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North Cascades National Park
Ross Lake and Lake Chelan National Recreation Areas
Sedro Woolley, Washington 98284

LAKE CHELAN
FISH FAUNA AND LIMNOLOGY STUDIES

Misc. Research Paper NCA-8

NOT FOR PUBLICATION

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November 30, 1974

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LAKE CHELAN FISH FAUNA AND LIMNOLOGY STUDIES

Studies at the head of Lake Chelan, Washington were carried out by Park Research Biologist Robert Wasem and Biological Technician Kevin Mullen between the afternoon of Tuesday, 25 June and noon of Friday, 28 June 1974. Prior research at the head of Lake Chelan was carried out in June 1972 (Wasem, 1972) and June 1973 (Wasem, 1974). Studies in 1974 consisted of measurements of lake limnology at five stations, continuation of the fish fauna study, measurement of physical and chemical characteristics of five tributary streams, and determination of the sanitary quality of the waters of Lake Chelan and Purple Creek.

Lake Chelan Limnology Studies - June 1974

Physical and chemical conditions of the lake were measured at the same four stations as described in the 1972 progress report. An additional sampling station was established in mid-lake near the recreation area boundary opposite Riddle Creek. This station is approximately 7.9 kilometers (4.9 miles) south of the Stehekin River outlet at the head of the lake.

All measurements were made in mid-lake at a depth of about 0.25 meters (0.82 ft). Water temperature profiles were determined to the end of the instrument probe at 30 meters (98.4 ft) except at station number 1 in shallow water. Calm lake conditions prevailed until 1130 on 26 June when winds gradually increased enough to cause some minor difficulty in measuring station 5.

Water temperature data is presented in Table 1 and Figure 1. On 26 June the water at the head of Lake Chelan was not thermally stratified into well-defined layers of hypolimnion, metalimnion and epilimnion. The only water area qualifying as almost a true thermocline occurred in the surface meter at station 4 as the sun's rays and calm air conditions permitted warming of the surface layer. Development of moderate winds and cloud formations obscuring the sun probably caused a disruption and cooling of this warm surface layer by the time station 5 was measured over an hour later. This is graphically illustrated in Figure 1.

Surface waters of Lake Chelan within the recreation area ranged from 6.5C (43.7F) at station 1 closest to the Stehekin River, to 10.2C (50.36F) 7.9 kilometers (4.9 miles) south, near the recreation area boundary. Water temperatures gradually increased at all equal depths (to 30 meters) with distance from the Stehekin River outlet. This is also graphically illustrated in Figure 1.

Basic water quality at the surface is shown in Table 2. While being colder, waters at station 1 were also slightly lower in dissolved oxygen and significantly lower in specific conductance, pH, hardness and alkalinity. Turbidity was greater, hence Secchi disc visibility less at stations 1 and 2 as influenced by inflowing turbid waters from the Stehekin River. Data suggests that, with the exception of temperature, lake water had pretty much stabilized in respect

to clarity, dissolved oxygen and ionic concentrations at station 2 which is located about 2.7 kilometers (1.7 miles) distance from the Stehekin River outlet.

Fish Fauna Studies

Four overnight gill net sets were made on 26-27 June and 27-28 June. Nets were of the experimental (variable mesh) type of monofilament construction and 120 feet long by 6 feet deep. Nets worked off the bottom and were attached to shore. All four sets were made along the northeast lakeshore south of Purple Point.

The four sets combined fished for 70.37 hours and captured 64 fish for a mean capture rate of 0.91 fish per hour and an average of 1.099 hours required to net each fish. The mean capture rate per hour per 100 ft² of gill net was 0.0316 fish for all nets combined.

Table 3 lists numbers of fish captured by species. Desirable sporting species comprised but 9.4 percent of the catch. A total of 64 fish of 7 species were taken in 4 gill net sets in 1974 as compared with 82 fish of 6 species in 6 net sets in June 1973, and 75 fish of 7 species in 5 net sets in June 1972. As in previous years Dolly Varden charr (Salvelinus malma), cutthroat trout (Salmo clarki), and mountain whitefish (Prosopium williamsoni) were not represented in the gill net catch. Cutthroat trout and Dolly Varden are both known to be native to the drainage but the mountain whitefish has always been a question mark (Evermann 1899, Tschirley 1957, Wasem 1972).

Means and extremes in lengths and weights of the seven species of fish are given in Table 4. The largest fish collected was a longnose sucker (Catostomus catostomus) weighing 880 grams (1.94lb avdp) and with a fork length of 433 millimeters (16.887 in).

