www.foodlab.com.cy
foodlab@cytanet.com.cy

Lead sampling and analysis report for

Paralimni Lake Natura 2000 site

under the project

'LIFE IP PHYSIS (PANDODEIRA)'

LIFE18 IPE/CY/000006

Work completed by Cp Foodlab Ltd as part of a tender by BirdLife Cyprus.

2021

***Executive summary**:* Soil and sediment samples were collected and analysed from the Larnaca Salt Lake (Main Lake 'Alyki') and from the Paralimni lake, as part of a tender by *BirdLife Cyprus*.

The sampling took place during the October - November 2021 period, when both areas of interest were dry.

The total number of samples analysed was 158 for Larnaca and 153 for Paralimni.

This report summarises the work performed for Paralimni Lake Natura 2000 - CY6000002.

Specifics: In order for the sampling to take place, relevant permits were obtained from the Department of Environment and from the Cyprus Game and Fauna Services.

The sampling plan that was designed and followed was based on the division of the region into *cells*. The size of each cell was directly related to the probable pollution of the selected area, mainly due to its proximity to the shooting range and other causes. In the case of areas expected to be highly polluted, the cells were smaller in size while areas expected to be less polluted were associated to larger cells. Three control areas were created for each lake (mainly depending on the size of the cells).

Experimental Design:

Sampling grid at Paralimni Lake (number of samples 124):

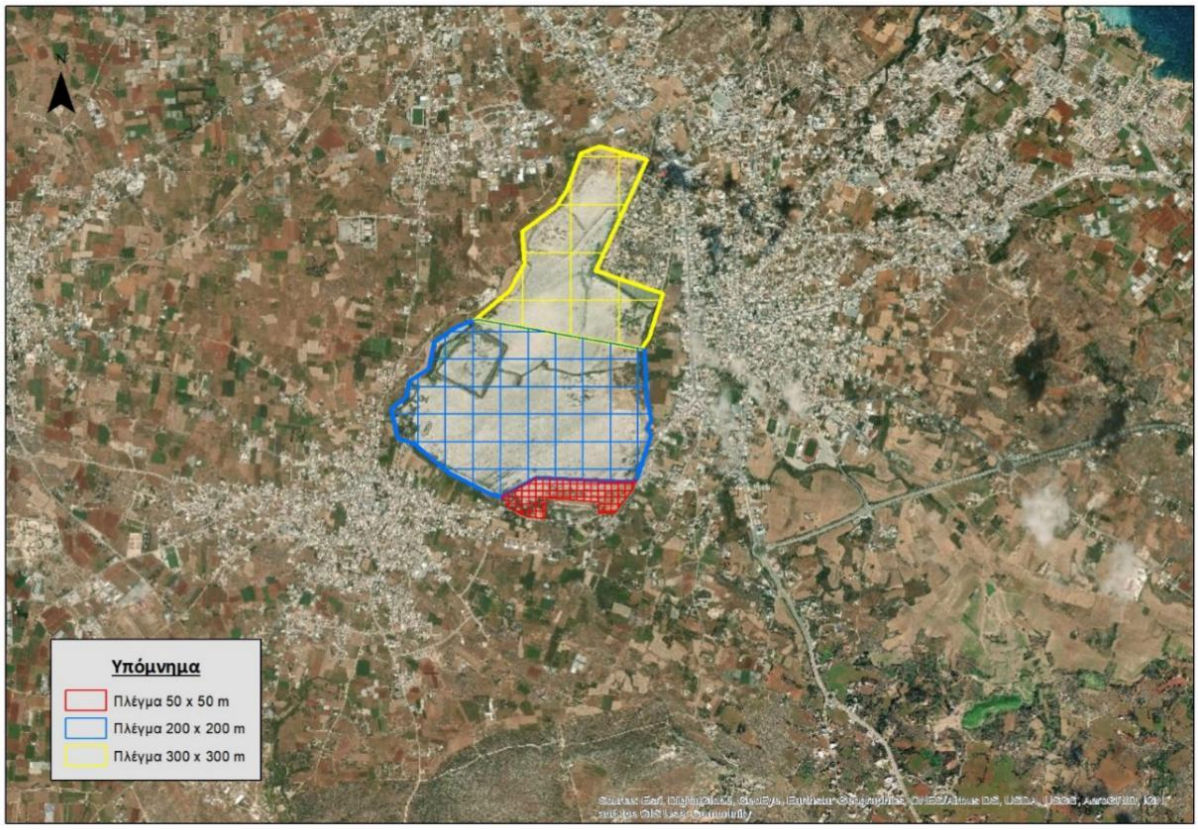
- *Shooting range → 50 x 50m (shown with red in image 1)*
- *Remaining lake volume (adjacent to the shooting area) → 200 x 200 m (shown with blue in image 1)*
- *Remaining lake volume (away from the shooting range) → 300 x 300 m (shown in yellow in image 1)*

