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Yield per recruit: Is there potential benefit from a size limit on skipjack and yellowfin catch?

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Yield per Recruit: Is there Potential Benefit from a Size Limit on Skipjack and Yellowfin Catch?

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Yield per recruit analysis is a commonly used and classical item in the arsenal of stock assessment scientists. It has received scant attention in the deliberations of the Western Pacific Yellowfin Research Group (WPYRG) for the good reason that proper yield per recruit analysis is awaiting information on the relationship of fishing and natural mortality to size or age of fish. Nevertheless, tentative yield per recruit analyses have been presented to meetings of parties to the South Pacific Regional Tuna Treaty (TBAP, 1992; Coan et al., 1993). Those analyses were conducted in response to concerns about the effect of localized large catches of small yellowfin and skipjack. This note is a summary of those results.

In the first analysis (TBAP, 1992), yield measured by catch in biomass was calculated as a function of a hypothetical lower size limit imposed on the fishery. Growth and length-weight parameters from the literature were assumed as well as mortality estimates from western Pacific tagging data. Natural and fishing mortality were assumed to be constant over all sizes or ages of fish. At current levels of exploitation no evidence was found that imposition of a size limit would improve yield from the fishery. At higher exploitation rates (up to 5 × the current level), there was still little to recommend a size limit for skipjack. For yellowfin, at a high exploitation rate of 5 × the current level, the analysis indicated that a size limit of 70 cm, if it could be effectively imposed, would increase yield by approximately 30%.

The next analysis (Coan et al., 1993) extended the first by expressing yield in terms of revenue instead of biomass in recognition of the fact that larger fish tend to command a higher price. There therefore might be an added incentive to increase the average size fish in the catch by imposing a lower size limit. Only at 5 × the current level was there an appreciable change from the first analysis. With skipjack showing some benefit from a size limit. Results for biomass and revenue yield are reproduced in Figure 1.

One of the problems mentioned by TBAP (1992) is that the catch of smaller fish is likely to be overestimated in the analysis because of the assumption of constant fishing mortality with size, i.e. the fishing mortality for small sizes should be less than the constant amount assumed for all sizes in the analysis. It is sometimes difficult to easily visualize the effects of such discrepancies on the results of an analysis. Therefore I re-ran the analysis for yellowfin with an alternate assumption of lower fishing mortality for fish less than 50 cm. (Figure 2). The results (Figure 3) show that there is even less indication of need for a size limit than in the original analysis, even at high exploitation levels. These results make sense in that if the fishing mortality for small fish is low anyway, then the benefits of a lower size limit are already realized to some extent.

It appears that unless the exploitation of skipjack and yellowfin in the the western Pacific is greatly increased, there is little indication from a population dynamic standpoint that size limitation should be considered as a potential management option. This conclusion applies to the region as a whole, and does not exclude the possibility of local situations for which a different conclusion might be warranted. Adequately dealing with such local questions requires better understanding of rates of movement and exchange within the region.

References

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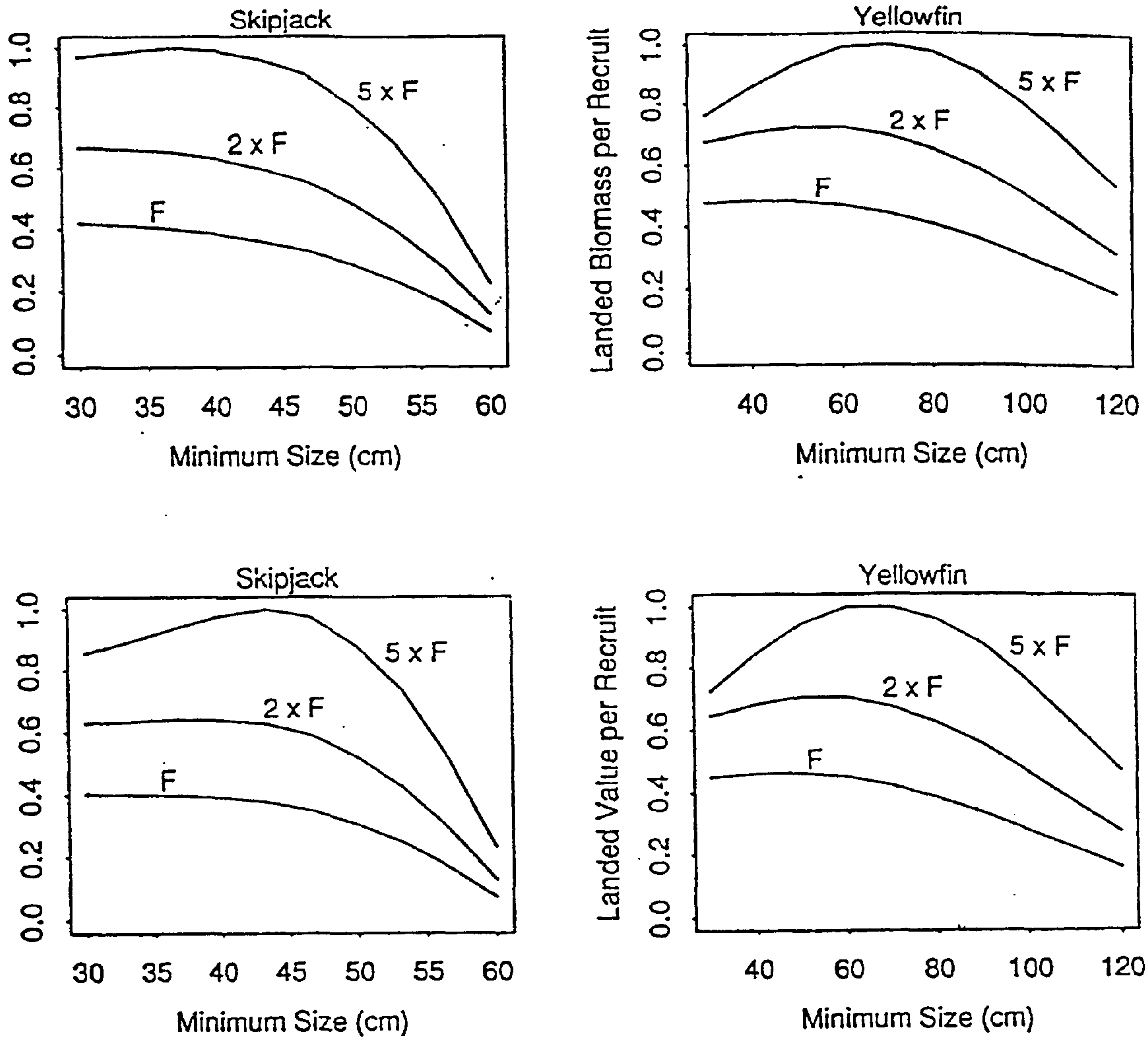

