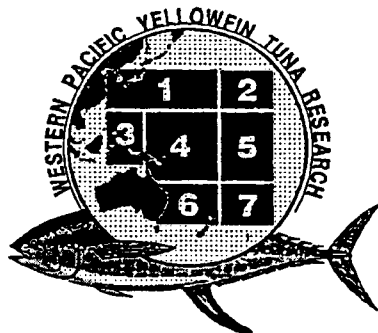




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Yellowfin tuna length-weight sampling
in the southwestern Pacific:
A progress report

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Working paper for the 4th Meeting of the Western Pacific Yellowfin Tuna Research Group,
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YELLOWFIN TUNA LENGTH-WEIGHT SAMPLING IN THE SOUTHWESTERN PACIFIC: A PROGRESS REPORT

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INTRODUCTION

Collection of individual weights of fish sampled at-sea and at unloading ports is usually more difficult than measuring individual fish lengths. Therefore, individual fish lengths are usually collected and scientists develop length-weight (L-W) relationships to estimate weight from length.

L-W relationships for yellowfin tunas were reviewed by the Western Pacific Yellowfin Tuna Research Group (WPYRG) at its second meeting in Honolulu, Hawaii. Nine relationships were found in the literature (WPYRG 1992). The WPYRG concluded that there were significant differences in L-W relationships among areas, seasons, sexes, years and fishing methods. The WPYRG decided to use the L-W relationship of Nakamura and Uchiyama (1966) for converting lengths to weights until further studies could be undertaken.

This report reviews progress on developing a L-W relationship, based on a sample of lengths and weights of yellowfin tuna caught by U.S. purse seiners fishing in the southwestern Pacific. A statistical comparison is made between the L-W relationship derived in this study, and that of Nakamura and Uchiyama (1966).

SAMPLING PROCEDURES

Collection of L-W data from yellowfin tuna landings began in June 1994. The landings were from U.S. purse seiners fishing in the southwestern Pacific and unloading in Pago Pago, American Samoa where individual fish lengths and corresponding weights were taken by National Marine Fisheries Service Fishery Biologists. The objective of the L-W sampling was to record the weights of at least 25 fish at each one-centimeter length class in the range of 35

to 150 cm. An assessment of the sample size needed to accurately predict the weight at each length class will be made when this objective is met, and sampling will be increased to reach this sample size.

Samplers take weight measurements in conjunction with length-frequency sampling. Since the length-frequency sampling is of higher priority, weights are only taken as time permits. The weighed fish are frozen and whole. Weights of smaller fish are measured with a spring scale of 50 lbs capacity and 0.5 pound graduations. Larger fish are measured with a dial scale of 150 or 300 lbs capacity and 1.0 pound graduations. Larger fish are cradled in netting attached to the dial scales and hoisted with a block and tackle system. Fork lengths (FL) were taken to the nearest cm.

Weights are recorded on the L-W sampling form which allows tracking of the number of fish measured in each length class (Figure 1). Also recorded are the quarter, sampling area (Figure 2), and set type (log set or school set). However, because of limited personnel, sampling at this time will not attempt to obtain an adequate number of samples from each area/time and set type. If funds are available, the sampling will be expanded in the future to assess these strata for differences in the L-W relationship.

Since females can be heavier than males at certain fork lengths, sex has been noted as a key factor causing differences in L-W relationships. However, L-W data collected for this study are not separated by sex since fish at the canneries were frozen, and thawing would have interfered with the unloading process. Also, while L-W relationships by sex would be more accurate, use of the L-W relationship is usually with data where the sex of each fish is unknown, and therefore, the pooled-sex L-W relationship, such as the one in this study, would be appropriate.

PRELIMINARY RESULTS

Length and corresponding weight measurements were taken from 1,180 yellowfin tuna in the landings of U.S. purse seiners fishing in the southwestern Pacific. Samples were taken from catches made in March to June 1994, with the majority of the samples coming from catches in May (Table 1). The numbers of samples drawn from the two set types (log or school) were nearly the same. Samples were drawn from catches made in sampling areas 1, 2 and 3 with the majority of the samples in area 2.