Sampling Method: Regarding the sampling technique, the top layer of soil and/or salt was carefully removed from the selected sampling point, as well as some plants (in a small number of cases). A sample of surface sediment up to a depth of 10 cm was taken using a small shovel. The sample was stored in a plastic container. The coordinates of the sampling point were written on each container for traceability.

The pH of each sample was measured (1:1 mixture of sample with deionized water) and lead measurement followed using ICP-OES.

The number of lead pellets in 50 g of each sample was recorded.

Image 1: Paralimni Lake - Indicative location of the sampling *cells*.



Upon completion of the analysis of the first series of samples that were collected based on the above map, sampling was repeated for some areas that appeared to show particular interest, increasing the total number of samples to 153. These locations appeared to exhibit higher than the average concentrations of lead (as shown in appendix 1) which led to the additional sampling. An example would be the additional samples collected from the center of the lake as hunting is permitted in the area which was considered an important variable for lead contamination.

Results:

A graphical representation of the results of the lead measurements is shown below (images 2 and 3). Raw data can be found in the annex.

According to the results, the area adjacent to the shooting range exhibited the highest concentrations of lead, with the highest concentration reaching 2187 mg/kg while other areas such as the center of the lake exhibited above average results. 14.4% of the samples tested exhibited concentrations higher than 37 mg/kg and only 0.8% of the samples tested exhibited concentrations between 0.4 (limit of quantitation) and 36 mg/kg. 37 mg/kg was considered as the threshold effect level according to US EPA 1996a[1] and was used for the statistical analysis of the results as an indicator of the toxicity levels.

[1] D. D. MacDonald, C. G. Ingersoll, T. A. Berger Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems Arch. Environ. Contam. Toxicol. 39, 20–31 (2000)

The vast majority of samples in the surrounding area (away from the shooting range and the center of the lake) showed no lead presence (<0.13 mg/kg) while the minimum concentration for the positive findings was 17 mg/kg.

The pH values were approximately constant for all the samples collected from the area of interest ranging from 7,4 to 7,8.

