PROVINCE OF BRITISH COLUMBIA

BC Environment

MEMORANDUM
FISHERIES BRANCH

Date: April 23, 1992 File: 0202-20

To: A.Martin, A.Tautz, and B.Hooton

Re: **Dave Bustard's 1991 population survey results for the Skeena drainage and implications**

I've quickly reviewed the report entitled "Juvenile steelhead surveys in the Kitwanga, Morice, Sustut, and Zymoetz rivers" by David Bustard & Associates. This was done to give me and those concerned a second opinion of the results. Given the large sample size (N = 123 sites) and diverse habitat conditions, it is not immediately evident what the results truly mean. I will first comment on what the data suggests and follow-up with comments on the technical merits of the report and implications for future inventory.

To assist in the overview, I've plotted fish density on mean weight by size class using log-log paper. This permits the display of all fish density data for all size classes and can be rated against maximum measures from past surveys or alkalinity model predictions of maximum population density (see attached scatter-plots). It must be remembered that past surveys rarely accounted for poor habitat suitability in a strictly quantitative sense; this means that strict comparisons are not possible among sites within a reach or among years. I am highly suspicious of the use of qualitative habitat terms to account for habitat suitability. An example of this judgement call can be seen from what is termed good "parr" habitat for site K4 (Kitwanga River). What appears in Photo 2 is habitat that is too shallow for larger sized fish with poor cover attributes (d_{90} = 30cm); unfortunately there is no entry for mean depth on the data form. As a result, the "low" parr densities cannot be unequivocally attributed to "poor" fry recruitment in the last two years since parr abundance is strongly affected by: "cover" attributes, interaction with juvenile chinook and Dolly Varden of similar size, and shallow hydraulics. Had the sample sites been deeper habitats with boulder or large woody debris (LWD) cover, the "low" parr densities may have been interpreted differently.

The 1991 Kitwanga data as plotted suggests this system was operating near carrying capacity particularly for steelhead fry. Despite Bustard's assertion that no prior quantitative surveys were completed (p.2) on this stream, there was one site surveyed in 1983. This data coupled with an alkalinity of $35mg \cdot L^{-1}$ suggests a capacity of $215g \cdot 100m^{-2}$ (95%CI: 182-254) per size class in suitable habitat. Since Dolly Varden and steelhead fry overlapped in fork length, their combined density of 324 FPU at a mean size of 0.99g gave a biomass density of $320g \cdot 100m^{-2}$ (95%CI. 273-367). Age (1+) and age (2+) steelhead densities were 20.7 FPU @10.6g and 4.6 FPU@18.5g respectively at the same site. The site also contained juvenile chinook at a density of 138 FPU@4.4g. Total biomass density was $1239\ g \cdot 100m^{-2}$ and it was associated with a complex sidechannel with LWD located 2.4km downstream of Kitwancool Cr. near Bustard's site K4. The comment high stream temperatures at site K7 seriously limits rearing appears spurious, particularly considering the highest steelhead "parr" density was estimated there (21 FPU). I don't think its reasonable to suggest the yearlings were only 18mm larger than the fry in this warm reach; it is more likely they are all age (0+) fish (eg.53.4 FPU@2.53g).

Bustard's conclusions about fry abundance (main target) for Morice tributaries seem generally reasonable and supported by the significant earlier work of Tredger et al. However comparisons in Buck Cr. are puzzling since no appended data is referenced; a mean steelhead fry density of 45 FPU@1.56g for 1991 sampling falls short of the observed and theoretical maximum of 192 FPU at the same mean size. A quick glance of the scatterplot for Owen/Lamprey/Pimpernel suggests fry densities close to the maximum while parr densities are about 20% of the maximum. The reasons for lower than expected parr abundance are probably a result of sampling bias towards shallow, low complexity habitats and the investigator's inability to extract parr from complex habitats (p.58). It is noteworthy that "open" sites sampled prior to 1991 are presumed to under-estimate true population density yet the maximum measures are actually consistent with those of Bustard.

Given the generally agreed upon difficulty in sampling parr populations, is it reasonable to recommend enhanced sampling of parr in 1992? According to Slaney (pers.comm.) there is no such thing as a parr density biostandard as suggested by Bustard on p.59. It is appropriate to use the alkalinity model or stream-specific estimates of maximum parr densities to "rate" observed, normalized fish densities of 1991. The recommendation to collect further water quality data is sound as it is a basic habitat productivity input.

