YIELDS FROM CORAL REEF FISHERIES

by

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In a recent letter to the editor of Fishbyte (Vol 2(2)p2) S. Marriott of the Tarawa Fisheries Division observed that the apparent harvests taken at Tarawa atoll amounted to around 10 mt/km of coast line and that this seemed to be much larger than harvest rates reported elsewhere.

Although metric tons per linear kilometer of shelf edge is probably a good measure of harvest rates for the deep-living snappers and groupers, which usually live in a narrow band of habitat on the deep outer reef slopes, it probably is not appropriate for the shallow neritic lagoon and reef species. For these groups, tons per square kilometer is a better measure of productivity and a figure for demersal and neritic pelagic fish production of 4-6 mt/km^2 of coralline shelf seems to be valid as a generalization of what can be taken by moderately heavy exploitation. For example, Tarawa atoll has a total shelf area approaching 500 km^2 and Marriott (1984) estimated the current reef and lagoon catch to amount to about 2200 mt or 4.4 mt/km^2.

To refine this approach it becomes necessary to decide what constitutes the area which is to be measured, because productivity could be much less in an area of sparse coral cover and much more in an area with dense seagrass beds or coral. The idea of an empirical morpho-edaphic approach to the problem has been suggested as one measure of potential harvests:

e.g. potential harvest/ km^2=

$$\frac{\text{Area of reef}}{\text{Area of shelf}} \times \text{"some other factors"}$$

Refining this approach is the main problem because this tells us nothing about the maximum harvests that can be sustained. Available evidence suggests that these maxima are probably 10-20 mt/km^2.

Further evidence on the fish production potential of coral reef areas can be derived from the study by Wass (1982), who gives details of the subsistence and artisanal fisheries of American Samoa. Thirteen villages were studied, of which 11 had discrete and identifiable reef areas which were fished exclusively by persons from the adjacent villages. The results include information on the area of reef within the 8 m isobath, the annual total catch of fishes and invertebrates taken by active and by passive methods within this zone and the catch per unit area within the 8 m isobath. Additionally, information is given on village populations and on catch/person/year. From these data it is also possible to calculate a measure of fishing intensity as the number of persons/ha of reef.

The most important feature of the data is that the total catch of fish and invertebrates averaged 266kg/ha/yr (26.6mt/km^2) with a range of 147-440 kg/ha/yr. The fish component of the catch averaged 160kg/ha/yr (16mt/km^2/yr) with a range of 69-355 kg/ha/yr. All of these values are high in comparison with catches reported from the Caribbean but are not seriously in conflict with the results reported in the Philippines by Alcala (1981) and Alcala and Luchavez (1981) The principal difference is that the reported production is exclusively from shallow reefs that are intensively fished for all edible organisms. Invertebrates (principally octopus, gastropod snails and clams) comprised 36% of the total catch taken by the eleven villages.

Details of these statistics are given in Table 1. The empirical technique developed for Jamaican fisheries (Munro, 1977) assumed that catch rates in a multispecies community will decline exponentially in response to fishing effort. The Samoan data suggest that this is true and

Table 1. Catch statistics for eleven American Samoan coastal villages (data from Wass 1982).

Village	Population	Reef area shallower than 8 m	Kg of fish & inverts./ ha/yr	Kg fish/ ha/yr	Kg fish & inverts./ capita/yr	Kg fish/ capita/yr	Persons/ ha. of reef	logN kg of fish & inverts./ person/yr	logN kg of fish/ person/yr
Faganeanea	191	29.4	311	215	47.3	32.8	6.5	3.85	3.49
Matu'u	315	44.0	147	69	20.0	9.4	7.2	2.99	2.24
Faga'ulu	757	36.8	209	124	9.6	5.7	20.6	2.26	1.74
Utulei	991	19.1	440	256	7.9	4.6	51.9	2.06	1.52
Leloaloa	789	35.2	166	102	6.8	4.2	22.4	1.91	1.43
Aua	1,471	48.6	281	149	8.7	4.6	30.3	2.16	1.52
Lauli'i	607	40.0	315	204	20.1	13.0	15.2	3.00	2.56
Fagaitua	429	31.6	394	315	27.5	22.0	13.6	3.31	3.09
Masefau	315	44.9	227	133	26.5	15.5	7.0	3.27	2.74
Fagasa	656	16.0	418	355	9.9	8.4	41.0	2.29	2.12
Vaitogi	661	10.4	165	165	2.0	2.0	63.6	0.69	0.69