Table 5 lists means and extremes of condition factor for the seven species. The K-FL of the single rainbow trout was slightly less than the average of 1.012 (0.835 to 1.135 extremes) of five rainbow taken from the head of Lake Chelan in June 1973 (Wasem, 1973). The K-TL of 0.61 of the single burbot specimen compares with an average K-TL of 0.67 (0.63 to 1.22 extremes) for 20 burbot collected from three reservoirs in South Dakota in 1954, 1958, 1959, 1961 and 1962 (Carlander, 1969).

The mean K-FL of the four kokanee salmon was 1.066 which compares with the 1.098 for 115 males and 1.023 of 96 females taken while spawning in Company Creek, a tributary of the Stehekin River, in early November 1973 (Wasem, 1974).

Stream Water Quality

Basic water quality of five important streams flowing into Lake Chelan was measured on 26, 27 and 28 June. These data with that of the well water supply for Stehekin Landing is presented in Table 6. All stream water was cold, clear, of slightly acid to slightly alkaline pH, and low in bicarbonate alkalinity, hardness, and specific conductance.

All streams were running moderately high. Discharge was determined near stream outlets at the lake by measuring average depths and widths with a meter tape and meter stick. Stream velocity was determined by use of a General Oceanics Model 2030 digital flowmeter. In late June 1974, Riddle Creek was discharging more water into Lake Chelan than Canyon Creek, Bridal Veil Creek and Castle Creek combined.

Sanitary Water Quality

Sanitary water quality was tested by membrane filtration of raw natural water by use of the Millipore Portable Water Laboratory. Prepared filters are placed in a growth media and incubated at a temperature of 35C (95 F) for 18 to 24 hours. The culture is then examined under a low power microscope or a hand lens and fluorescent light and the Coliforms separated from non-Coliforms by distinctive characteristics. The American Public Health Association (1971) has set a maximum limit of 4 Coliform colonies per 100 milliliter (ml) sample for drinking water supplies. Some states have even more stringent regulations.

Sanitary water quality was measured on 28 June by testing for presence of total Coliform bacteria at 7 locations at the head of Lake Chelan as well as 1 stream location and the Stehekin Landing well. Results were negative for Coliforms from 3 different volume samples from the well and 3 lake locations (Table 7). Three other lake sampling locations yielded small, insignificant numbers of Coliform colonies, while the sample point in open lake water off Weaver Point showed 3 and 2 colonies for the 100 and 50 ml sample sizes respectively.

The Purple Creek sample was taken only 30 meters or so upstream from Lake Chelan. High bacteria counts indicate possible sewage effluent seepage into the stream. It is recommended that drinking water from this source continue to be chlorinated. Monitoring of Coliform bacteria levels in Purple Creek will continue.

In the future, Total Coliform and Fecal Streptococcus tests will be conducted if equipment and growth media can be obtained. Such tests will help differentiate between the many harmless and natural Coliforms and harmful pathogenic species introduced by man.

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Table 1. Water temperature profiles for 5 stations at the head of Lake Chelan on 26 June 1974. Weather was calm to light winds and mostly clear.

Depth in Meters	No. 1 (0910)	No. 2 (0950)	No. 3 (1035)	No. 4 (1120)	No. 5 (1245)
Air Temp. (°C)	15.0 ^{3/}	17.9 ^{3/}	19.1 ^{3/}	16.8 ^{4/}	16.2 ^{5/}
Surface (°C)	6.5	9.8	10.2	11.4	10.2
0.5	6.1	9.5	9.9	10.5	10.2
1.0	6.0	9.3	9.8	10.1	10.2
1.5	5.9	9.2	9.5	9.8	10.2
2.0	5.9	9.1	9.4	9.7	10.1
2.5	5.8	9.0	9.3	9.6	10.0
3.0	5.7	9.0	9.2	9.6	10.0
3.5	5.6 ^{1/}	8.9	9.2	9.6	9.9
4.0		8.9	9.1	9.5	9.9
4.5		8.7	9.0	9.5	9.8
5.0		8.6	9.0	9.4	9.7
5.5		8.5	9.0	9.3	9.6
6.0		8.5	8.9	9.3	9.6
6.5		8.5	8.8	9.2	9.5
7.0		8.5	8.7	9.1	9.5
7.5		8.5	8.7	9.1	9.5
8.0		8.5	8.6	9.1	9.5
8.5		8.4	8.6	9.0	9.4
9.0		8.4	8.6	9.0	9.3
9.5		8.4	8.6	9.0	9.3
10.0		8.3	8.6	9.0	9.3
10.5		8.3	8.5	8.9	9.2
11.0		8.3	8.5	8.9	9.2
11.5		8.2	8.4	8.8	9.2
12.0		8.2	8.4	8.8	9.1
12.5		8.2	8.4	8.7	9.1
13.0		8.1	8.4	8.7	9.1
13.5		8.1	8.3	8.7	9.1
14.0		8.1	8.3	8.7	9.1
14.5		8.1	8.3	8.7	9.0
15.0		8.0	8.3	8.6	9.0
15.5		8.0	8.3	8.6	9.0
16.0		8.0	8.3	8.6	9.0
16.5		8.0	8.3	8.6	9.0
17.0		8.0	8.2	8.6	8.9
17.5		8.0	8.2	8.5	8.9
18.0		7.9	8.2	8.5	8.9
18.5		7.9	8.2	8.5	8.9
19.0		7.9	8.2	8.5	8.9
19.5		7.8	8.2	8.4	8.9
20.0		7.8	8.2	8.4	8.9