Fry sizes would be expected to be larger in 1992 as a result of sub-saturation levels of recruitment (re.density-dependence).

Both steelhead fry and parr densities are highly depressed in the Sustut. The scatterplot shows the **maximum** observed densities of 1991 are about 25% of capacity, not 50% as suggested by Bustard. The sample results for 1983-85 provide a superior measure of representative fish abundance under more favourable recruitment despite Bustard's assertion on p.35; see scatterplot of 1983-85 results for comparison. There is no doubt in my mind having seen the habitat photos and descriptions for the earlier surveys that densities, though greater, are not entirely reflective of suitable habitats. The only way of adjusting for "low" densities is to divide the observed density for fry by quantified estimate of hydraulic suitability. There is some truth in Bustard's criticism of the small areas sampled earlier (eg.<50m^2) in that parr can be displaced from their preferred areas during enclosure of the sample site; however most sites sampled by Reg.6 staff in 1983-85 were >100m^2.

The sample density (eg.45 sites per 118km) appears somewhat excessive particularly since some of the reaches were previously classified as non steelhead-bearing. A more reasonable sample number would be 17 stratified among the four reaches. The geometric mean fry density for samples made in the four primary reaches used by steelhead suggests fry rearing habitat was saturated at 4.2% of capacity. This reflects a potential spawning population of about 96 adults (95%CI:48-192) and is far short of the minimum escapement goal of 2475.

No
Given the importance of stream.

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Contrary to Bustard's observation that "there are no historic juvenile steelhead data for the mainstem Zymoetz (downstream of McDonnel Lake)" (pp.2,48), there in fact is. I completed a cursory examination of the influence of a glacial tributary (Serb Cr.) in 1978 and regional staff completed one site in a sidechannel of the lower river in 1983. The scatterplot of 1991 data suggests most sites were supporting near 40% of the expected capacity except for site Z1 (cf.100% capacity). The historic densities were generally lower than those of 1991 especially for "fry". Given the "poor" parr habitat conditions at site Z12 and upper mainstem sites, the "low" parr densities do not necessarily suggest habitat under-utilization (p.58).

To summarize:

1.The 1991 results generally confirm the SMU spreadsheet results suggesting a higher probability for recruitment failure in the Sustut (eg.max allowable exploitation of 38%) compared to the Kitwanga (exploit= 80%). The results for the Morice and Zymoetz are intermediate; their fry densities represented 40% or higher capacities and their allowable exploitations range from 47-56% respectively. It is recommended that the Kitwanga be dropped as a candidate stream.

2.Sampled parr densities in 1991 cannot be easily adjusted for variations in habitat suitability because of the lack of hydraulic transects. Comment on their biological meaning would be dangerous. This criticism is also valid to a lesser degree for interpretation of "fry" densities. Any future stock monitoring should include stream transect data and computation of suitability indices. This would obviate the need to sample the exact same sites and the same streamflows each year.

3.Greater effort is needed to describe steelhead abundance and what is expected in the larger mainstem habitats (eg.Bulkley, middle and upper Skeena). These habitats evidently account for the majority of juvenile steelhead biomass and potential adult run size (cf.53% total). Their low stock productivity indices suggest high vulnerability to commercial over-exploitation (eg.<40% allowable exploitation) as for the Sustut. Unfortunately we have no inventory results relevant to the Skeena or Bulkley mainstems for 1991 and no surveys were recommended by Bustard for 1992 (p.62) for these important reaches.

Nor do we know where they spawn

4.It remains uncertain given the recent coast-wide poor escapements how we will validate our habitat productivity estimates for the Skeena drainage. This is especially true for the reaches described in point#3. We gained a sense of habitat capacity in the Bulkley in 1983-85 at a time of better-than-average adult returns and fry recruitment. We have very little data for the Skeena mainstem other than some qualitative boat-shocking results. Fortunately we do have some measurement of habitat capacity following controlled recruitment experiments in headwater tributaries of the Skeena. The results may not be applicable to habitats affected by suspended sediments.

We should discuss the above in light of stock assessment efforts proposed for 1992 at your collective convenience.

