SPC/Fisheries 25/Information Paper 4
10 March 1994

ORIGINAL: FRENCH

SOUTH PACIFIC COMMISSION

TWENTY-FIFTH REGIONAL TECHNICAL MEETING ON FISHERIES
(Noumea, New Caledonia, 14-18 March 1994)

GROWTH OF THE GREEN HUMPHEAD PARROTFISH
(Bolbometopon muricatum)
and its exploitation in New Caledonia

(by Emmanuel Couture and Claude Chauvet)

Age/length key, values calculated by the Von Bertalanffy model.

Age (years)	**0**	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**
Length (cm)	0.5	9.4	14.0	18.4	22.7	26.9	31.0	34.9	38.7
Age (years)	**4.5**	**5**	**5.5**	**6**	**6.5**	**7**	**7.5**	**8**	**8.5**
Length (cm)	42.4	46.0	49.4	52.8	56.0	59.2	62.2	65.2	68.0
Age (years)	**9**	**9.5**	**10**	**10.5**	**11**	**11.5**	**12**	**12.5**	**13**
Length (cm)	70.8	73.5	76.1	78.7	81.1	83.5	85.8	88.0	90.2
Age (years)	**13.5**	**14**	**14.5**	**15**	**15.5**	**16**	**16.5**	**17**	**17.5**
Length (cm)	92.3	94.3	96.2	98.2	100.0	101.8	103.5	105.2	106.8
Age (years)	**18**	**18.5**	**19**	**19.5**	**20**	**20.5**	**21**	**21.5**	**22**
Length (cm)	108.4	109.9	111.4	112.8	114.2	115.6	116.9	118.2	119.4
Age (years)	**22.5**	**23**	**23.5**	**24**	**24.5**	**25**			
Length (cm)	120.6	121.7	122.8	123.9	125.0	126.0			

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The green humphead parrotfish, *Bolbometopon muricatum* (Valenciennes, 1840), an Indo-Pacific species with a very wide geographical distribution, from the Red Sea to the central Pacific, is the largest representative of family *Scaridae* (parrotfish). It can grow to a length of 117 cm and a weight of 46 kg (Randall and Bruce, 1983). A gregarious fish, it feeds on coral polyps and algae in contrast to other *Scaridae* species, which are mainly herbivores (Randall, 1974).

The von Bertalanffy (1938) growth model $LT=L\infty(L_i\text{-}e^{-K.(t-to)})$ was calculated and used in yield-per-recruit model (Ricker, 1954).

Length/weight relationship (174 pairs of measurements)

Ln (PT) = 3.203 Ln(LT) - 11.714

$$\boxed{PT = 8.2{,}10^{-6}{,}LT^{3.2}}$$

where PT is in kg and LT in cm.

The constant of the equation has the confidence interval (95%) $3.282 \geq a \geq 3.141$.
The length-weight coefficient (b=3.2) is significantly higher than 3 at the 95% threshold.

Length/age relationship (by scale reading)

It was not possible to validate the time interval separating the two growth bands. For the purposes of this study, it was set at one year.

The values of the asymptotic length ($L\infty$) and the growth coefficient (K) calculated from the Ford-Walford plot are:

$$\boxed{L\infty = 157.75 \text{ cm and } K = 0.063}$$

The value of t_o calculated from the plot $L_n(L\infty\text{-}L_i) = a_i\text{+}b$ is:t_o= -0.47 year
So, the von Bertalanffy growth function is:

$$\boxed{LT = 157.75\ (L_i\text{-}e^{-0.063.(t+0.47)})}$$

Total mortality (Z = F + M) was estimated using the method of Beverton and Holt (1956) and natural mortality (M) using Pauly's formula (Pauly, 1978).

Mean size of captures, L_m, and size at first capture, L_c, are:

$$\boxed{L_m\text{=}88.545 \text{ cm ; } L_c\text{=}67.5\text{cm.}}$$

Total mortality is:

$$\boxed{\begin{array}{c} Z = 0.207 \\ M\text{=}0.1 \text{ and } F\text{=}0.107 \end{array}}$$

DISCUSSION

Bolbometopon muricatum has a slow growth rate (K=0.063) and, in our sampling work, reached an age of 16 years. The size record in New Caledonia seems to be a fish weighing 61 kg (gutted weight). The results regarding determination of age would, however, need validation a *posteriori* of the time interval elapsing between the appearance of the *annuli*, and which will define more accurately the K unit.

Analysis of the Ricker model.