Table 1
Cont'd.

	1	2	3	4	5
20.5		7.8	8.2	8.4	8.9
21.0		7.8	8.2	8.4	8.9
21.5		7.8	8.1	8.4	8.9
22.0		7.8	8.1	8.4	8.8
23.0		7.8	8.1	8.3	8.8
24.0		7.7	8.1	8.3	8.8
25.0		7.7	8.1	8.3	8.8
26.0		7.7	8.1	8.2	8.8
27.0		7.7	8.1	8.2	8.7
28.0		7.7	8.0	8.2	8.7
29.0		7.7	8.0	8.2	8.6
30.0		7.7 <u>2/</u>	8.0 <u>2/</u>	8.2 <u>2/</u>	8.6 <u>2/</u>
Mean	5.937	8.27	8.564	8.906	9.253

- 1/ lake bottom at 3.4 meters (11.15 ft)
2/ end of temperature probe at 30 meters (98.4 ft)
3/ mostly calm with clear sky
4/ wind increasing to approx. 3 to 6 m.p.h. out of south and hazy cloud cover increasing gradually
5/ windy with high, thin overcast; lake moderately rough

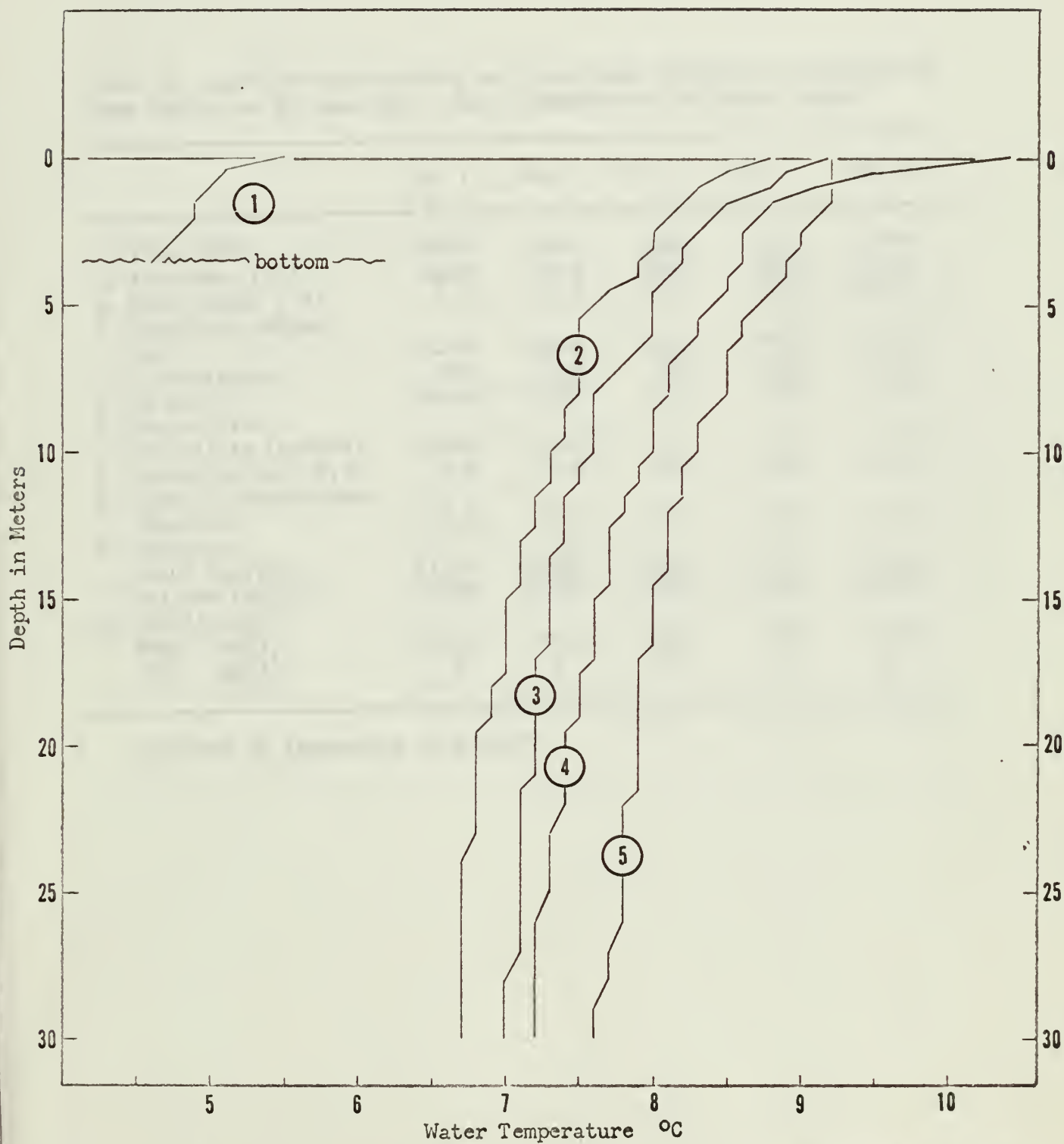


Fig. 1. Thermal profiles of upper 30 meters at 5 mid-lake stations at the head of Lake Chelan on the morning of 26 June 1974.

Table 2. Surface water quality at 5 mid-lake stations at the head of Lake Chelan on 26 June 1974. Water sampled at 0.25 meter depth.

	No. 1	No. 2	No. 3	No. 4	No. 5
1. Time (PDT)	0900	0950	1030	1115	1240
2. Air temp. (°C)	15.0	17.9	19.1	16.8	16.2
3. Water temp. (°C)	6.5	9.8	10.2	11.4	10.2
4. Dissolved oxygen:					