Figure 1. Yield-per-recruit based on biomass and on revenue assuming current fishing mortality, F, and elevated fishing mortalities (2×F and 5×F). Values are scaled (0 to 1.0). From Coan et al. (1993).

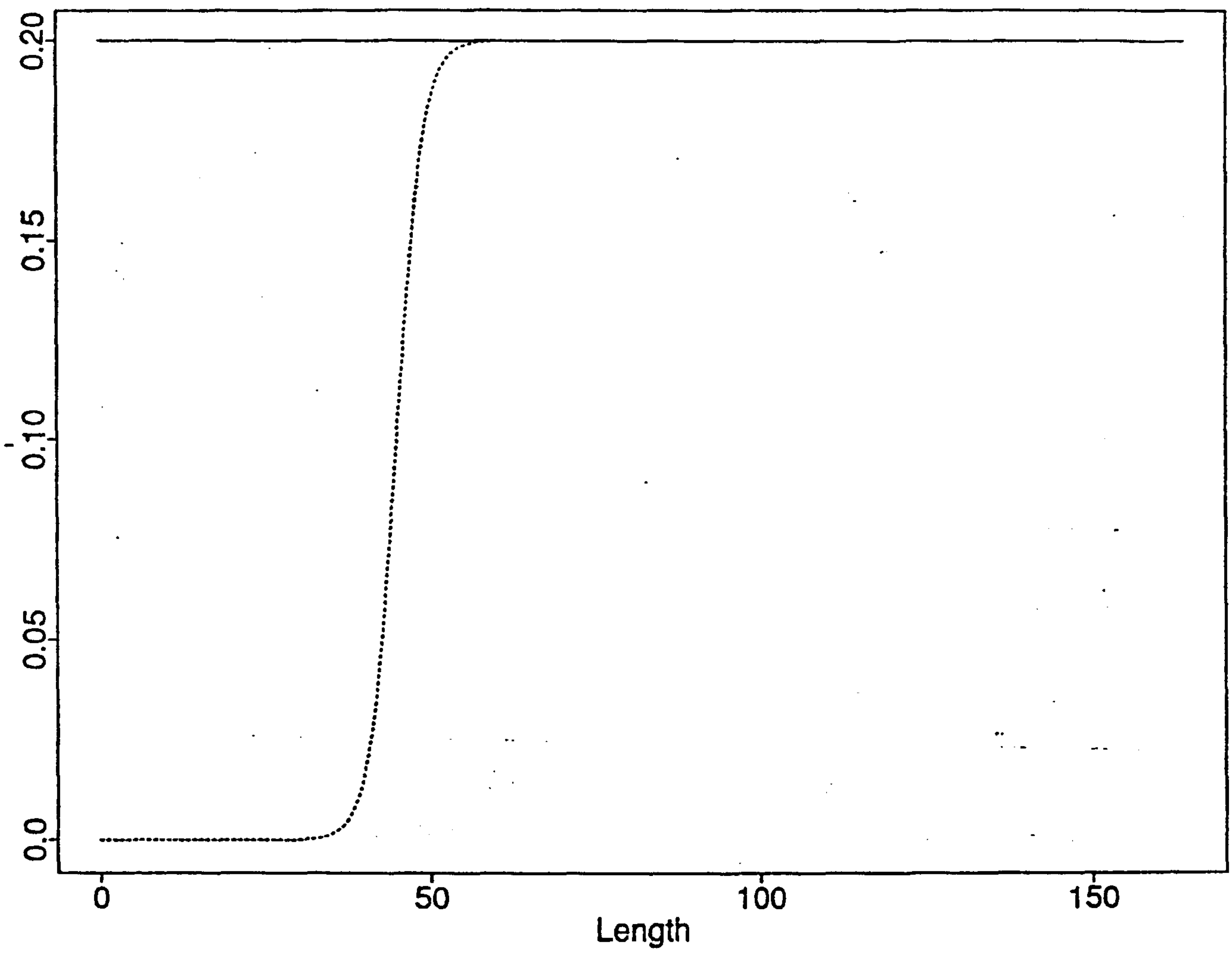