In the analysis, the stock in the northern zone of the New Caledonia reef appears to be well exploited. The size at first capture Lc observed is close to the calculated figure of 68.05 cm which gives maximum yields per recruit.

It should be remembered that yield per recruit models do not depend on the time unit used to estimate growth rate. Results expressed in biomass are not influenced by non-validation of the temporal rhythm of growth. So, no matter how long it may take for a fish to reach 68.05 cm, this size is the optimum one in current exploitation conditions.

On the other hand, the time required to attain this size is important if the fishery is observed from the angle of mortality F. A certain F mortality applied over many years does not have the same effect, in terms of population, as one which is applied for a shorter period. From this vantage point, it is then necessary to consider F's importance in relation to M. The longer a short-lived species is subject to a high natural mortality M, the greater the exploited segment F can be.

For *Bolbometopon muricatum* in New Caledonia, M is, on the contrary, low and F also seems to be low. In addition, if fishing mortality were to increase due to an increase in nominal effort, the number of fishermen for example, this new fishing effort would have to be spread more widely over the fishing ground.

This initial work shows that fishing mortality can be increased up to twice its current level while maintaining approximately the same yield per recruit. However, the distribution area of the stock must be known (e.g. through tagging) in order to determine the geographical limits for application of the above-mentioned reasoning. It may be, in fact, that the current fishing area is being resupplied through migration from neighbouring areas where there is little or no fishing.

CONCLUSION

From this initial study of green humphead parrotfish exploitation in New Caledonia has emerged a definition of the basic biological parameters of this fish, something which was not previously known, and an estimate of the impact of fishing in New Caledonia. The principal comments are:

1. The green humphead parrotfish is very vulnerable to seine fishing, as it is a large, gregarious fish easily located on the reef flat.

2. The green humphead parrotfish has a slow growth rate, a low natural mortality and is long-lived. Consequently, it is feared that this species would have difficulty supporting any fishing effort at rates substantially above twice the current level.

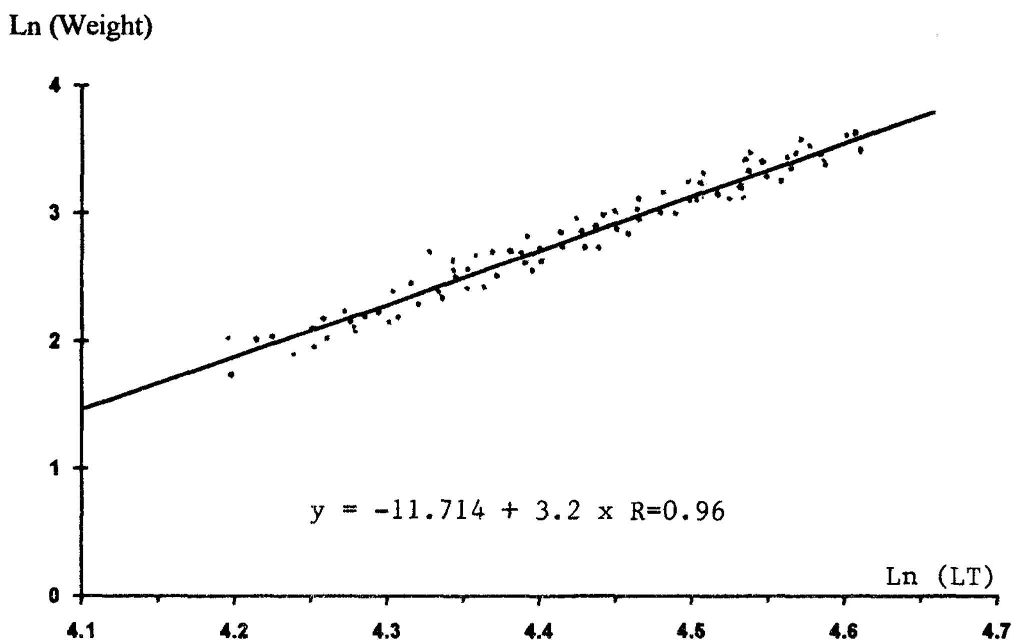
3. The current size at first capture is good and is close to the size calculated with the Ricker maximum yield per recruit model.

However, these results must be backed up by additional research as research on this type of fishing should be done over a longer period of time. Sampling should be carried out in the other areas surveyed, particularly those containing larger fish (Surprise, Huon, Astrolabe). Validation of the determination of age by more precise means (otolith microstructure) is needed, and we do not have any information about of reproduction or development patterns for juvenile fish.