Image 2. Paralimni Lake – Distribution of Lead

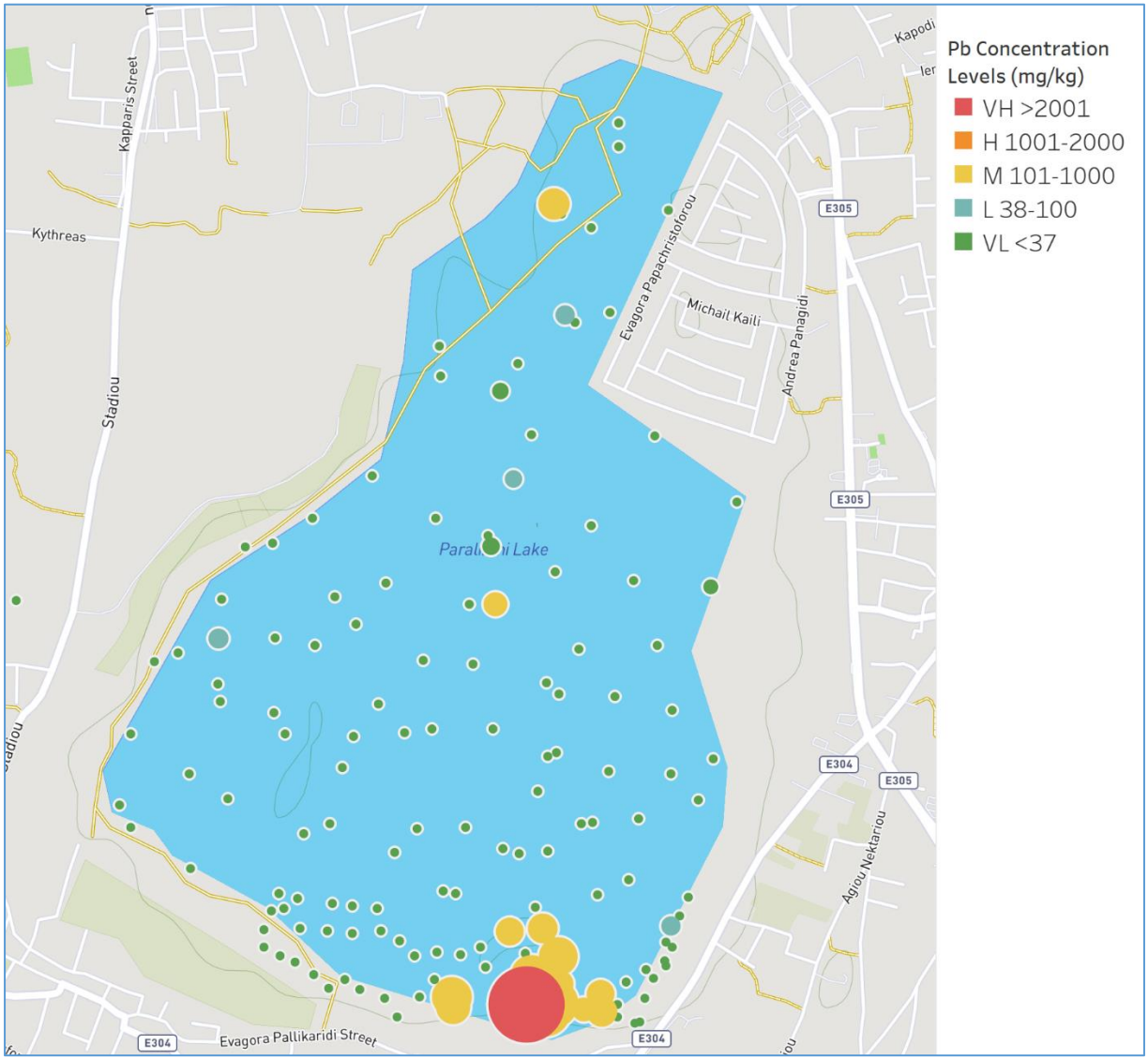
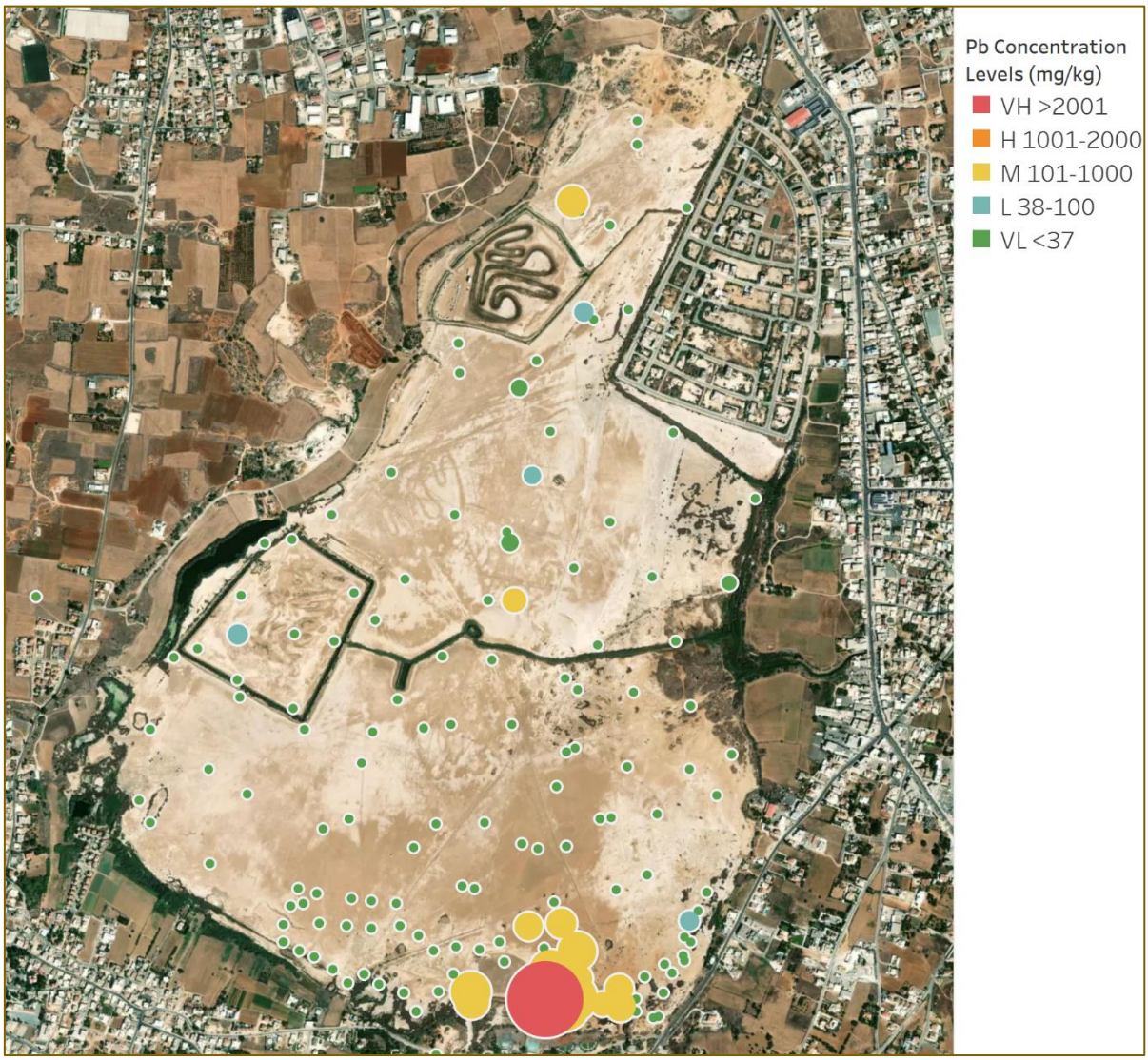


