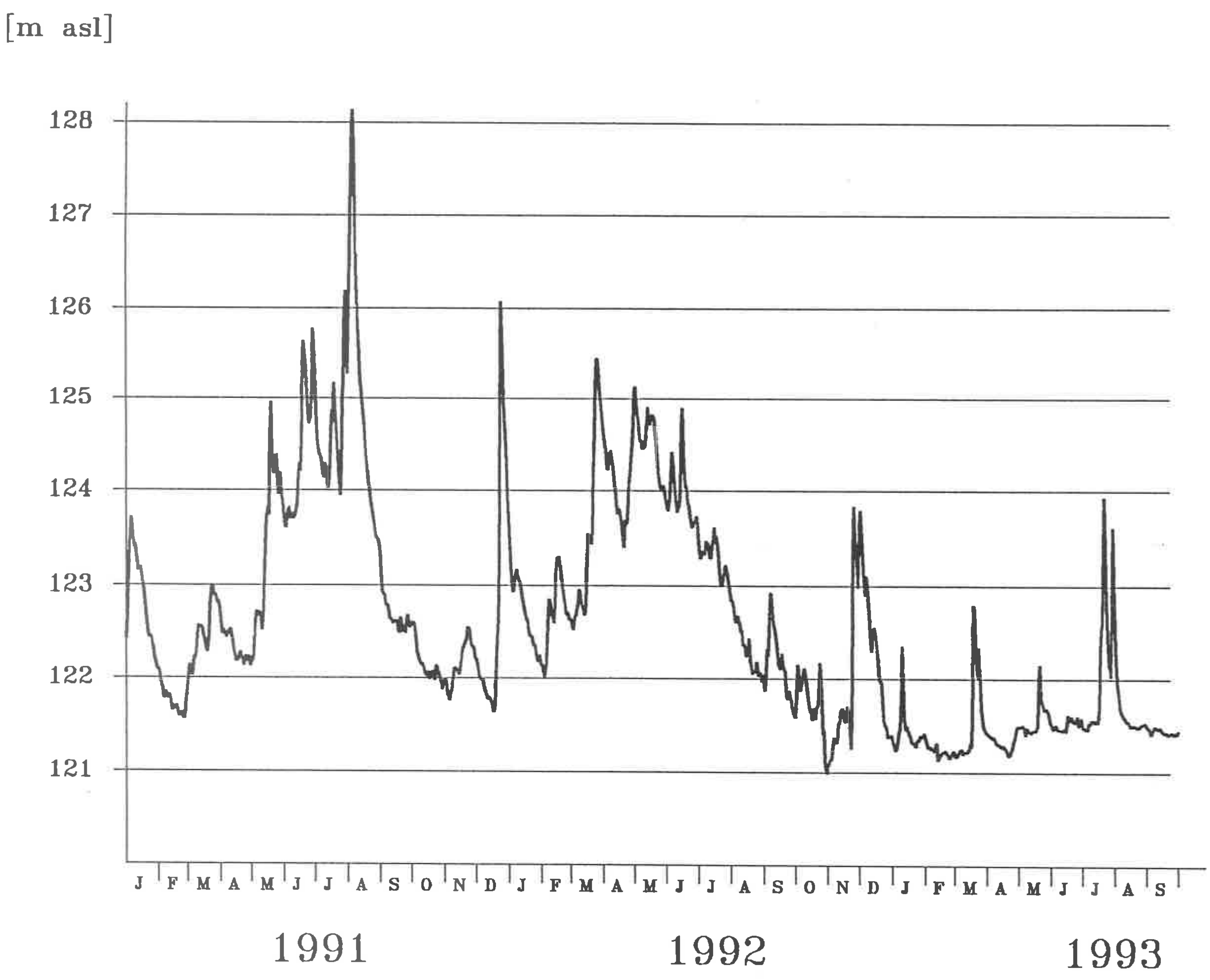


Ground Water Level - H9452

Ground Water Level – R9366



Ground Water Level - R9378



Ground Water Level - R50

SEDIMENTATION AND EROSION

SEDIMENTATION AND EROSION

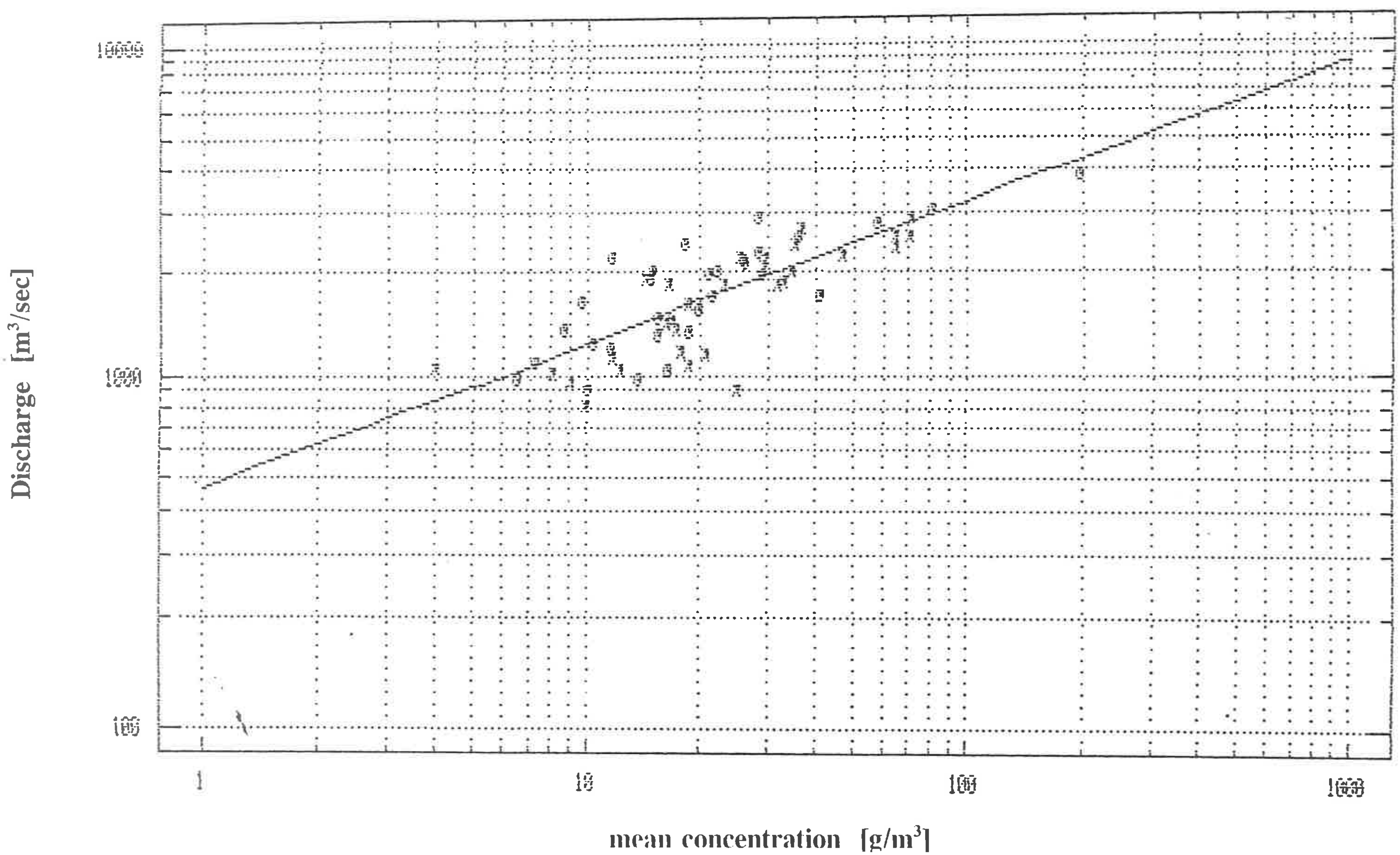
The effect of the damming at Cunovo is highly significant on the balance of sedimentation/erosion.