Bibliography

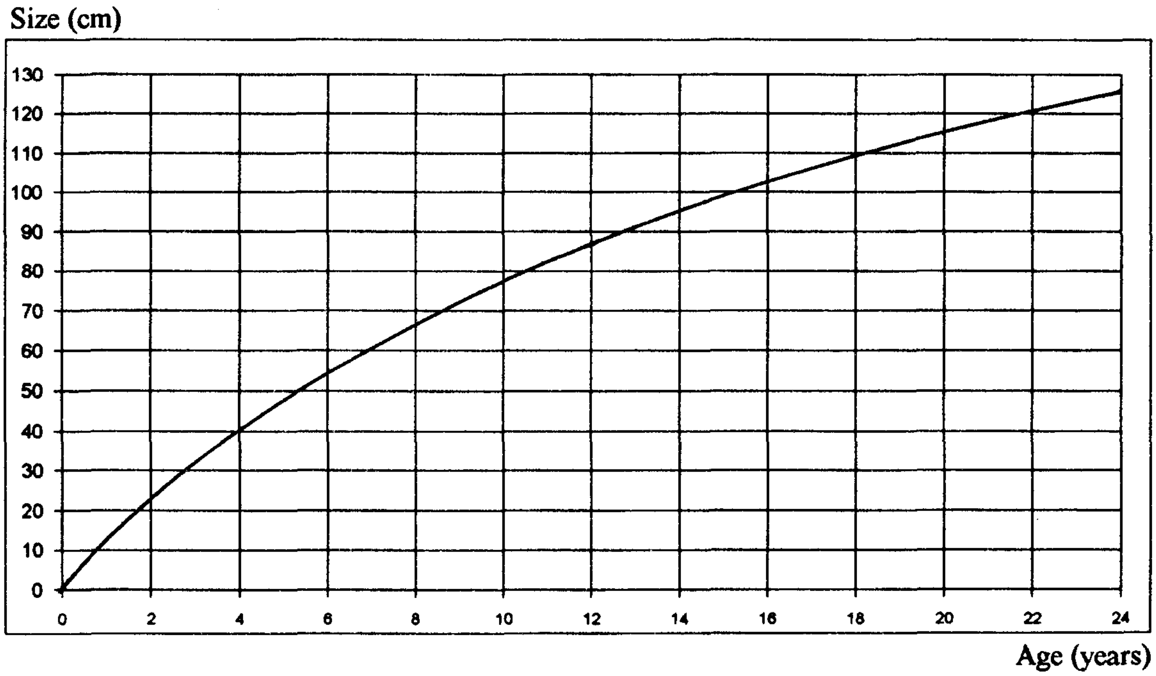
BEVERTON R.J.H. & S.J. HOLT, 1956. A review of methods for estimating mortality rates in fish with special references to sources of bias in catch sampling. *Rapp.P. V., Reun Cons. Int. Explor. Mer.* 140, pp.67-83.
FORD E., 1933. An account of the herring investigations conducted at Plymouth during the years from 1924-1933. *J.Mar. Biol. Assoc.* U.K. 19, pp.305-384.
PAULY D., 1978. A discussion of the potential use in population dynamics of the interrelationship between natural mortality, growth parameters, and mean environmental temperature in 122 stocks. *I.C.E.S., C.M.,* 1978/G-21, 35p.
RANDALL J.E., 1974. The effect of fishes on corals reefs. *Proceedings of the Second International Corals Reef Symposium,* Brisbane, pp.159-161.
RANDALL J.E. & R.W. BRUCE, 1983. The parrotfishes of the subfamily Scaridae of the western Indian Ocean with descriptions of three new species. *Inchth.Bull.,* 47, p 6.
RICKER W.E., 1980. Calcul et interpr,tation des statistiques biologiques des populations de poissons. *Bull. Fish. Res. Board Can.* 191F, 409 p.
VON BERTALANFFY L., 1938. A quantitative theory of organic growth (inquiries in growth laws). *In Ricker, 1980. Human Biol.,* 10, pp.181-213.
WALFORD L.A., 1946. A new graphic method of describing the growth of animals. in Ricker 1980. *Biol. Bull.,* 90, pp.141-147.

Length/weight relationship (logarithmic transform)



Age/length key, measured values

Age (years)	1	2	3	4	5	6	7
Length (cm)	15.0	23.7	31.7	38.8	45.9	53.1	59.6
Age (years)	8	9	10	11	12	13	14
Length (cm)	66.3	71.8	77.0	81.9	86.9	91.5	94.5



Size/age relationship for *Bolbometopon muricatum*. Von Bertalanffy model.