mg/l	11.8	12.6	12.8	12.8	12.4
% saturation	100	115	118	121	115
5. pH units	6.95	7.25	7.30	7.30	7.25
6. Secchi disc					
visibility (meters)	2.25	5.65	6.15	7.4	6.5
7. Turbidity (J.T.U.)*	2.9	2.0	0.67	0.81	0.77
8. Specific conductance					
(Mhos/cm)	28.8	41.6	45.5	43.3	44.5
9. Hardness:					
Total (mg/l)*	11.91	18.26	18.67	18.26	18.93
Calcium (mg/l)*	9.89	14.46	15.65	15.26	15.22
10. Alkalinity:					
HCO ₃ (mg/l)	12.0	17.0	18.0	18.0	18.0
CO ₃ (mg/l)	0	0	0	0	0

* measured in laboratory on 6/30/74

Table 3. Fish captured in gill nets during faunal studies at the head of Lake Chelan; 26-28 June 1974.

Common Name	Scientific Name	Fish Captured	
		Number	Percent
Rainbow trout	<u>Salmo gairdneri</u>	1	1.56
Kokanee	<u>Oncorhynchus nerka</u>	4	6.25
Burbot (ling)	<u>Lota lota</u>	1	1.56
Peamouth	<u>Mylocheilus caurinus</u>	6	9.38
Northern squawfish	<u>Ptychocheilus oregonensis</u>	11	17.18
Largescale sucker	<u>Catostomus macrocheilus</u>	23	35.94
Longnose sucker	<u>Catostomus catostomus</u>	18	28.12
	TOTAL	64	99.99

Table 4. Summary of lengths and weights of 64 fish captured by gill net from the head of Lake Chelan on 26 - 28 June 1974.