Image 3. Paralimni Lake – Distribution of Lead (aerial view)



Conclusions:

For the case of sediment samples collected from the *Paralimni Lake*, the highest concentrations of lead were identified at the area adjacent to the shooting range as well as the central area of the lake.

The number of lead pellets found in several cases is consistent with the presence of lead in the soil / sediment samples collected from the specific areas. This finding suggests that lead pellets may be the main cause of high lead concentrations and therefore the associated toxicity. The fact that high concentrations of lead were also identified in areas other than the ones close to the shooting range, in combination to the findings of high numbers of lead pellets at the same locations suggests that contamination may be due to other sources such as hunting which is also permitted in the area.

The above findings may suggest that preventing the future use of lead pellets will help decrease lead contamination in the area.

For cp FoodLab Ltd

Chara Papastephanou, Chemist

G. Director

Annexes:

Paralimni lake			
coordinates	Pb(mg/kg)	pH/ T (◦C)	number of shrapnels
35.0280218 / 33.9661964	457	7,6 T=24,8	7
35.0280062 / 33.9652422	<0,13	7,7 T=24,8	0
35.026468 / 33.965197	<0,13	7,5 T=24,7	0
35.0275153 / 33.9646113	<0,13	7,6 T=24,8	0
35.0279727 / 33.9642233	<0,13	7,8 T=25,0	0
35.0281786 / 33.9634884	<0,12	7,6 T=24,7	0
35.0284180 / 33.9630660	<0,13	7,6 T=24,8	0
35.0282170 / 33.9625691	<0,12	7,7 T=24,9	0
35.0285586 / 33.9621248	<0,13	7,6 T=24,8	0
35.0288647 / 33.9615928	<0,13	7,7 T=24,8	0
35.0290141 / 33.9611525	<0,13	7,5 T=24,7	0
35.0292040 / 33.96066128	<0,13	8,0 T=24,8	0
35.0296230 / 33.9606550	<0,13	7,9 T=25,0	0
35.0300710 / 33.9608780	<0,13	7,6 T=24,7	0
35.0304991 / 33.9610949	<0,13	7,6 T=24,8	0
35.0303859 / 33.9616648	<0,13	7,8 T=24,8	0
35.0302769 / 33.9626700	<0,13	7,6 T=24,8	0
35.0302050 / 33.9632748	<0,13	7,9 T=25,0	0
35.0301581 / 33.9640031	<0,13	7,6 T=24,7	0
35.0296101 / 33.9641110	<0,13	7,4 T=22,6	0
35.0293501 / 33.9646659	<0,13	7,9 T=25,0	0
35.0295560 / 33.9632631	<0,13	7,6 T=24,7	0
35.0295961 / 33.9625242	<0,13	7,7 T=22,7	0
35.0296639 / 33.9617239	<0,13	7,7 T=23,7	0
35.0289891 / 33.9651091	<0,13	7,4 T=21,7	0
35.0290909 / 33.9657670	<0,13	7,5 T=25,0	0
35.0290421 / 33.9664821	<0,13	7,6 T=24,7	0
35.0287450 / 33.9671989	<0,13	7,6 T=24,7	0
35.0296021 / 33.9679312	171	7,4 T=22,2	2
35.0296570 / 33.9689092	208	7,6 T=24,8	4
35.0289940 / 33.9693561	423	7,7 T=24,9	7
35.0285251 / 33.9685531	511	7,5 T=24,7	15
35.0290569 / 33.9683811	<0,14	8,0 T=25,0	3
35.030555 / 33.965943	<0,13	7,9 T=25,0	0
35.032112 / 33.966621	<0,13	7,8 T=24,7	0
35.033558 / 33.962994	<0,13	7,6 T=25,0	0
35.034467 / 33.965608	<0,13	7,7 T=24,8	0
35.094290 / 33.963294	<0,13	7,6 T=24,8	0
35.034359 / 33.961292	<0,13	7,9 T=25,0	0
35.035129 / 33.959383	<0,13	8,0 T=25,2	0
35.036090 / 33.957448	<0,13	8,0 T=25,2	0
35.034352 / 33.956742	<0,12	7,6 T=22,1	1
35.032633 / 33.956397	<0,12	7,6 T=23,1	0
35032108 / 33.956732	<0,13	7,6 T=22,9	0
35.031109 / 33.958517	<0,13	8,0 T=25,2	0
35.032801 / 33.959586	<0,13	8,0 T=25,0	0
35.033400 / 33.958454	<0,13	7,6 T=22,1	0