The smallest yellowfin tuna sampled was 32 cm FL and the largest was 146 cm FL (Figure 3). All 1-cm length intervals from 32 to 146 cm, except for four (33, 141, 144 and 145 cm), had at least one fish sampled. Nine 1-cm intervals had 25 or more fish sampled. For these nine length intervals, calculated sample sizes needed to estimate the mean weight in each length interval with 95% confidence were as high as 233 fish (Table 2). The higher sample sizes were for fish greater than 120 cm FL and were due to a higher standard deviation in the recorded weights of these fish. This high standard deviation could be caused by, among other things, differences in weights of spawning and non-spawning fish, differences in weights of males and females of this length, or changes in the environment during the life cycle of some fish that may have slowed growth.

The L-W data were fit to the power function,

$$W = \alpha L^{\beta}$$

where W is weight in kilograms, L is fork length in cm, and α and β are constants. The estimated value for α was 0.00002287 and β 2.966098. The r^2 value was 0.996, indicating a very good fit. The scatter plot of the fitted data and the resulting L-W relationship are shown in Figures 4 and 5.

The fitted L-W relationship was compared, using a Kolmogorov-Smirnov test, to that of Nakamura and Uchiyama (1966). The null hypothesis (H_0 = the two estimated L-W distributions generated from their respective L-W relationships are the same) was accepted at the 95% level of confidence. The resulting D value was 0.00829. Values of weight calculated from the fitted L-W relationship were very close to those calculated from Nakamura and Uchiyama (1966) and the greatest differences occurred with fish larger than 120 cm.

CONCLUSIONS

Sampling thus far has produced results very similar to those of Nakamura and Uchiyama (1966). However, more samples will be needed before an accurate comparison can be made. The number of fish measured, especially for fish larger than 120 cm fork length, will probably have to be increased to 250 fish per length class to accurately predict the weights with acceptable confidence. It also seems that enough samples can be obtained to assess the differences between months, areas and set types, and this will be attempted in future sampling and analyses.

LITERATURE CITED

- Nakamura, E.L. and Uchiyama, J.H. 1966. Length-weight relations of Pacific tunas, pp 197-201. In: T.A. Manar (ed). Proceeding, Governor's Conference on Central Pacific Fisheries Resources, State of Hawaii.
- WPYRG 1992. Report of the second meeting of the Western Pacific Yellowfin Tuna Research Group, Honolulu Hawaii, June 17-24, 1992. 79 pp.

Table 1. Number of length-weight measurements of yellowfin tuna from landings of U.S. purse seiners fishing in the southwestern Pacific by month, set type and sampling areas.

MONTH	NUMBER OF SAMPLES	SET TYPE	NUMBER OF SAMPLES	SAMPLING AREA	NUMBER OF SAMPLES
3	25	1	541	1	460
4	166	2	501	2	595
5	783			3	114
6	195			4	0

Table 2. Number of yellowfin tuna weighed in each one centimeter length interval with at least 25 fish sampled, standard deviations, and predicted sample sizes needed to estimate the weight at each length interval with a 95% level of confidence.

LENGTH INTERVAL	NUMBER SAMPLED	STANDARD DEVIATION	PREDICTED SAMPLE SIZE
54	30	0.4383	3
55	28	0.5676	5
56	35	0.6883	7
57	29	0.6723	7
58	26	0.6257	6
59	25	0.5126	4
120	26	3.8902	233
123	27	2.9018	129
124	25	2.5240	98

Figure 1. Length-weight sampling form used to sample yellowfin tuna landings of U.S. purse seiners fishing in the southwestern Pacific.

LENGTH WEIGHT SAMPLING FORM

AREA CODES (A) = 1, 2, 3, 4

QUARTER CODES (Q) = 1, 2, 3, 4

SCHOOL TYPE CODES (T) = 1 (LOG), 2 (SCHOOL)