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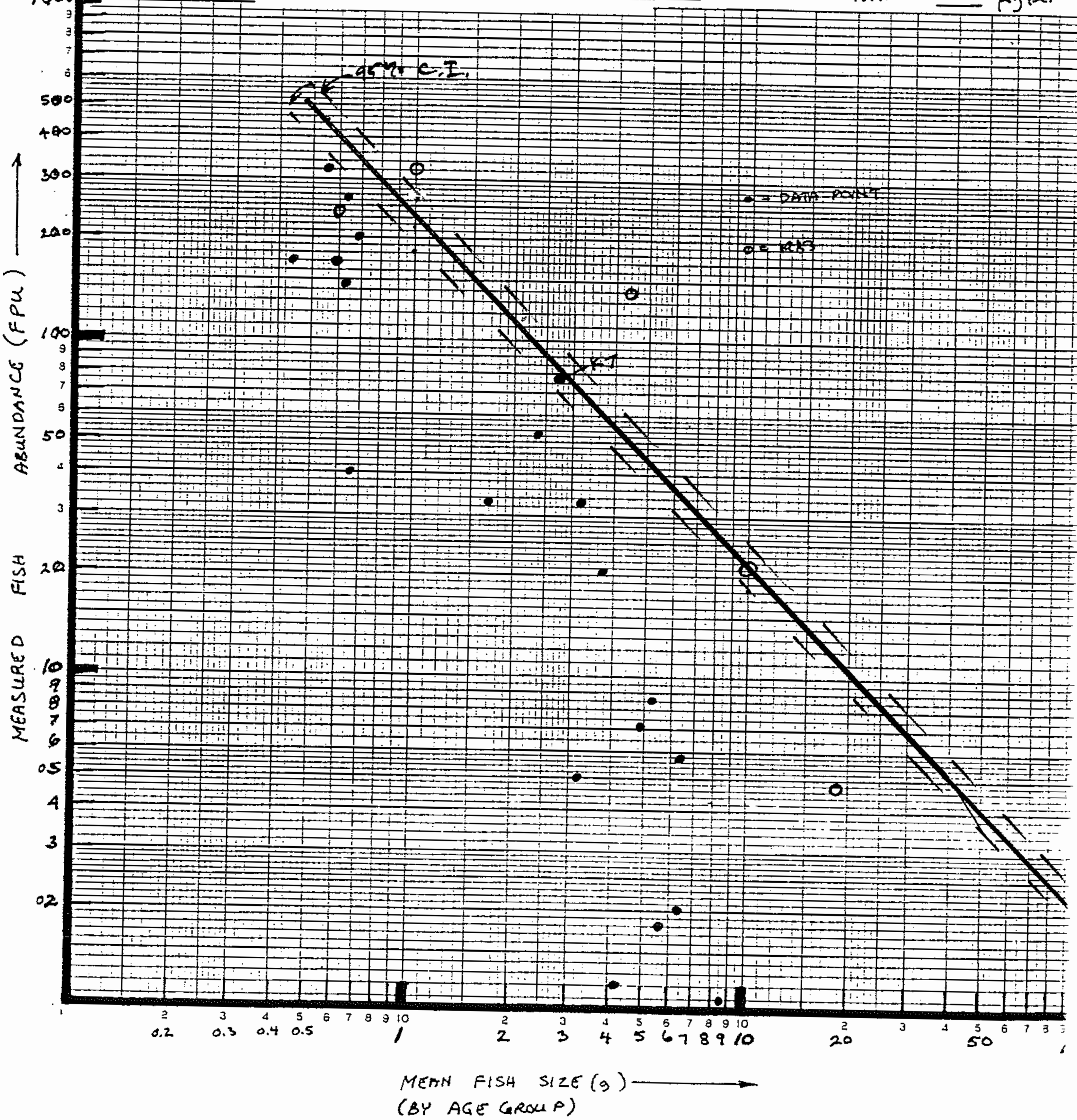
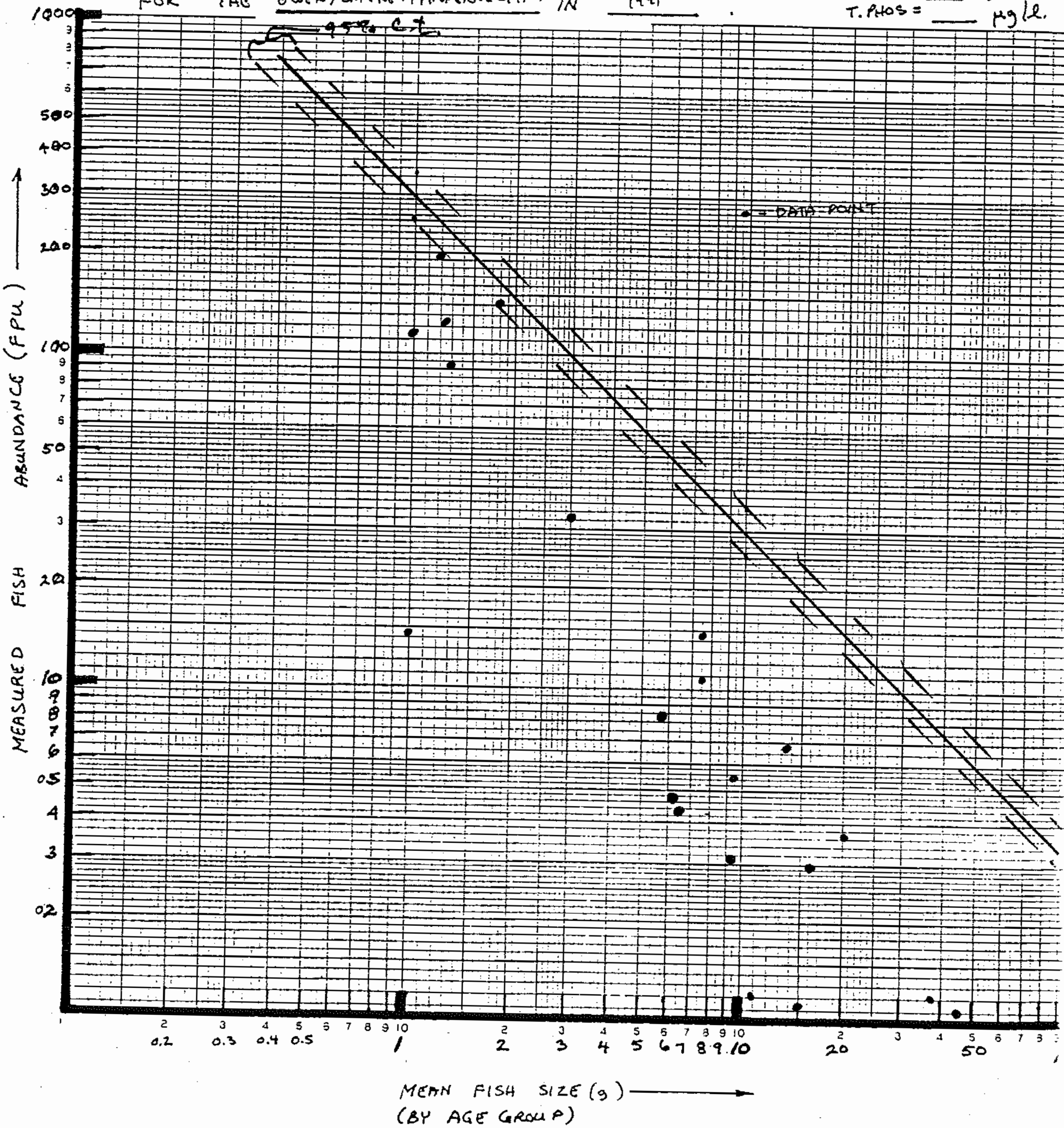
SCATTERGRAM OF ACTUAL (MEASURED) JUVENILE STHD/DV/CHIC DENSITY
VERSUS MEAN SIZE WITH SOLID LINE DEPICTING MAXIMUM (THEORETICAL)
FOR THE KITWANGA (MID-AUGUST) IN 1991

