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EFFORT AND CPUE AS MEASURES OF ABUNDANCE

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I have two short comments relative to what Dr. Gulland and Dr. Hayasi have written in their reports on effort and cpue as measures of abundance.

First, Dr. Gulland asks how can one deal with trends in effective fishing power from year to year? For purse-seining the IATTC has used the successful set ratio (SSR) to correct effort from year to year. The rational is as follows:

For a given instant in time (say a day)

$f =$ effort (number of boats fishing in that day)

$\overline{S} =$ average number of fish per school

$\overline{N} =$ average number of fish in the stock

$a =$ probability that a given school is sighted in a day by a given unit of effort.

$$= b\left(\frac{\overline{N}}{\overline{S}}\right)f$$

where

$b =$ constant of proportionality.

$c =$ probability that a school is capture <u>given</u> that it is sighted

$= \text{SSR}$

$d =$ probability that a given fish is in the sighted school.

$$= \frac{\overline{S}}{\overline{N}}$$

Then the probability that an individual fish is captured in a unit of time (day) is the instantaneous daily fishing mortality rate and is given by.

$$F = qf = acd$$

$$= \left\{ b\left(\frac{\overline{N}}{\overline{S}}\right)f \right\} \left\{ c \right\} \left\{ \frac{\overline{S}}{\overline{N}} \right\}$$

$$= bcf$$

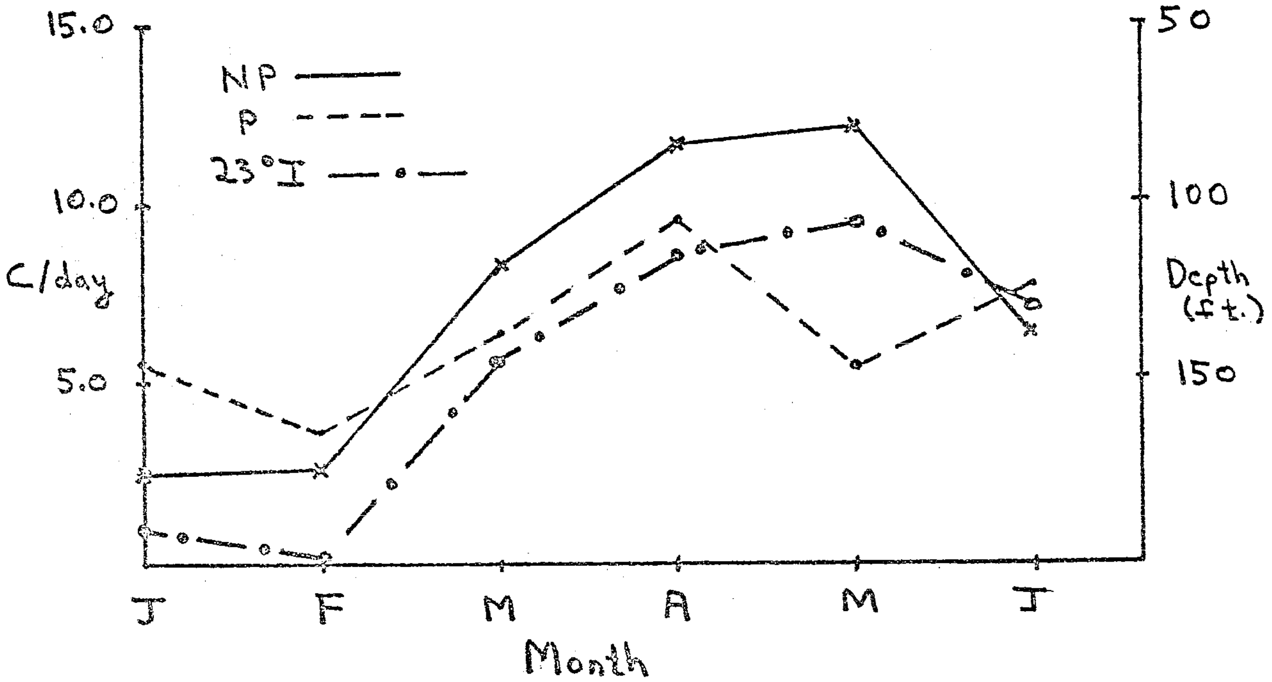
And thus

$$q = bc$$

which implies that the catchability coefficient is proportional to the successful set ratio. The question that I pose is whether or not this is an adequate manner to standardize purse seine effort from year to year?

Second, Dr. Hayasi refers to the fact that, in certain cases, catchability of tunas may be related to environmental conditions and resultant gear selectivity. I offer the following data as evidence for this in the case of yellowfin tuna in the eastern Pacific. Below is a table of monthly catch rates (CPSDF) of yellowfin tuna for the first six months of 1973 in an area along the coast of Central and South America (Areas A5 and A3 - Francis (1974)) where a significant number of yellowfin were caught in both the porpoise (29,933 tons non-regulated logged catch) and the non-porpoise (41,304 tons non-regulated logged catch) modes of fishing. The fish caught in the porpoise fishery were relatively large (approx. 75% of the catch in numbers greater than 85cm.) and the fish caught in the non-porpoise fishery were relatively small (approx. 10% of the catch in numbers greater than 85cm.) The following table and graph give the monthly catch rates (CPSDF) for the two modes of fishing and the monthly mean depth (ft) of the 23°C isotherm (Miller, personal communication) in the area of concern.

MONTH	CPSDF (NP)	CPSDF (P)	MEAN DEPTH of 23°C ISOTHERM
Jan.	2.48	5.70	190
Feb.	2.66	3.67	200
Mar.	8.16	6.26	145
Apr.	11.76	9.54	116
May	12.03	5.55	105
June	6.38	7.86	130



It has been hypothesized (Sharp, personal communication) that yellowfin tuna show a thermal preference for 23°C, and that the preference is most rigidly adhered to in young fish. It is therefor thought that the short-term availability of small fish to surface fishing gear may be related to the depth of the 23°C isotherm. It is quite apparent from the above table and graph that in this case there was a strong linear relationship between the catch rates in the non-porpoise fishery, made up of predominantly small fish, and the depth of the 23°C isotherm ($r = -0.94$, significant for $\alpha = .01$) and there was less of a linear relationship between the catch rates in the porpoise fishery, made up predominantly of large fish, and the depth of the 23°C isotherm ($r = -0.66$, non-significant for $\alpha = .05$)

REFERENCE

Francis, R. C. (1974) Effects of fishing modes on estimates of fishing power, relative abundance and surplus production in the eastern Pacific yellowfin fishery. Informal background document for ICCAT Workshop on Tuna Population Dynamics. Nantes, France. September 2-14, 1974.