Figure 2. Two assumed relationships of fishing mortality with size.

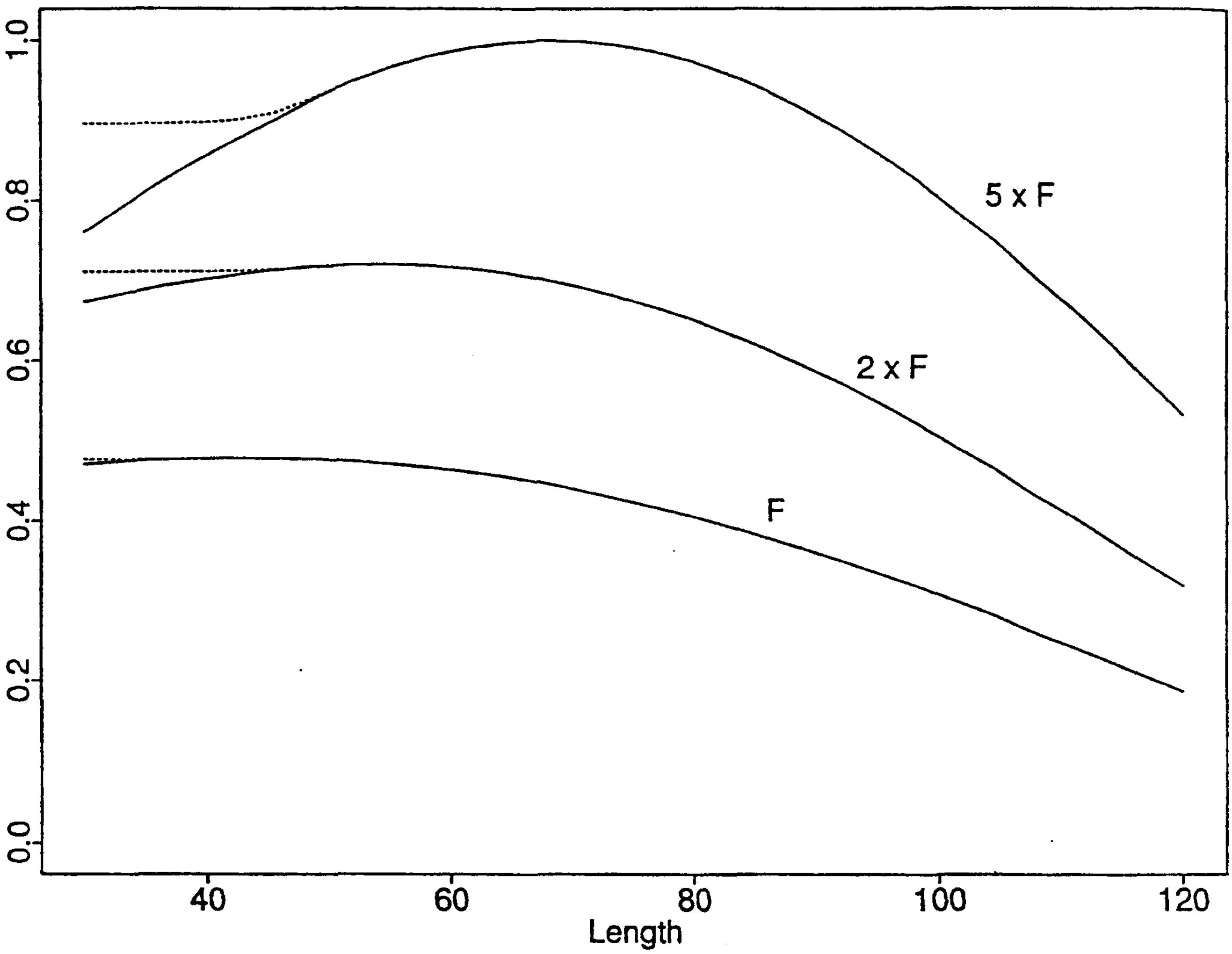

Figure 3. Yield-per-recruit for yellowfin. Solid lines are original analysis. Dotted lines are results based on diminished fishing mortality for smaller fish as in Figure 2. Values are scaled (0 to 1.0).