T.ALK = 35 mg/l
T.PHOS = ___ µg/l.

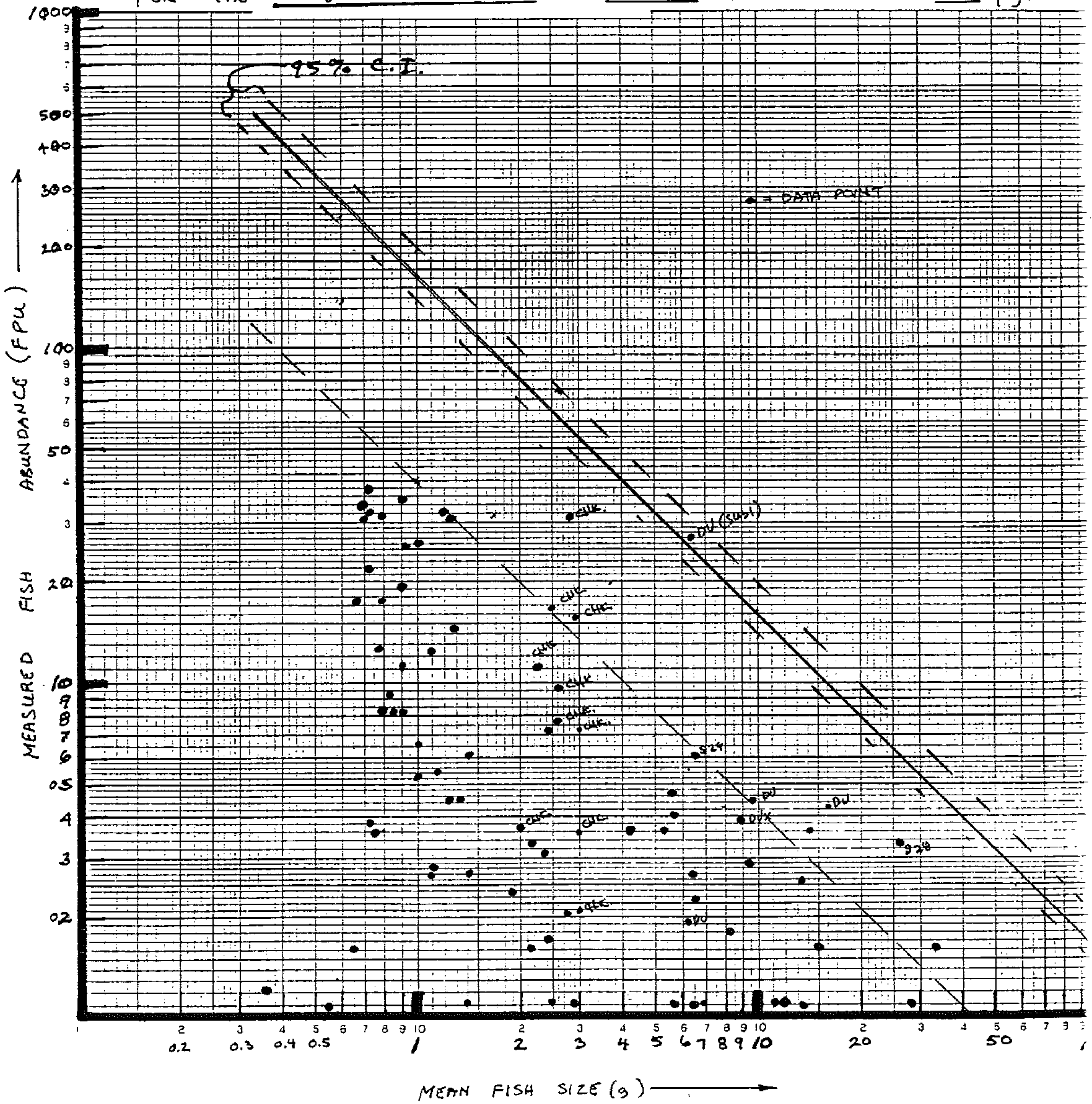


SCATTERGRAM OF ACTUAL (MEASURED) JUVENILE STHD/DV/CHK DENSITY VERSUS MEAN SIZE WITH SOLID LINE DEPICTING MAXIMUM (THEORETICAL) FOR THE OWEN/LAMPREY/PIMPERNEL/H.T IN 1991

T.ALK = 68 mg/l
T. PHOS = ___ µg/l.



SCATTERGRAM OF ACTUAL (MEASURED) JUVENILE STHD / DV / CHK DENSITY
VERSUS MEAN SIZE WITH SOLID LINE DEPICTING MAXIMUM (THEORETICAL)
FOR THE SUSTUT IN 1991. T. ALK = 20 mg/l T. PHOS = ____ μg/l.