Species	N	Forklengths (millimeters)			Total Length (millimeters)			Weight (grams)	
		Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min. Mean
Salmo gairdneri	1			269			288		178
Oncorhynchus nerka	4	241	222	233	266	246	257	153	120 136
Lota lota *	1						372		314
Mylocheilus caurinus	6	190	165	174	213	185	198	72	44 54
Ptychocheilus oregonensis	11	309	165	240	345	180	262	343	52 170
Catostomus macrocheilus	23	408	137	264	432	152	286	860	35 258
Catostomus catostomus	18	409	162	301	433	179	320	880	50 355

1 millimeter = 0.039 inches; 1 gram = 0.0327 ounces (avdp)

* no fork length category for burbot

Table 5. Condition factors for seven species of fish captured by gill net at the head of Lake Chelan; 26-28 June 1974.

Species	N	Condition Factor (K-FL)			Mean	
		Max.	Min.	Range	Condition Factor K-FL	Condition Factor C-FL
Salmo gairdneri	1				0.9145	33.013
Oncorhynchus nerka	4	1.1068	0.9659	0.1409	1.0656	38.470
Lota lota *	1				0.6100	22.020
Mylocheilus caurinus	6	1.1379	0.8647	0.2732	1.0228	36.926
Ptychocheilus oregonensis	11	1.3071	0.8058	0.5013	1.1294	40.773
Catostomus macrocheilus	23	1.4161	1.0373	0.3821	1.2151	43.867
Catostomus catostomus	18	1.2862	1.0808	0.2054	1.1476	41.428

* K-FL and K-TL identical with this species

Table 6. Water quality from five streams flowing into the head of Lake Chelan and from the well water system at Stehekin; late June 1974. Streams measured near lake.

	Canyon	Bridal	Castle	Riddle	Purple	Stehekin
	Creek	Veil Creek	Creek	Creek	Creek	Well Water
Date	6/27	6/26	6/27	6/26	6/28	6/28
Time (Pacific Daylight)	0930	1745	1030	1330	1110	1030
Air temperature (°C)	16.2	14.5	16.4	21.3	17.9	23.9
Water temperature (°C)	6.9	7.2	6.6	7.1	9.0	7.3
pH units	6.95	6.90	7.0	7.05	7.2	6.65
HCO ₃ alkalinity (mg/l) ^{1/}	9.5	6.0	9.75	11.5	14.5	10.75
Total hardness (mg/l)	9.02	6.12	10.20	10.08	13.22	15.26
Ca hardness (mg/l)	7.85	5.57	8.02	9.30	11.49	12.08
Specific conductance (Mhos/cm)	22.3	17.2	26.9	25.8	32.6	36.5
Total dissolved ionizable solids (mg/l)	7.70	5.13	8.55	8.55	12.83	14.55
Dissolved oxygen (mg/l)	13.0	12.2	13.2	12.8	12.4	*
Dissolved oxygen (% sat.)	110	105	112	110	112	*
Turbidity (J.T.U.)	0.24	0.36	0.42	0.60	0.21	0.28
Mean depth (meters)	0.11	0.145	0.33	0.23	*	-
Stream width (meters)	2.50	3.50	4.0	17.0	*	-
Velocity (m/sec)	1.50	1.85	1.83	1.71	*	-
Discharge (m ³ /sec)	0.33	0.75	1.97	5.28	*	-
Discharge (c.f.s.)	11.65	26.7	69.5	188.4	*	-

^{1/} no CO₃ alkalinity

* not measured

Table 7. Coliform bacteria tests of waters of Lake Chelan, Purple Creek and Stehekin well on 28 June 1974. Lake samples from 0.25 meter depth at between 1145 and 1230 PDT.

Sample Volume Tested and Sample Location		No. Coliforms per 100 ml
T-100 ml	tap water from well (not	0
T-50	chlorinated) taken in North	0
T-25	Cascades Lodge	0
P-100	Purple Creek just below	55
P-50	Stehekin Road bridge	28
P-25		88
C1-100	Lake Chelan at public	1
C1-50	dock at Stehekin	0
C1-25		0
C2-100	1/3 distance across Lake	0
C2-50	Chelan from public dock	0
C2-25		0
C4-100	Lake Chelan off NPS boat	0
C4-50	dock at old ranger station	0
C4-25	at Stehekin Landing	0
C5-100	1/3 distance across Lake	1
C5-50	Chelan from NPS boat dock	0
C5-25		0
C6-100	at dock at Weaver	1
C6-50	Point, Lake Chelan	0
C6-25		0
C7-100	1/3 distance across Lake	3
C7-50	Chelan from Weaver Point	2
C7-25		0
C8-100	Approx. 100 meters off	0
C8-50	Painted Rocks, Lake Chelan	0
C8-25		0