Erosion in the section between Rajka and Sap almost totally disappeared, it can only be detected at most at flood causing local rearrangements of the sediment. We have to consider the effect of two kinds of changes: Most of the transported material of the river have already settled upstream in the reservoir. On the other hand, the velocity of water has been reduced very much. The sedimentation therefore will probably continue, and it will change the size distribution of the sediments (decreasing). The vegetation on the shallows will be increased. The last two things together unanimously will lead to the reduction of the permeability of the riverbed.

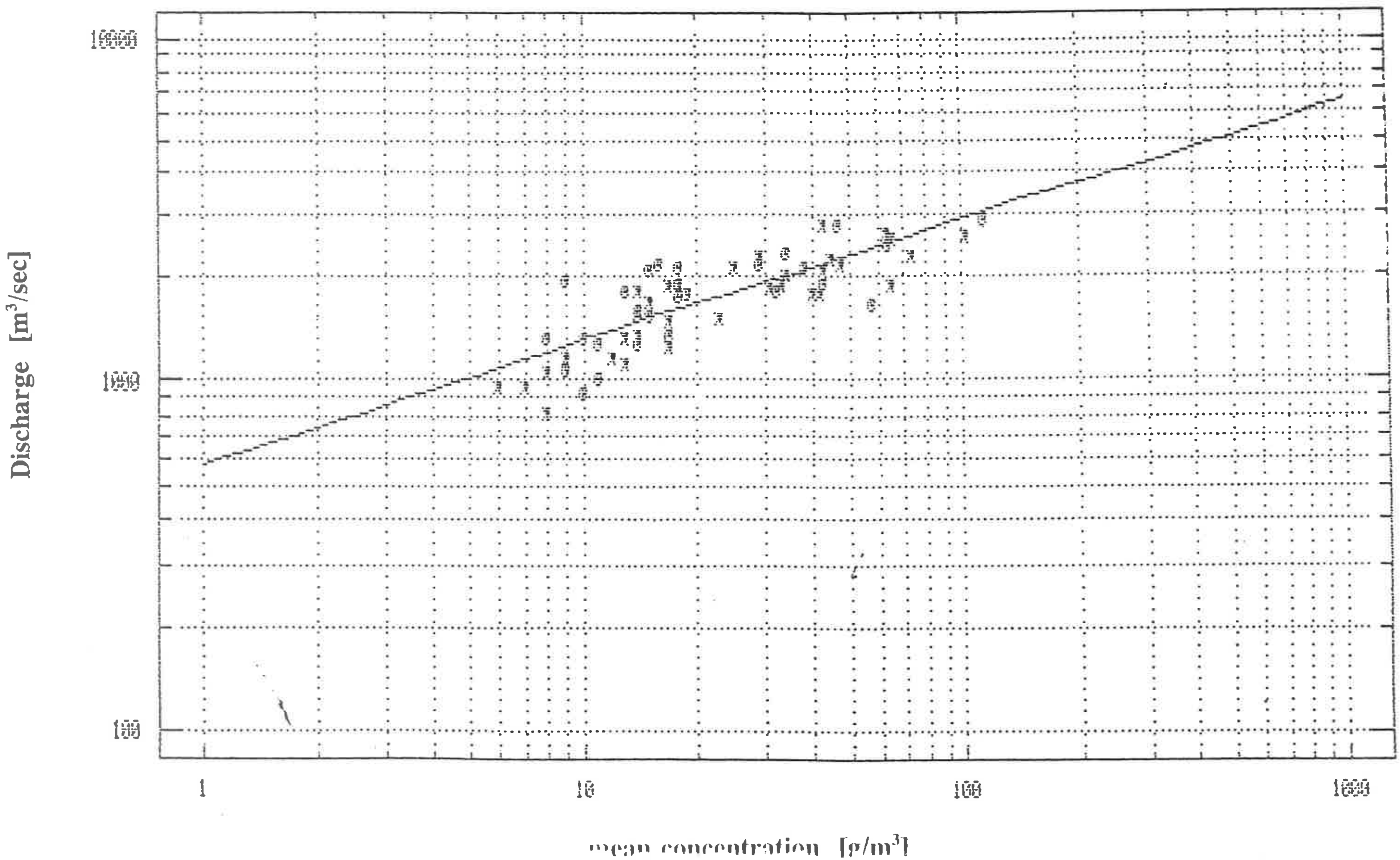
Erosion and sedimentation have been changing in a haphazard way because of the big fluctuation of the water-discharge values depending of actual weir operations.

List of Figures:

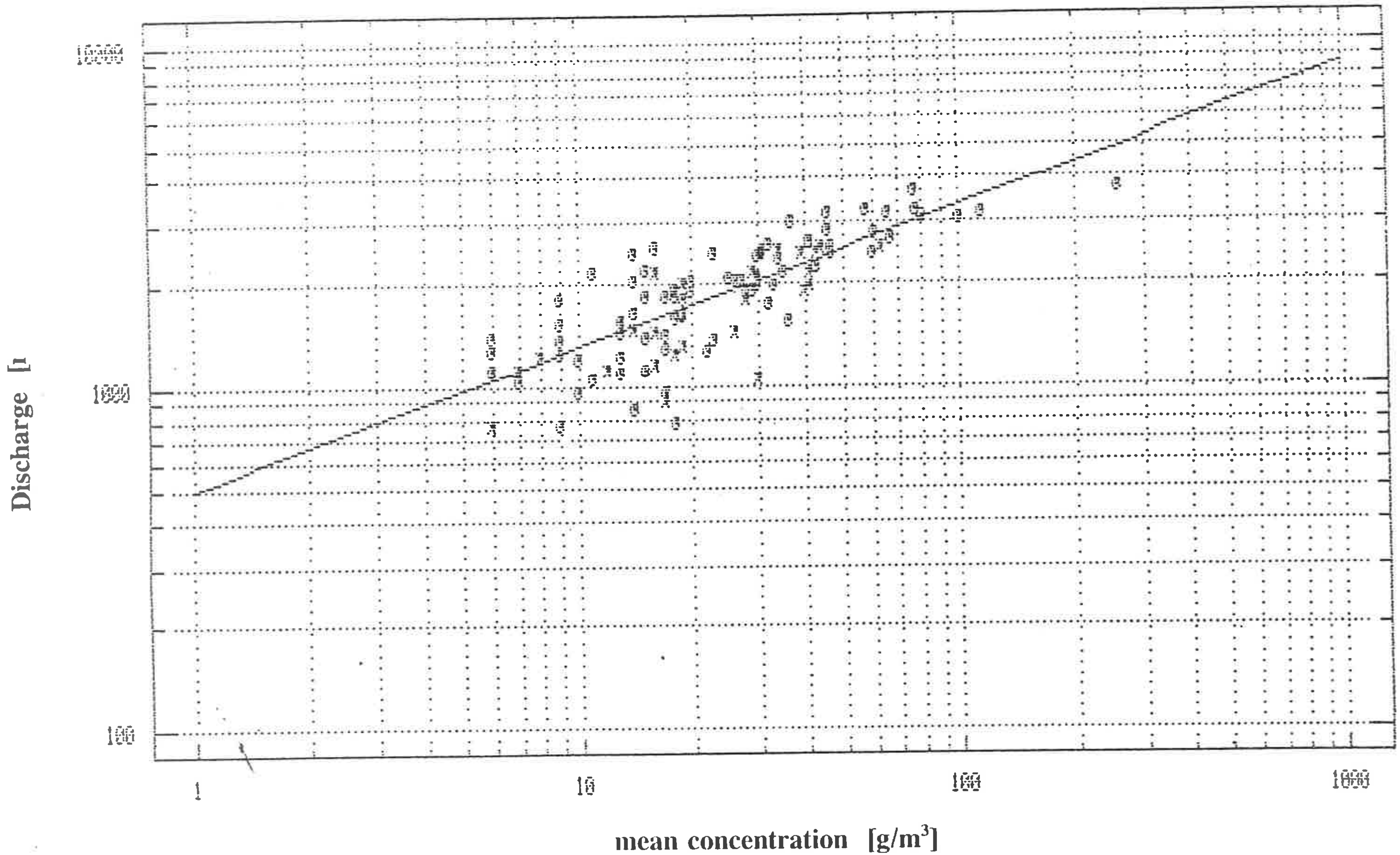
RELATION OF WATER DISCHARGE AND SEDIMENT TRANSPORT AT RAJKA



RELATION OF WATER DISCHARGE AND SEDIMENT TRANSPORT AT DUNAREMETE



RELATION OF WATER DISCHARGE AND SEDIMENT TRANSPORT AT MEDVE



QUALITY OF SURFACE AND UNDERGROUND WATER

QUALITY OF SURFACE AND UNDERGROUND WATER

The annexed maps display the sampling points of water quality measurements. The data referring to 1991-1993 years are summarized in tables. The data volume will be presented in Budapest.

1. Surface water quality

The water quality components in tables :

Dissolved oxygen, chemistry: (COI_d) five day biochemical, oxygen demand (BOI_5), ammonia (NH_4^{+}), nitrate (NO_3^{-}), orthophosphate (PO_4^{3-}), sulphate (SO_4^{2-}) ion, chlorophyll-a.

The marking of water quality categories according to Hungarian Standard (MI-10-172-2/1984) are as follows:

I. class	not marked
II. class	x
III. class	xx

2. The reliability of surface water quality date

The water quality data, depending on the type of the sample, derive of equal (weekly)- time-interval sampling, so the data sets can be regarded homogenous. The reliability of water quality data involves the reliability of sampling and of the analytical measurements, that's why it can be different according to different sampling points. Generally speaking one can state for water quality parameters and sampling sites that in most cases the interval of relative confidence does not exceed $\pm$ 5 per cent.

3. The evaluation of surface water quality

In the inundation area of Szigetköz, the negative water quality change was immediately after diversion of Danube veritable in the dewatering periods of river branches, when the algae production in the left behind water bodies was significant. The unfavourable change in water quality, decreasing dissolved oxygen content, increasing organic matter content and algae could be observed this year in the summer season, as well.

Among the characteristics of oxygen regime the dissolved oxygen regime and the dissolved oxygen content of water in the surveyed Danube reach, can be evaluated as adequate. The exception is the Rajka-reach affected by the diversion where, in August 1993, a very low concentration of dissolved oxygen was measured, the lowest in the past 10 years (5.8 mg/l).

The change of organic water content by measures of chemical- and five-day-biochemical oxygen demand (COD_d, BOD_5) along the joint Slovak-Hungarian reach of the Danube refers to increasing organic matter contamination load in both sides.

The highest COD_d value was registered in Rajka reach of the Danube on 24 of November 1992 as an affect of operational action and flood event. The erosion caused by flooding in the diverted reach exceedingly increased the suspended load of the water. Beside this the total iron content was extremely high. The ion-concentration values of orto-phosphate ($PO_4{}^{3-}$) are always higher in autumn and winter, and this shows the extent of potential nutrient reserve of the river. Due to this effect, in the vegetation period, except of the flood events, the river is in eutrophic state continuously, what is marked by the chlorophyll-a plant pigment concentration values.

In the surveyed reach of the Moson-Danube the joint influence of Danube, the channel-drained ground water the river Lajta, and the treated and untreated sewage water can be traced. There is no chance to separate the contamination effects unambiguously. The 1993 data of water quality values refer to lability of water quality status despite of the fact that the water supply became more balanced from the Danube.

4. The quality of underground water

In the tables the data exceeding the limit value of Hungarian Standard are marked by #. The limiting values were verified by the aspects of suitability as drinking water (MI-10/433-3/1984).

Summary

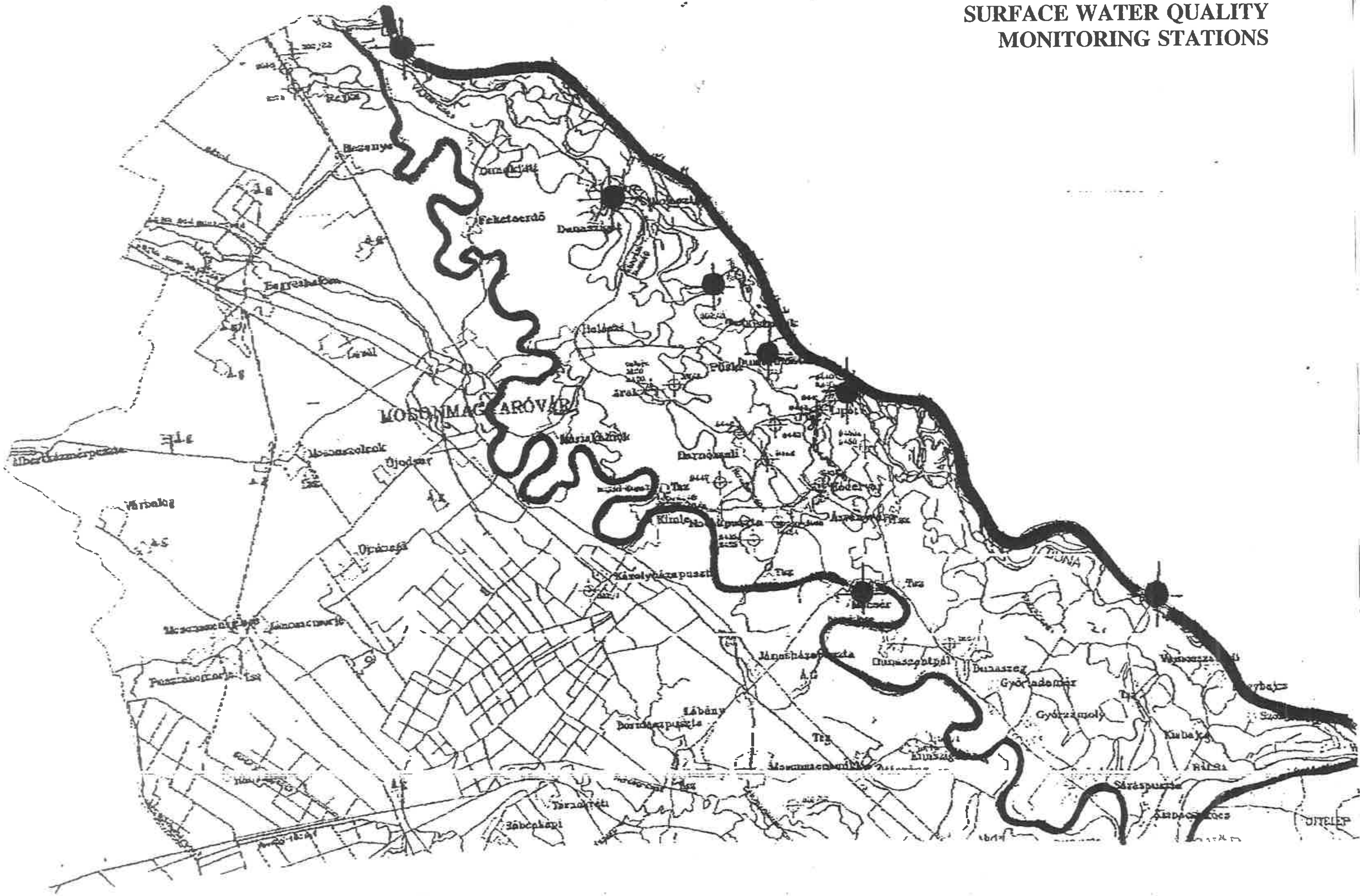
Since the diversion of the Danube no significant change of water quality could be ascertained in surface subsurface water. This is obvious, because