35031960 / 33.961847	<0,13	7,7 T=24,8	0
35.030154 / 33.961263	<0,13	7,6 T=24,8	0
35.027761 / 33.966264	184	7,9 T=24,9	7
35.027762 / 33.966264	307	8,0 T=25,2	2
35.027816 / 33.967906	503	8,0 T=25,3	9
35.027825 / 33.968432	2187	7,6 T=22,1	18
35.027689 / 33.968970	871	8,0 T=25,3	14
35.027755 / 33.969520	68	7,6 T=24,1	1
35.027721 / 33.970099	120	7,6 T=25,1	2
35.027665 / 33.970650	226	7,7 T=22,1	1
35.027520 / 33.971091	<0,13	8,0 T=25,0	0
35.027374 / 33.971610	<0,13	7,6 T=22,1	0
35.027424 / 33.971740	<0,13	8,4 T=21,9	0
35.027994 / 33.971900	<0,13	7,8 T=21,6	0
35.028460 / 33.972158	<0,13	7,8 T=21,6	0
35.028763 / 33.972528	<0,13	7,8 T=21,6	0
35.029225 / 33.972720	<0,13	7,8 T=22,9	0
35.029707 / 33.972803	<0,12	8,0 T=25,0	0
35.029973 / 33.972920	<0,13	7,6 T=25,1	0
35.029737 / 33.972688	55	7,7 T=21,6	0
35.029340 / 33.972532	<0,13	7,8 T=21,5	0
35.02888 / 33.972479	<0,13	7,8 T=21,5	0
35.028681 / 33.971939	<0,13	7,9 T=21,6	0
35.028381 / 33.971339	<0,13	7,8 T=22,2	1
35.028098 / 33.970595	172	8,0 T=25,0	8
35.027888 / 33.969426	122	7,6 T=24,1	4
35.027859 / 33.969224	762	7,4 T=21,4	7
35.0314638 / 33.9681786	<0,13	8,4 T=21,9	0
35.0321847 / 33.9700286	<0,13	7,7 T=22,8	0
35.0339038 / 33.8693008	<0,13	8,4 T=21,9	0
35.0344661 / 33.9674148	<0,13	8,4 T=22,9	0
35.0355831 / 33.9690131	<0,13	7,3 T=22,6	0
35.0360459 / 33.9668351	<0,13	7,9 T=24,9	0
35.0375792 / 33.953366	<0,13	8,0 T=25,2	0
35.0388789 / 33.9601061	<0,13	8,0 T=25,3	0
35.0395641 / 33.9620910	<0,13	7,6 T=22,1	0
35.0405661 / 33.9638472	<0,13	8,0 T=25,3	0
35.0395589 / 33.9657371	<0,12	7,6 T=24,1	0
35.0380049 / 33.9642730	<0,13	7,6 T=24,1	0
35.0374770 / 33.9667409	<0,13	7,7 T=23,1	0
35.0391441 / 33.9672891	<0,13	8,0 T=25,0	0
35.0415590 / 33.9685719	<0,13	7,6 T=24,1	0
35.0429790 / 33.9658900	<0,13	7,7 T=22,6	0
35.0432891 / 33.9681699	<0,13	8,0 T=25,2	0
35.0471498 / 33.9692119	241	7,6 T=24,8	0
34.0490929 / 33.9711428	<0,12	7,7 T=24,8	0
35.0469909 / 33.9726160	<0,13	7,6 T=24,7	0
35.0445156 / 33.9708608	<0,13	7,6 T=24,6	0
35.030411 / 33.973185	<0,13	7,8 T=25,1	0
35.030823 / 33.971410	<0,13	7,6 T=24,7	0