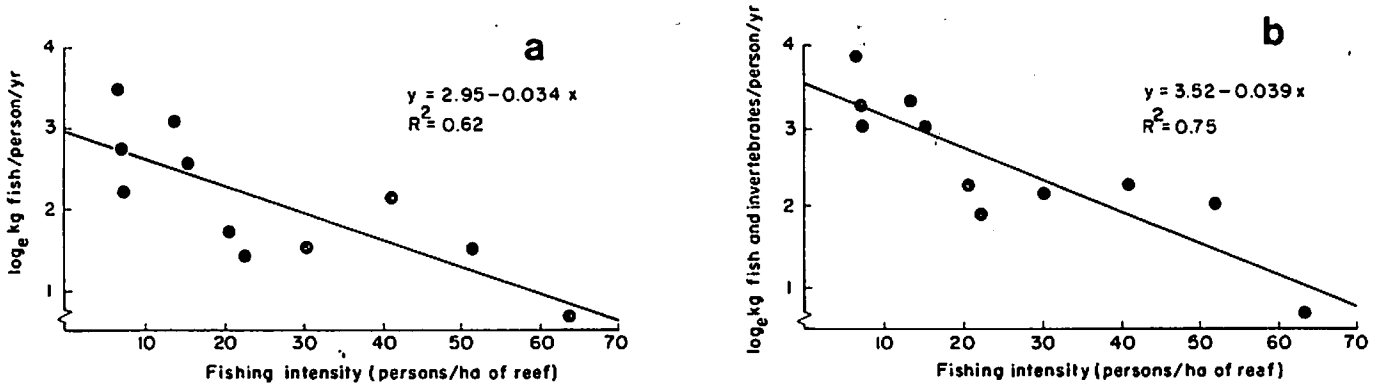

Fig. 1. Semi-logarithmic plots of catches (kg) per person per year against fishing intensity, expressed as persons per hectare of reef within the 8 m isobath, for eleven coastal villages in American Samoa: a. fish and invertebrates combined; b. fish only.

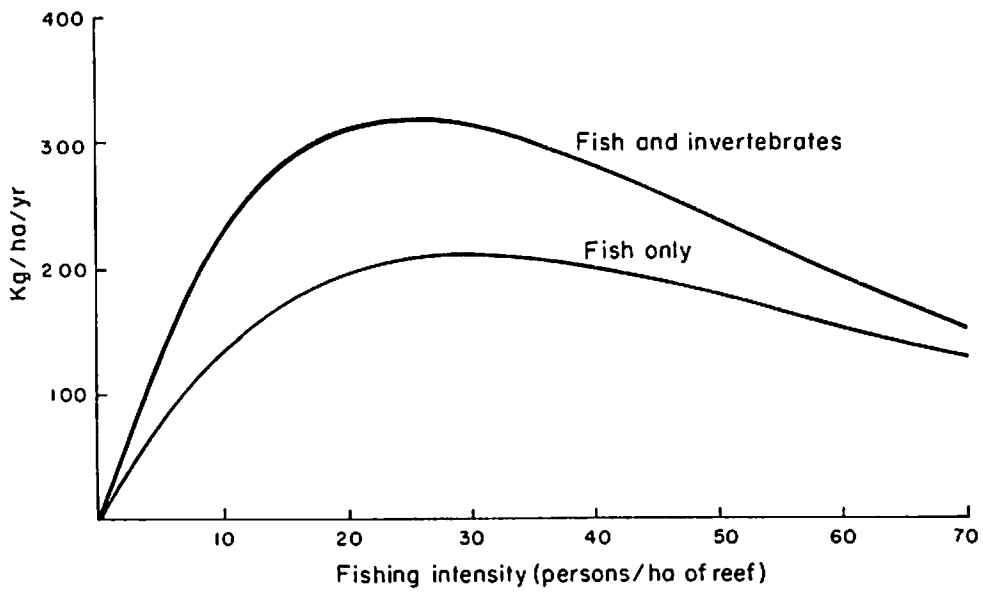

Fig. 2. Calculated fishing-intensity surplus yield curves for American Samoan reefs. Reef area is that within the 8 m isobath.

that there will consequently be a linear relationship between the logarithm of the catch /ha/yr in different areas and the fishing intensities in those areas (expressed here as persons/ha). The underlying assumption is that the ecological and productive characteristics of areas are similar. The semi-logarithmic relationships between catch rates and fishing intensities are shown in Fig 1a and b, and the regression lines translated into yield curves in Fig 2. Given the spread of the points around the regression lines it is not possible to draw many detailed conclusions from the data, but if we accept that Wass' statistics are reasonably accurate, the inescapable conclusion is that total catches of fish and invertebrates could be around 35 tons/km^2/yr and that fish harvests of 20mt/km^2/yr are readily achieved. These are extraordinarily high values. Either the data have a systematic positive error or the shallow reef systems are indeed hyperproductive. More data from other regions are needed to substantiate these observations.

References

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SOFTWARE DEVELOPMENT

AMULPES I

Spanish speaking members will be pleased to hear of a new compendium of microcomputer programs prepared by Jorge Campos and Albert Bornemisza of the Centro de Investigacion en Ciencias del Mar y Limnologia (CIMAR) of the University of Costa Rica (Ciudad Universitaria, Rodrigo Facio, Costa Rica). Entitled AMULPES I (for Analysis Multiple en Pesquerias), the set consists of eight programs including Spanish versions of Pauly's ELEFAN 0, I and II programs . The ELEFAN 0 and I have a few added features which allow the investigator to use raw data instead of data in the form of a length frequency distribution. Programs called JONES/ COHORTES and DILOG work with cohort analysis. AFREC and NAGRU give the user the option of building a length frequency distribution from raw data and the capability to modify the class intervals. The latter programs were developed because the authors felt that ELEFAN 1, JONES/COHORTES and DILOG gave results which depended on the class interval selected. Additionally, AFREC builds a length frequency distribution and makes it easier to manipulate voluminous data.

Several other programs are planned or in preparation by the CIMAR group. All are written in a reasonably standard form for execution on a Burroughs 6900 computer. More about this when the programs have been reviewed at ICLARM.

ELEFAN I modification

F. Brouard and R. Grandperrin of the ORSTOM laboratory have written a modification of ELEFAN I for use with a plotter which generates a contoured surface of the explained sum of peaks (ESP) for different combinations of K and L(inf) and thus facilitates identification of the best combination of these parameters. Details of the program (written for a HP85 microcomputer) are given in their paper on the deep reef fishes of Vanuatu (see "Publications by Members" column for full reference). Write to Dr Grandperrin at Mission ORSTOM, B.P. 76, Port Vila, Vanuatu for more information.