1. The effects of diversion on water quality will only be measurable after a long while.

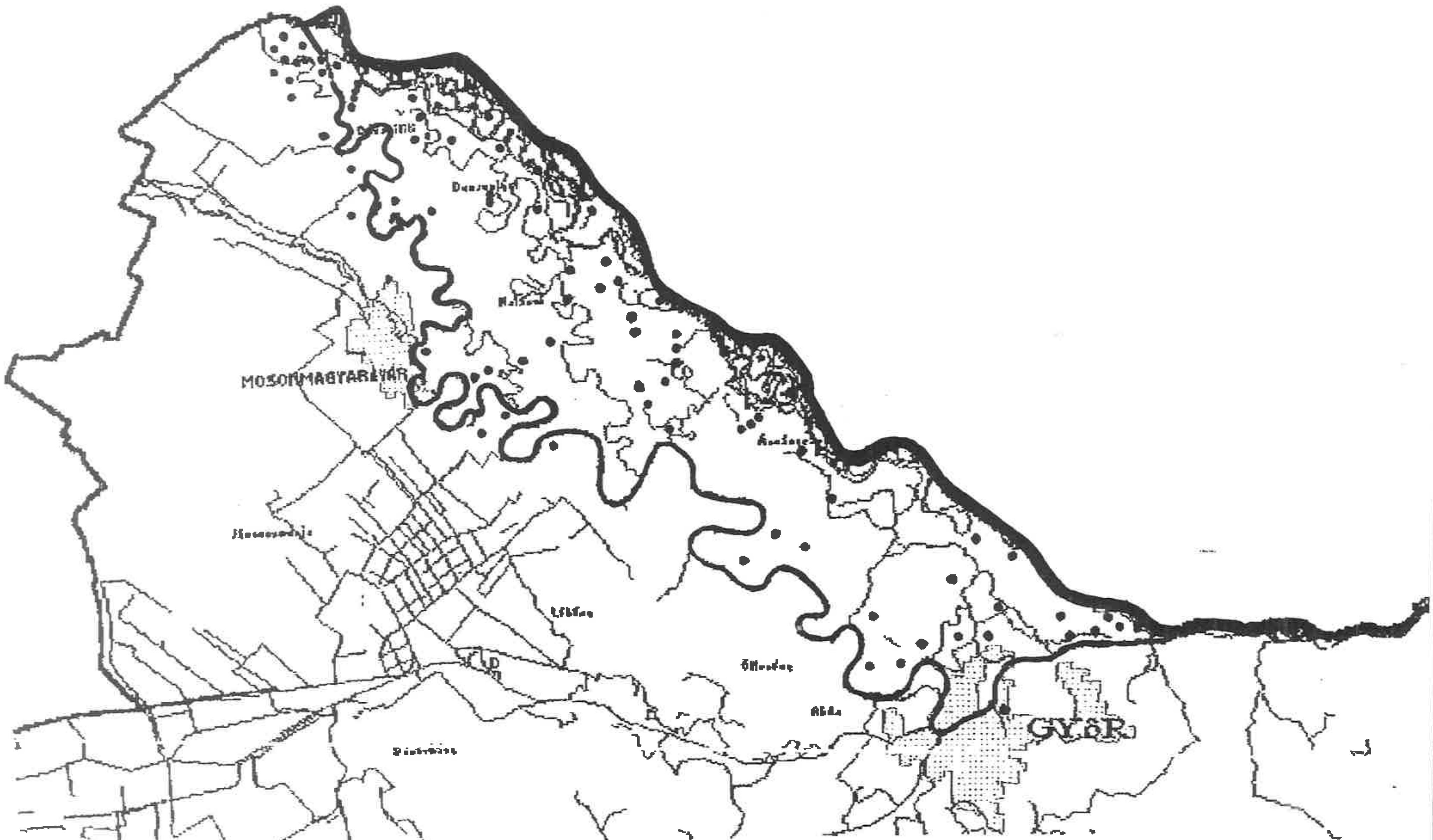
2. The collected data set of the last few months after the diversion, from statistical point of view, is insufficient for proving any change.

For supporting the above statement data set concerning surface water quality is annexed.