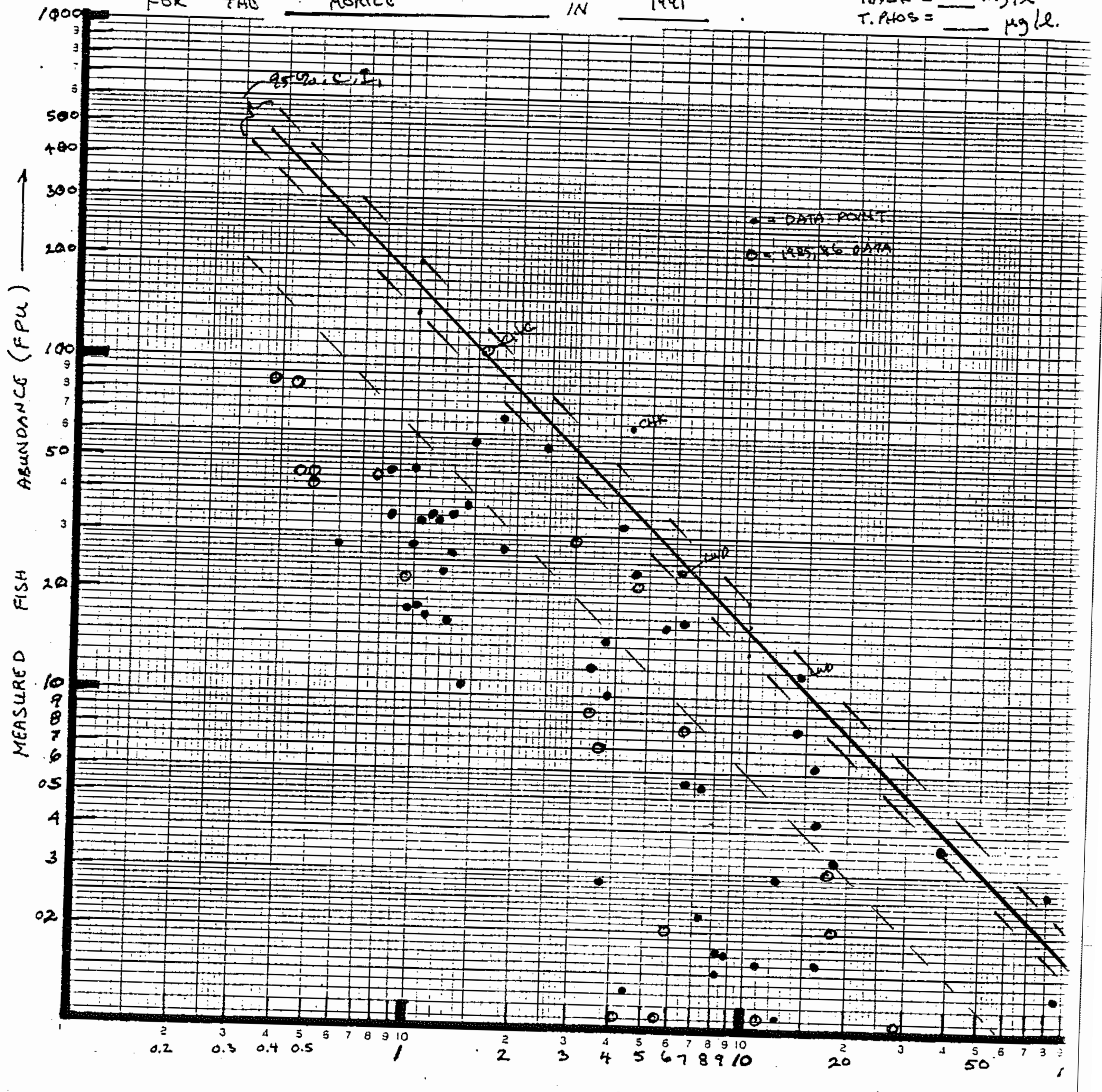


∴ SUSTUT @ ≤ ~25% CAPACITY (BIOMASS)

Full Logarithmic, 3 × 3 Cycles

SCATTERGRAM OF ACTUAL (MEASURED) JUVENILE COHO/DV/CHK DENSITY VERSUS MEAN SIZE WITH SOLID LINE DEPICTING MAXIMUM (THEORETICAL) FOR THE MORICE IN 1991

T.ALK = 20 mg/l
T.PHOS = ___ μg/l.



RV FRY @ 38% POTENTIAL

Full Logarithmic, 3 × 3 Cycles

SCATTERGRAM OF ACTUAL (MEASURED) JUVENILE STHD/DV/CHK DENSITY
VERSUS MEAN SIZE WITH SOLID LINE DEPICTING MAXIMUM (THEORETICAL)
FOR THE ZYMOETZ IN 1991

T.ALK = 28 mg/l
T.PHOS = ____ μg/l.