LENGTH (CM)																				
	WGT	A	Q	T	WGT	A	Q	T	WGT	A	Q	T	WGT	A	Q	T	WGT	A	Q	T
SPECIMEN 1																				
SPECIMEN 2																				
SPECIMEN 3																				
SPECIMEN 4																				
SPECIMEN 5																				
SPECIMEN 6																				
SPECIMEN 7																				
SPECIMEN 8																				
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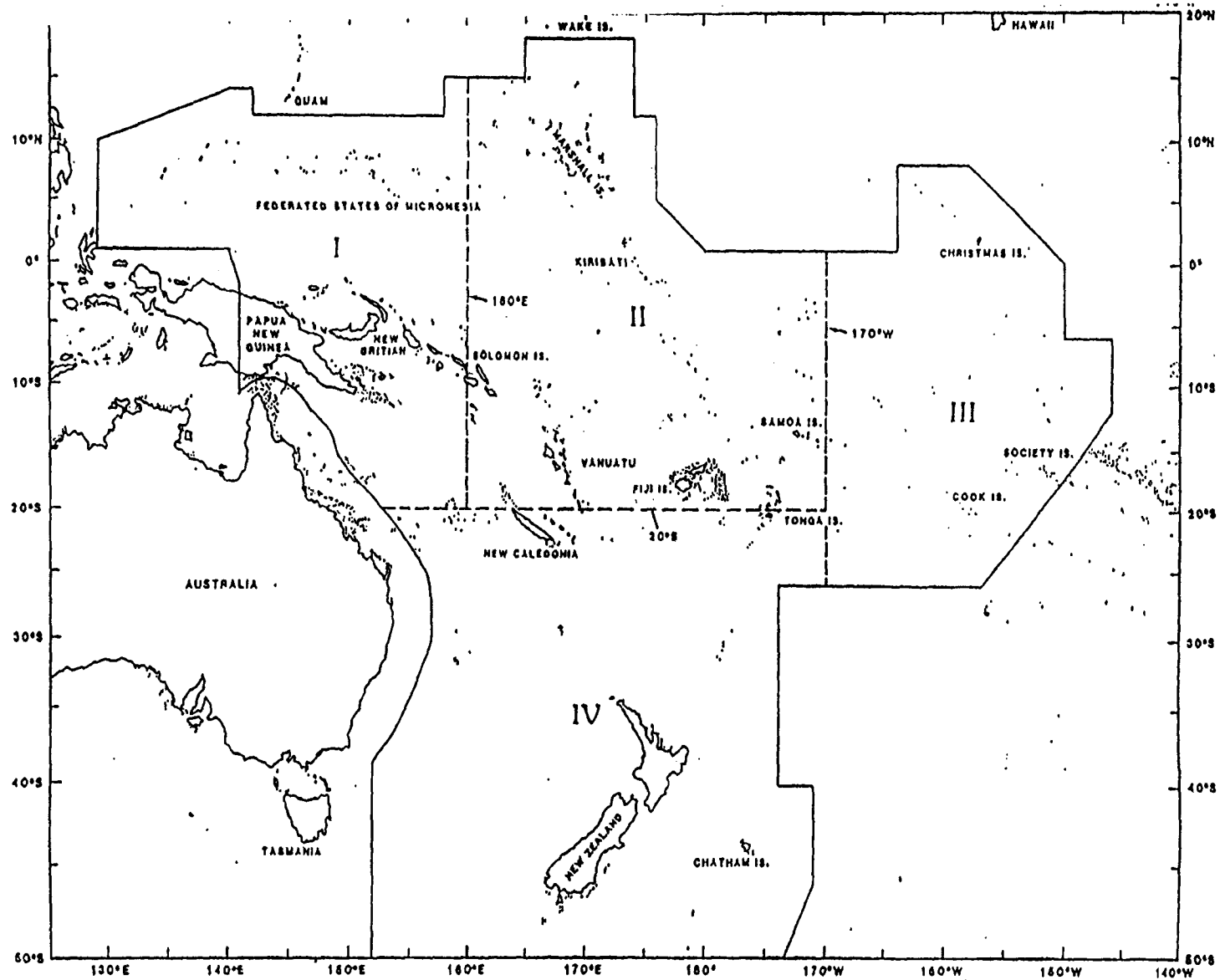


Figure 2. Statistical sampling areas used to sample length and weight of yellowfin tuna landings from U.S. purse seiners fishing in the southwestern Pacific.