SURFACE WATER QUALITY MONITORING STATIONS



GROUNDWATER QUALITY
MONITORING STATIONS



QUALITY DATA OF DANUBE WATER
RAJKA, 1991

Dátum	Old.ox. mg/l	KOId mg/l	BOI-5 mg/l	NH4+ mg/l	NO3- mg/l	PO4--- mg/l	SO4-- mg/l	Klor.-a mg/m3
91-01-02	10.80	13.00	3.50	0.45	14.40	0.31*	38.40	4.80
91-01-08	10.24	15.00	3.50	0.51	15.40	0.33*	36.00	3.90
91-01-14	11.04	14.00	2.00	0.33	14.80	0.29	36.00	3.20
91-01-22	10.80	12.00	3.30	0.57	15.30	0.44*	40.80	2.40
91-01-28	11.20	9.00	2.60	0.57	16.00	0.40*	40.80	5.10
91-02-05	14.40	8.00	2.60	0.51	16.00	0.57*	60.00	5.40
91-02-11	13.20	10.00	3.10	0.51	15.30	0.52*	57.60	7.70
91-02-19	12.80	16.00	4.00	0.69	16.00	0.37*	50.40	13.60
91-02-25	12.80	11.00	3.10	0.75	14.40	0.39*	52.80	18.90
91-03-05	12.40	15.00	3.80	0.33	14.40	0.49*	50.40	34.80*
91-03-11	12.64	14.00	3.80	0.33	15.70	0.43*	48.00	26.40*
91-03-19	10.00	16.00	3.20	0.25	14.40	0.38*	48.00	25.40*
91-03-25	11.20	17.00	3.40	0.16	12.70	0.44*	45.60	50.10*
91-04-03	10.40	19.00	4.00	0.19	12.40	0.31*	45.60	26.60*
91-04-08	10.56	18.00	3.80	0.11	12.40	0.21	45.60	67.40*
91-04-16	10.88	18.00	4.50	0.11	10.90	0.10	45.60	63.40*
91-04-22	12.80	18.00	4.80	0.15	10.80	0.57*	45.60	96.40**
91-04-30	10.40	23.00	4.80	0.15	9.20	0.07	45.60	117.50**
91-05-06	10.24	14.00	3.80	0.25	8.90	0.14	45.60	106.40**
91-05-13	10.56	21.00	4.00	0.13	9.20	0.13	40.80	62.60*
91-05-20	10.40	28.00*	3.60	0.68	10.70	0.35*	43.20	20.30*
91-05-28	11.36	12.00	4.00	0.12	7.50	0.48*	40.80	39.90*
91-06-03	11.20	14.00	4.00	0.11	7.80	0.10	38.40	70.80*
91-06-10	10.40	17.00	4.70	0.13	6.00	0.05	31.20	51.80*
91-06-17	10.56	10.00	3.20	0.11	6.30	0.14	38.40	
91-06-24	8.24	16.00	4.20	0.15	7.70	0.75*	36.00	13.60
91-07-01	10.24	17.00	3.40	0.15	13.60		33.60	8.70
91-07-08	9.44	13.00	2.60	0.15	7.50	0.29	38.40	48.60*
91-07-15	8.24	11.00	3.00	0.22	6.90	0.12	36.00	16.00
91-07-22	6.64	14.00	3.00	0.25	6.30	0.29	33.60	13.00
91-07-29	9.44	42.00**	7.30*	0.14	5.50	0.13	26.40	
91-08-12	8.16	15.00	2.60	0.05	7.50	0.25	33.60	11.70
91-08-21	8.16	15.00	2.90	0.11	7.50	0.42*	40.80	14.50
91-08-26	9.20	12.00	2.00	0.05	7.20	0.15	38.40	29.40*
91-09-02	8.80	12.00	2.00	0.20	7.40	0.37*	38.40	41.30*
91-09-09	9.28	11.00	2.00	0.15	7.50	0.10	38.40	59.20*
91-09-16	9.60	11.00	2.80	0.10	5.50	0.33*	38.40	42.50*
91-09-23	9.20	19.00	3.20	0.03	7.40	0.24	43.20	48.10*
91-09-30	9.04	11.00	2.20	0.09	10.10	0.24	45.60	30.00*
91-10-07	9.44	9.00	2.20	0.23	10.20	0.25	45.60	23.00*
91-10-14	8.32	10.00	2.10	0.03	9.50	0.34*	43.20	14.30
91-10-21	8.48	10.00	2.70	0.14	10.60	0.42*	45.12	12.40
91-10-28	9.60	10.00	2.40	0.26	1.02	0.39*	48.00	9.70
91-11-04	11.20	10.00	2.80	0.30	11.10	0.29	50.40	18.80
91-11-11	10.40	9.00	2.40	0.25	11.00	0.35*	48.00	11.90
91-11-18	8.00	12.00	2.40	0.41	11.30	0.35*	48.00	8.70

QUALITY DATA OF DANUBE WATER
RAJKA, 1992

Dátum	Old.ox. mg/l	KOId mg/l	BOI-5 mg/l	NH4+ mg/l	NO3- mg/l	PO4--- mg/l	SO4-- mg/l	Klor.-a mg/m3
91-11-25	9.92	11.00	3.00	0.44	12.50	0.41*	45.60	4.90
91-12-02	10.40	12.00	3.00	0.49	12.70	0.36*	50.40	4.10
91-12-09	11.84	9.00	2.60	0.40	12.00	0.38*	45.60	4.40
91-12-16	11.20	11.00	2.70	0.58	11.30	0.32*	48.00	3.80
92-01-02	11.20	12.00	2.40	0.56	12.30	0.29	45.60	4.30
92-01-07	11.60	17.00	2.40	0.56	12.70	0.47*	48.00	2.20
92-01-07	10.64	11.00	2.40	0.56	13.50	0.52*	47.	1.90
92-01-13	8.64	10.00	2.70	0.42	13.40	0.39*	48.00	1.70
92-01-21	11.60	13.00	2.00	0.59	14.60	0.33*	48.00	3.60
92-01-27	12.00	9.00	2.30	0.59	14.90	0.39*	50.40	4.10
92-02-04	11.20	10.00	2.20	0.56	12.80	0.52*	50.40	
92-02-10	10.24	10.00	2.20	0.37	12.70	0.36*	52.80	7.80
92-02-18	10.40	14.00	3.20	0.26	12.00	0.27	45.60	
92-02-24	11.36	14.00	4.10	0.50	14.70	0.24	48.00	16.00
92-03-03	12.00	16.00	3.20	0.19	13.60	0.22	45.60	41.40*
92-03-09	11.52	12.00	3.00	0.14	12.50	0.18	43.20	36.50*
92-03-17	11.20	19.00	4.40	0.21	11.00	0.45*	41.76	44.70*
92-03-23	8.80	14.00	2.60	0.48	12.00	0.21	38.40	17.70
92-03-31	10.24	22.00	4.00	0.25	15.50	0.26	39.36	17.00
92-04-06	10.72	13.00	2.20	0.10	14.70	0.22	40.32	17.70
92-04-14	10.48	13.00	3.40	0.26	14.60	0.18	39.84	32.70*
92-04-21	10.48	12.00	2.20	0.17	10.80	0.11	40.32	31.70*
92-04-28	9.84	12.00	3.00	0.38	8.10	0.05	35.52	40.90*
92-05-04	10.56	16.00	3.00	0.44	1.65	0.14	38.40	48.10*
92-05-12	8.72	12.00	2.00	0.19	6.60	0.06	32.64	[illegible]
92-05-18	11.20	11.00	3.40	0.29	5.30	0.09	28.80	26.60*
92-05-26	10.56	10.00	2.70	0.17	4.40	0.08	30.72	31.70*
92-06-01	9.68	12.00	2.50	0.55	4.50	0.04	27.84	70.20*
92-06-08	9.20	10.00	2.10	0.19	5.00	0.15	29.76	17.70
92-06-15	9.60	12.00	3.00	0.52	7.00	0.22	30.72	26.90*
92-06-22	8.36	9.00	1.30	0.14	6.10	0.09	36.00	40.90*
92-06-29	8.16	12.00	2.00	0.25	6.30	0.13	29.76	31.40*
92-07-06	8.88	12.00	3.20	0.09	5.70	0.19	27.36	52.10*
92-07-13	9.60	8.00	2.00	0.24	5.70	0.14	35.04	30.70*
92-07-20	8.80	12.00	2.40	0.07	6.30	0.10	28.32	53.20*
92-07-28	8.00	10.00	2.40	0.26	4.10	0.07	28.80	29.40*
92-08-03	8.96	12.00	3.00	0.71	5.60	0.12	29.28	6.10
92-08-10	8.16	9.00	2.40	0.13	5.80	0.16	29.28	9.60
92-08-17	8.00	13.00	1.20	0.09	5.70	0.15	33.12	43.30*
92-08-24	7.76	18.00	2.20	0.19	5.60	0.20	31.20	21.80*
92-08-31	7.20	14.00	2.00	0.09	5.10	0.14	37.44	36.50*
92-09-15	8.00	15.00	1.70	0.30	6.70	0.45*	33.12	23.50*
92-09-21	8.96	14.00	1.40	0.04	6.50	0.15	33.60	7.20
92-09-29	8.16	13.00	2.60	0.32	8.00	0.17	34.08	33.70*
92-10-06	7.76	11.00	1.80	0.24	7.40	0.14	38.88	10.20
92-10-13	8.00	10.00	2.30	0.40	9.50	0.26	43.68	6.50