35.032306 / 33.971705	<0,13	7,6 T=24,8	0
35.03276 / 33.973499	<0,13	7,7 T=24,6	0
35.033767 / 33.973940	<0,13	7,6 T=24,8	0
35.034932 / 33.972719	<0,13	7,8 T=25,1	0
35.033403 / 33.972669	<0,13	7,6 T=24,6	0
35.033451 / 33.970831	<0,13	7,7 T=24,3	0
35.033823 / 33.969029	<0,13	7,9 T=22,2	0
35.035314 / 33.969360	<0,13	7,8 T=22,0	1
35.035260 / 33.971017	<0,13	7,6 T=23,1	0
35.0322267 / 33.970344	<0,13	7,6 T=22,9	0
35.032987 / 33.968754	<0,13	8,1 T=25,2	0
35.031521 / 33.969029	<0,13	8,02 T=25,0	0
35.030491 / 33.970508	<0,13	7,6 T=22,1	0
35.030187 / 33.968658	<0,12	7,7 T=24,8	0
35.031603 / 33.967723	<0,13	7,6 T=24,8	0
35.030508 / 33.966313	<0,13	7,9 T=24,9	0
35.029214 / 33.967069	<0,13	8,1 T=25,2	0
35.028446 / 33.965713	<0,13	8,0 T=25,3	0
35.0389591 / 33.9609390	<0,13	7,6 T=22,1	0
35.0376110 / 33.9594182	<0,13	8,0 T=24,3	0
35.0363021 / 33.9581280	<0,12	7,7 T=24,1	0
35.0355499 / 33.9593250	<0,12	7,6 T=25,1	0
35.0348751 / 33.9609641	<0,13	7,6 T=24,1	0
35.0366809 / 33.9609950	<0,12	8,0 T=25,0	0
35.0364981 / 33.9621828	<0,13	7,6 T=25,1	0
35.6376541 / 33.9627511	<0,13	8,3 T=21,9	0
35.0366510 / 33.9593360	59	8,0 T=24,0	1
35.0382761 / 33.9692699	<0,13	7,6 T=24,1	0
35.0364149 / 33.9699432	<0,13	7,4 T=24,4	0
35.0364931 / 33.9722629	<0,13	8,4 T=21,9	0
35.0379011 / 33.9738401	17	7,7 T=24,8	0
35.0399520 / 33.9746159	<0,13	8,2 T=21,9	0
35.0415570 / 33.9721841	<0,13	8,1 T=22,9	0
35.0393731 / 33.9703120	<0,13	7,7 T=22,1	0
35.0380620 / 33.9715759	<0,13	7,6 T=21,7	0
35.046901 / 33.96946	<0,13	7,7 T=24,6	0
35.04655 / 33.970319	<0,13	7,8 T=24,8	0
35.037013 / 33.963376	<0,13	7,8 T=25,1	0
35.036126 / 33.965361	<0,13	7,6 T=24,6	0
35.034383 / 33.96482	<0,13	7,7 T=24,4	0
35.048506 / 33.971135	<0,13	7,9 T=22,2	0
35.043705 / 33.96583	<0,13	7,8 T=24,0	0
35.032063 / 33.965199	<0,13	7,8 T=23,1	0
35.044473 / 33.969565	52	7,6 T=24,9	2
35.035073 / 33.964055	<0,13	8,1 T=25,2	0
35.027799 / 33.969376	230	8,0 T=25,0	3
30.042944 / 33.966758	<0,13	7,7 T=23,1	0
35.044279 / 33.969848	<0,13	7,7 T=24,8	0
35.032192 / 33.962596	<0,13	8,02 T=25,0	0
35.042628 / 33.96766	28	7,6 T=22,1	1

35.04052 / 33.968046	43	7,7 T=24,8	2
35.038868 / 33.967359	35	7,6 T=24,8	2
35.037498 / 33.967488	108	7,8 T=24,9	5
35.031489 / 33.964527	<0,13	8,1 T=25,1	0
35.028326 / 33.969393	178	8,1 T=25,0	3
35.027838 / 33.971093	<0,13	7,7 T=22,1	0