SOUTHWESTERN PACIFIC YELLOWFIN TUNA

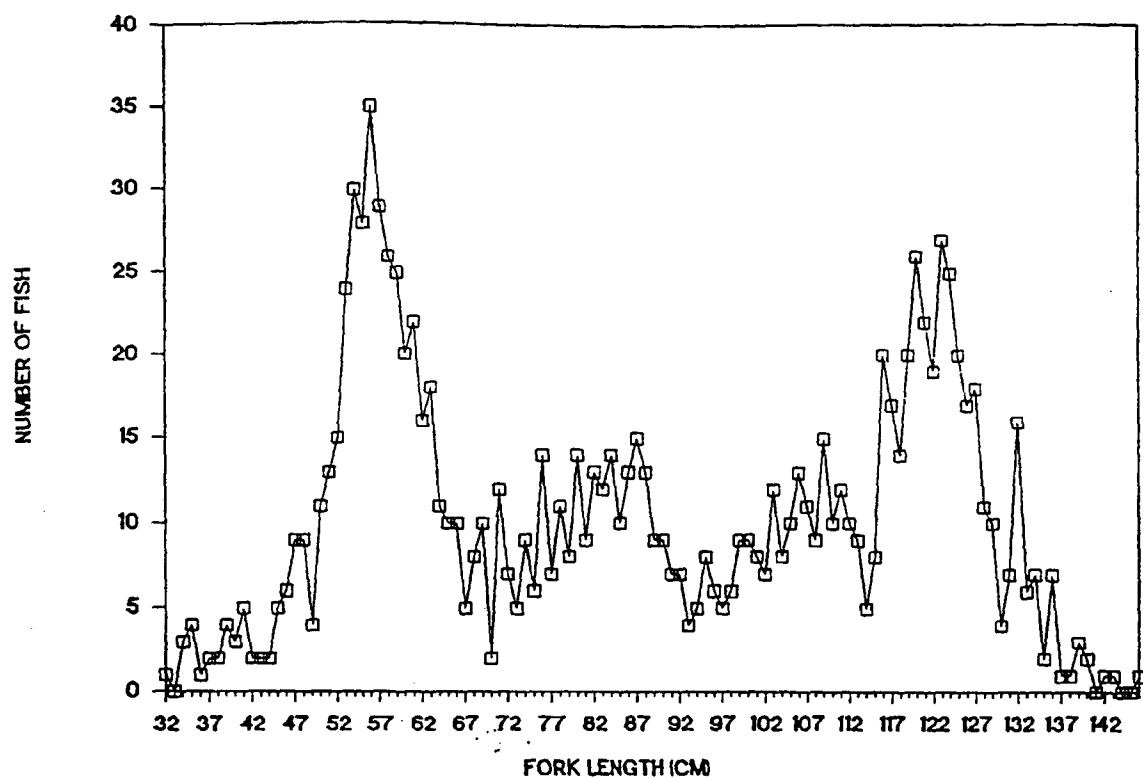


Figure 3. Number of yellowfin tuna sampled for length and weight by one-cm fork length groups from landings of U.S. purse seiners fishing in the southwestern Pacific.