QUALITY DATA OF DANUBE WATER
RAJKA, 1993

Dátum	Old.ox. mg/l	KOId mg/l	BOI-5 mg/l	NH4+ mg/l	NO3- mg/l	PO4--- mg/l	SO4-- mg/l	Klor.-a mg/m3
92-10-19	9.40	11.00	2.20	0.11	9.70	0.28	42.24	6.10
92-10-26	9.04	11.00	1.20	0.32	10.10	0.27	42.72	8.20
92-11-02	8.82	12.00	1.80	0.35	9.40	0.28	42.24	2.70
92-11-10	9.55	16.00	1.20	0.62	9.30	0.22	45.12	2.70
92-11-16	8.47	15.00	2.10	0.36	10.20	0.22	45.12	2.40
92-11-24	10.51	48.00**	2.70	0.54	11.00	0.24	36.00	1.70
92-11-30	10.99	26.00*	1.60	0.40	10.10	0.19	34.56	1.70
92-12-08	10.44	18.00	2.80	0.58	10.80	0.17	35.04	5.50
92-12-14	10.44	15.00	1.80	0.62	12.10	0.22	36.00	3.10
92-12-21	9.51	11.00	1.80	0.50	13.90	0.24	34.08	2.00
93-01-04	11.18	11.00	1.00	0.54	12.50	0.20	41.28	1,0
93-01-12	10.12	13.00	2.80	0.64	10.90	0.22	43.20	1.40
93-01-18	8.40	14.00	1.30	0.68	10.70	0.24	43.20	2,0
93-01-26	7.61	14.00	1.70	0.36	11.20	0.25	42.72	1,4
93-02-01	11.92	14.00	3.30	0.39	12.70	0.22	43.20	3,1
93-02-09	9.34	13.00	1.30	0.15	13.10	0.22	46.56	13,0
93-02-15	8.63	11.00	2.80	0.23	12.50	0.19	45.60	19,8
93-02-23	9.38	14.00	3.20	0.26	12.60	0.23	52.32	16,4
93-03-01	13.44	12.00	2.70	0.26	13.50	0.18	50.40	37,9x
93-03-09	10.80	18.00	3.20	0.16	12.40	0.07	50.40	96,8xx
93-03-16	12.16	18.00	3.30	0.04	12.90	0.04	50.88	115,9xx
93-03-23	10.40	17.00	2.70	0.47	15.00	0.17	42.24	19,8
93-03-29	10.40	17.00	4.10	0.19	11.30	0.13	47.04	22,8x
93-04-06	11.60	17.00	4.00	0.22	9.98	0.07	39.84	78,0x
93-04-13	10.24	17.00	3.00	0.22	9.67	0.07	43.20	68,9x
93-04-20	9.68	18.00	3.30	0.31	9.10	0.08	46.08	61,0x
93-04-26	10.32	13.00	2.60	0.14	8.00	0.07	42.72	40,9x
93-05-04	9.60	12.00	3.00	0.20	6.90	0.05	39.36	40,2x
93-05-10	10.40	15.00	4.50	0.22	6.70	0.05	38.88	83,5xx
93-05-18	9.76	18.00	3.70	0.22	5.30	0.04	28.80	75,6x
93-05-24	8.64	16.00	3.00	0.18	6.30	0.07	36.48	21,5x
93-06-02	10.05	10.00	2.90	0.10	6.30	0.04	38.88	
93-06-07	8.96	11.00	2.60	0.16	6.80	0.07	35.52	22,5x
93-06-15	8.96	12.00	3.70	0.19	6.30	0.05	32.64	28,6x
93-06-21	8.40	10.00	2.20	0.05	6.70	0.29	29.28	11,6
93-06-29	8.24	14.00	3.90	0.16	5.90	0.26	32.64	23,2x
93-07-05	8.00	12.00	1.60	0.27	6.80	0.12	42.24	25.60*
93-07-13	9.62	11.00	2.40	0.22	6.20	0.10	33.12	22.80*
93-07-19	10.69	17.00	3.20	0.31	6.40	0.24	48.00	19.10
93-07-27	9.90	15.00	3.10	0.22	8.60	0.30	32.64	-
93-08-02	8.64	13.00	3.20	0.21	8.60	0.25	21.12	36.10*
93-08-10	7.12	8.00	2.10	0.11	6.80	0.17	52.80	13.90
93-08-16	5.84*	8.00	2.50	0.17	7.20	0.22	55.68	20.40*
93-08-24	8.00	13.00	1.80	0.01	7.00	0.18	33.60	51.50*
93-08-30	9.32	12.00	2.80	0.03	7.50	0.15	34.56	18.40

FLORA AND FAUNA

FLORA AND FAUNA

The faunistic and floristic sampling sites are indicated on the given map. The lists of species detected (approximately 2800 animal and 820 plant species) in the area between 1991-1993 will be presented in Budapest.

1. Brief assessment of changes occurring after the diversion of the Danube

Comparing the state of Szigetköz in 1991-1992 with the state after the diversion until August 1993 the detected changes in the flora and fauna of the Szigetköz could be discussed according to two different time scales.

a) Drastic, quick, already detectable short-term effects

First of all the aquatic biota and the biota directly connected to water were affected. In the drying parts considerable destruction of mussels, aquatic snails, planktonic animals and fishes were detected. The quick decrease of water level has changed or completely destroyed several habitats.

b) Long-term changes and destruction

For the assessment of these effects a period of less than one year is clearly insufficient. It is probable that within a single year none of the plant or animal species have become extinct in the Szigetköz. These changes usually start with the decrease of number of individuals of a species, and not with the immediate extinction of a species. Therefore the detected changes or even the detection of no changes at all should be interpreted with precaution. For a certain period of time the increase of species diversity may occur, which indicate biological degradation of this area.

We present an example here indicating the magnitude of deterioration in the river bed of the Danube, which affects not only the flora and fauna but other important aspects (the preservation of freshwater quality) as well. Between the 1828th and 1829th kilometres of the Danube (in the region of Dunaremete) a vast part of the river have become dry (See the photograph). Before the diversion on this section a mud plant association (Nanocyperion) was present with the following species: Cyperus fuscus, Juncus bufonius, Limosella aquatica, Eleocharis acicularis, Potamogeton fluitans, Batrachium sp.

In the desiccated river bed a terrestrial weed vegetation appeared very quickly. This is a natural process on the Central-European section of the Danube. This plant association is called: Echinochloo-Polygoneotum-lapathifolii. Species richness is considerably high in this weed association, the plant coverage value is increasing from the new shore line towards the original shoreline. The value ranges from zero (gravel bed without plants) to 50%. Most of the species are pioneer weed plants, with low competition abilities: for example Chenopopdium striatum, Erigeron canadensis, Rumex limosus.

Place of vegetation survey: Dunaremete, in the river bed of the Agg-Duna.

Date of survey: 14th of June 1993.

Plant association: Echinochloo-Polygoneotum-lapathifolii.

The size of the surveyed area: 10 metres by 10 metres.
Total coverage: 10%

Species list:

Agropyron repens
Agrostis stolonifera
Artemisia nigra
Aster tradescantii
Chenopodium album
Chenopodium rubrum
Chenopodium striatum
Echinochloa crus-galli
Gnaphalium uliginosum
Lythrum salicaria
Matricaria inodora
Plantago media

Polygonum aviculare
Polygonum lapathifolium
Rorippa sylvestris
Rumex sanguineus
Veronica anagalloides.

Place of vegetation survey: Dunaremete, in the river bed of the Agg-Duna between the 1828th and 1829th kilometres.

Date of survey: 8th of July 1993.

Plant association: A species rich primer river bed plant association: Echinochloo-Polygoneotum-lapathifolii.

Species list:

Alopecurus aequalis
Artemisia annua
Aster tradescantii
Chenopodium glaucum
Chenopodium rubrum
Chenopodium striatum
Cyperus fuscus
Epilobium dodonei
Epilobium hirsutum
Epilobium parviflorum
Erysimum cherianthoides
Gnaphalium uliginosum
Juncus articulatus
Juncus bufonius
Lactuca viminea
Limosella aquatica
Lythrum salicaria
Matricaria inodora
Mentha pulegium
Plantago lanceolata
Plantago media
Poa palustris
Polygonum lapathifolium
Polygonum mite
Polygonum persicaria
Potentilla supina

Ranunculus sceleratus
Rorippa amphibia
Rorippa islandica
Rorippa sylvestris
Rumex conglomeratus
Rumex sanguineus
Salix triandra
Senecio vulgaris
Solidago gigantea
Sonchus asper
Tunica prolifera
Urtica dioica
Veronica anagalloides.

Place of vegetation survey: Dunaremete, in the river bed of Öreg-Duna

Date of survey: 14th of October 1993.

Plant association: A river bed plant association:
Echinochloo-Polygoneotum-lapathifolii.

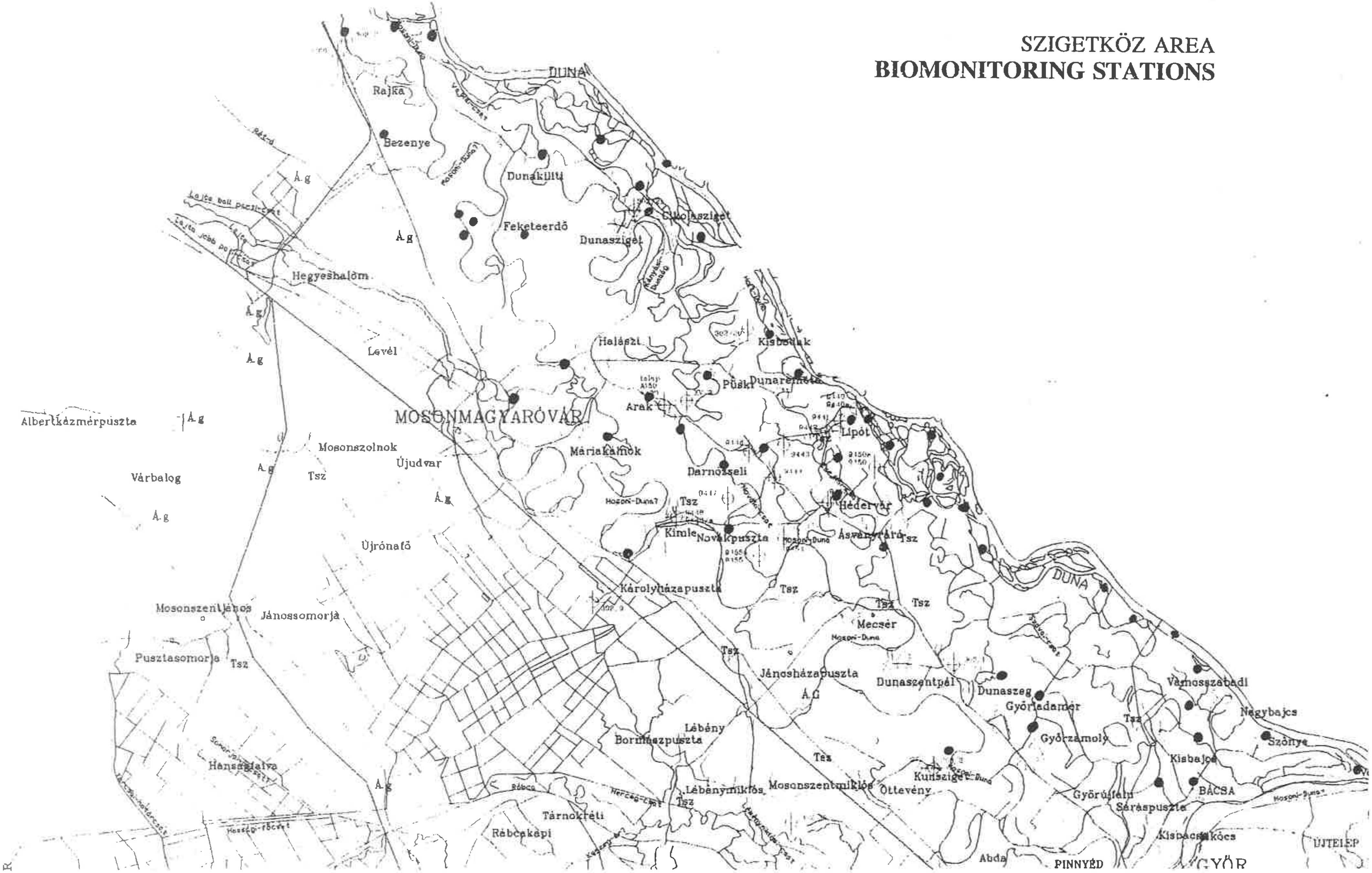
Size of surveyed area: 20 metres by 20 metres.
Total plant coverage: 10-15%

Species list:

Acer negundo
Achillea millefolium
Agrostis stolonifera
Annagallis arvensis
Arctium lappa
Artemisia annua
Artemisia vulgaris
Aster tradescantii
Capsella bursa-pastoris
Chenopodium striatum
Chaenorhinum minus
Chrysanthemum vulgare
Cirsium arvense
Cirsium lanceolata
Cynodon dactilon