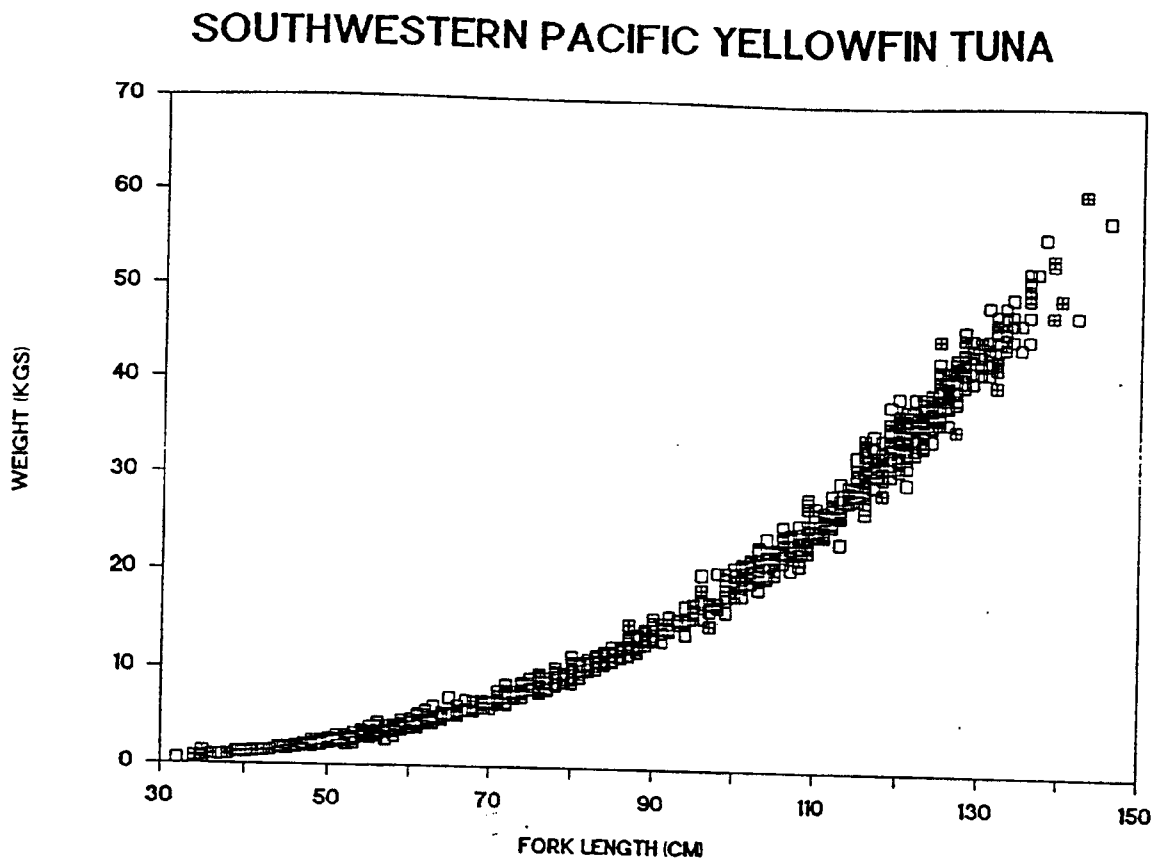


Figure 4. Scatter plot of fork length and round weight measurements of yellowfin tuna from landings of U.S. purse seiners fishing in the southwestern Pacific.

SOUTHWESTERN PACIFIC YELLOWFIN TUNA

LENGTH-WEIGHT RELATIONSHIPS

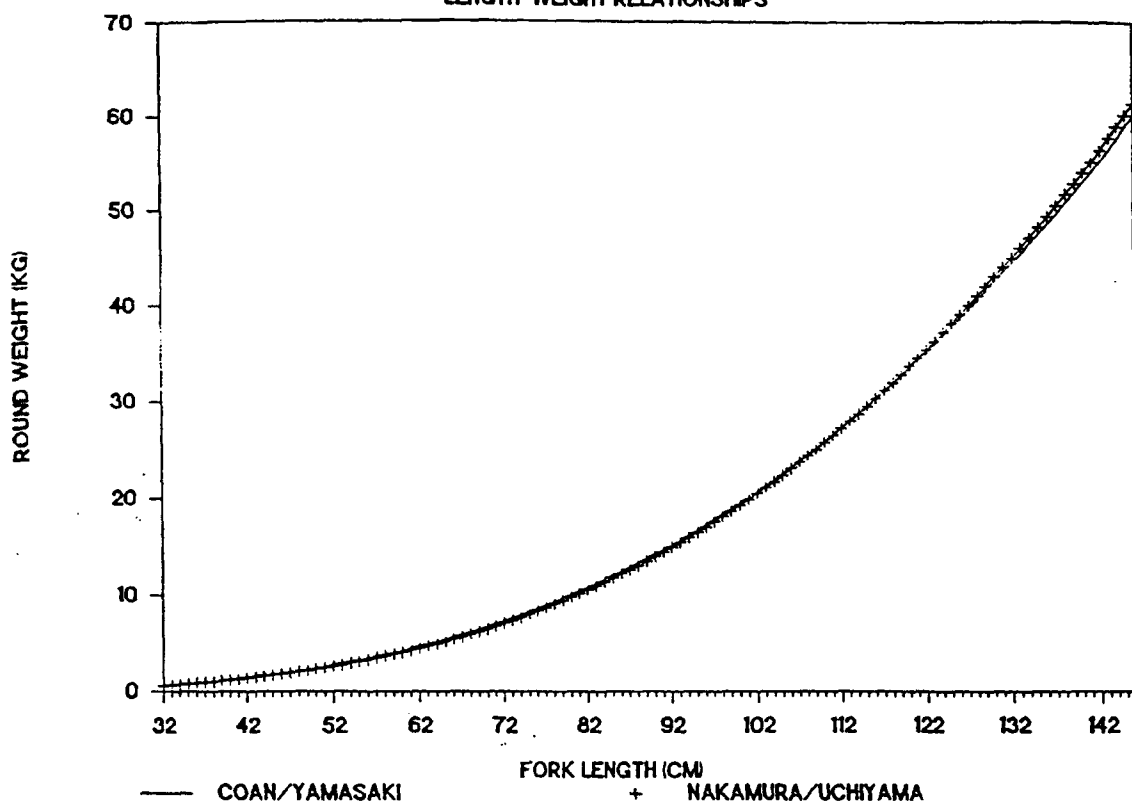


Figure 5. Predicted weights from the length-weight relationship of this study (Coan/Yamasaki) and that of Nakamura and Uchiyama (1966). Data for this study are from U.S. purse seiners fishing in the southwestern Pacific.