Cyperus fuscus
Daucus carota
Deschampsia caespitosa
Echinochloa crus-galli
Epilobium dodonei
Epilobium parviflorum
Erygeron canadensis
Eysimum cheiranthoides
Galinsoga parviflora
Galium verum
Heracleum sphondylium
Hypericum perforatum
Matricaria inodora
Medicago lupulina
Myosoton aquqtica
Oenothera biennis (?)
Oxalis stricta
Phalaris arundinacea
Plantago altissima
Plantago lanceolata
Plantago major
Poa compressa
Poa palustris
Polygonum kitaibelianum
Polygonum lapathifolium (1%)
Polygonum minus
Polygonum mite
Polygonum persicaria
Populus alba
Populus euramericana
Picris hieracioides
Reseda lutea
Rorippa islandica
Rorippa sylvestris
Rumex limosus
Rumex sanguineus
Salix purpurea
Salix triandra
Scrophularia umbrosa
Solidago gigantea
Stachys annua
Stenactis strigosa
Tussilago farfara

SZIGETKÖZ AREA
BIOMONITORING STATIONS



DUNAREMETE, RIVER BED OF THE DANUBE

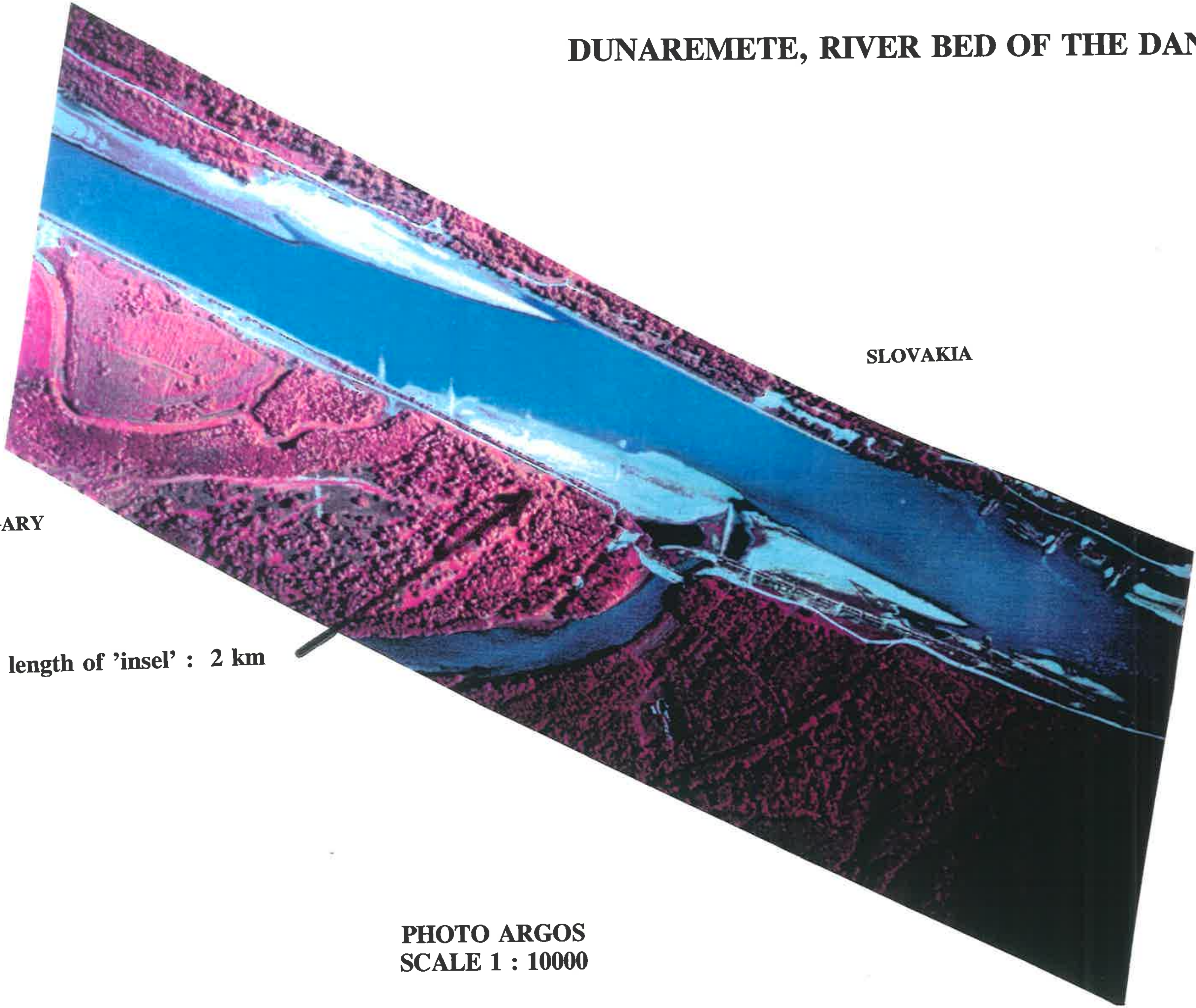


PHOTO ARGOS
SCALE 1 : 10000

THE EFFECTS ON FORESTRY

THE EFFECTS ON FORESTRY

The negative effect of variant C is highly significant on the forestry, especially in the flood plain of the upper Szigetköz (from 1816 rkm upstream). Different tree species and varieties show damages and decline to various degree. Loss of foliage and reduced growth is typical. Roughly 5% of the flood plain trees already died. The attached tables illustrates the situation. The dominant poplar and willow are very much effected. According to the forestry experts, these species will not survive 2-3 additional years with the present conditions. Even the EC recommended 2/3 discharge will cause substantial loss in timber production.

Comments to the perimeter growth data

The perimeter growth was measured weekly in 11 location on 9 tree species and varieties altogether on 117 trunks. A modified Hall-Liming's dendrometer tape (copper) was fastened with a steel spring at 1,3 m height on the trunks. The distance between the two stabilized points of the tape was measured every week. The accuracy of the measurement is 0,1 mm.

DUNASZIGET 15/A 1991 (10 years old)
I-214 Italian poplar (Populus * euramericana hybrid)
Perimeter growth in mm at 130 cm height

tree speci-men	start of vegetation - until 31. July	from 31.July - end of vegetation	Total
A	34,9	12,1	47,0
B	50,4	19,0	69,4
C	39,5	20,4	59,9
D	30,9	9,1	40,0
E	35,2	23,6	58,8
mean	38,2	16,8	55,0

DUNASZIGET 15/A 1992 (11 years old)
I-214 Italian poplar (Populus * euramericana hybrid)
Perimeter growth in mm at 130 cm height

tree speci-men	start of vegetation - until 31. July	from 31.July - end of vegetation	Total
A	41,0	6,6	47,6
B	49,1	9,2	58,3
C	52,5	5,9	58,4
D	30,8	2,6	33,4
E	56,9	6,4	63,3
mean	46,1	6,1	52,2

DUNASZIGET 15/A 1991-1992 mean

DUNASZIGET 15/A 1993 (12 years old)

I-214 Italian poplar (Populus * euramericana hybrid)
Perimeter growth in mm at 130 cm height

tree speci-men	**start of vegetation - until 31. July 1991-1992 mean**	**start of vegetation - until 31. July 1993**
A	38,0	10,6
B	49,7	11,7
C	46,0	15,0
D	30,9	8,6
E.	46,1	28,0
mean	42,1	14,8