NOTAS E COMUNICAÇÕES

ON THE STANDARDIZATION OF THE FISHING EFFORT

Álvaro Carvalho de LIMA[1], Carlos Edwar de Carvalho FREITAS[1], Maria Aparecida Pion ABUABARA[2], Miguel PETRERE Jr.[3], Vandick da Silva BATISTA[1]

Abstract - In this note we demonstrate that the use of an index to standardize the fishing effort using the *cpue* of a standard vessel or gear is mistaken, once the $cpue_t$ - catch per unit of total effort after standardization is similar to $cpue_s$ - catch per unit of effort of the standard vesel or gear arbitrarily chosen.

Key-words: Fishing effort, standardization.

Sobre a Padronização do Esforço de Pesca

Resumo - Nesta nota nós demonstramos que o uso de um índice para padronizar o esforço de pesca de um barco ou aparelho padrão é errado, uma vez que a $cpue_t$ – captura por unidade de esforço total após a padronização é igual a $cpue_s$ – captura por unidade de esforço de um barco ou aparelho arbitrariamente escolhido como padrão.

Palavras-chaves: Esforço de pesca, padronização.

Fisheries scientists are always concerned with reliable estimates of the fishing mortality and fishing effort. In some cases these estimates are difficult to calculate due to the differences between the fishing power generated by the several fishing gears employed (Beverton & Holt 1957; Rothschild 1977; Hilborn & Walters 1992). Errors in stock assessment are more likely to appear due to the misinterpretation of the magnitude of the fishing effort applied to the fish stock (Rothschild 1977). The problem is more acute in small scale tropical fisheries which are multiespecific and multigear essencially.

The use of an index to standardize the fishing power is a common procedure in the fisheries literature (Robson 1966) and it was further discussed by Gulland (1983) and Fonteles Filho (1989). In this note we demonstrate that this procedure is a fallacy.

In its simplest form (Fonteles 1989), the method suggested was:

$$cpue_t = n^{-1} . \sum cpue_{si} \qquad (1)$$

where,

$cpue_t$ - catch per unit of total effort

$cpue_{si} = \sum C_i \ / \ f_{si}$, catch per unit of effort standardized for the gear i $(i = 1, 2, ..., n)$

where,

C_i - catch of the gear i $(i = 1, 2, ..., n)$

[1]Departamento de Ciências Pesqueiras. FUA - Faculdade de Ciências Agrárias - Av. General Rodrigo Otávio Ramos Jordão, 3000 - Coroado - 69.077-000. Manaus(AM), Brazil.
[2]Departamento de Matemática - UNESP - Caixa Postal 178 - 13.500-230. Rio Claro(SP) - Brazil.
[3]Departamento de Ecologia. UNESP - Instituto de Biociências - Caixa Postal 199 - 13.506-900. Rio Claro(SP), Brazil.

f_{si} - standardized effort of gear i (i = 1, 2, ..., n)
with,
$f_{si} = f_i \,.\, \text{IEC}$ (2)
where,
f_i - effort of the gear i (i = 1, 2, ..., n)
and IEC = $cpue_i / cpue_s$, index of effort conversion (3)
where,
$cpue_i = C_i / f_i$ - catch per unit of effort of the gear i (i = 1, 2, ..., n)
$cpue_s = C_s / f_s$ - catch per unit of effort of the standard gear arbitrarily chosen, and there are two different ways for calculating average cpue,

$$cpue_{t1} = \sum C_i \Big/ \sum f_{si} \qquad (4)$$

or

$$cpue_{t2} = n^{-1} . \sum (C_i / f_{si}) \qquad (5)$$

Beginning with (4)

$$cpue_{t1} = \sum C_i \Big/ \sum f_{si}$$

and substituting in (2)

$$cpue_{t1} = \left[\sum C_i \Big/ \left(\sum f_i \,.\, IEC \right) \right]$$

and taking (3)

$$cpue_{t1} = \left\{ \sum C_i \Big/ \left[\sum f_i \,.\, (cpue_i / cpue_s) \right] \right\}$$

$$= \left\{ \frac{\sum C_i}{\sum f_i \,.\, \left[(C_i / f_i) / (C_s / f_s) \right]} \right\}$$

$$cpue_{t1} = \left[\frac{\sum C_i}{\sum C_i / (C_s / f_s)} \right]$$

as f_s and C_s are constant values of the standard gear

$$cpue_{t1} = \frac{\sum C_i}{(f_s / C_s) . \sum C_i}$$

and finally,

$$cpue_{t1} = \frac{C_s}{f_s} = cpue_s$$

Now, working with (5)

$$cpue_{t2} = n^{-1} . \sum (C_i / f_{si})$$

and substituting (2)

$$cpue_{t2} = n^{-1} . \sum \left[C_i / (f_i \,.\, IEC) \right]$$

and using (3)

$$cpue_{t2} = n^{-1} . \sum \frac{C_i}{\left[f_i \,.\, (cpue_i / cpue_s) \right]}$$

$$= n^{-1} . \sum \frac{C_i}{\left\{ f_i \,.\, \left[(C_i / f_i) / (C_s / f_s) \right] \right\}} =$$

$$cpue_{t2} = n^{-1} . \sum \frac{C_s}{f_s}$$

Now, as C_s and f_s are single constant values

$$cpue_{t2} = n^{-1} . \frac{C_s}{f_s} \sum 1 = n^{-1} . \frac{C_s}{f_s} n$$

and again

$$cpue_{t2} = \frac{C_s}{f_s} = cpue_s$$

Previously, Gulland (1983) proposed the use of a logarithmic transformation, taking

$$ln\ cpue_t = ln \left(\frac{\sum C_i}{\sum f_{si}} \right) \qquad (6)$$

but this procedure is not effective to avoid this problem as it may be shown by the algebraic calculations as we did here that

$$ln\ cpue_t = ln\ cpue_s$$

Thus, the global cpue is identic to the standard cpue of the standard gear arbitrarily defined whichever it is.

Thus, the use of Generalized Linear Models (GLM) for the standardization of the fishing effort, as proposed by Hilborn & Walters (1992) is better, since this procedure is unbiased.

Acknowledgments

To FUA, UNESP and CNPq for partial financial support.

Literature cited

Beverton, R.J.H.; Holt, S.J. 1957. *On the Dynamics of Exploited Fish Population*. Fisheries Investment Series 2, vol. 19 U.K. Ministry of Agriculture and Fisheries, London. 514 p.

Fonteles Filho, A.A. 1989. *Recursos Pesqueiros: Biologia e Dinâmica Populacional*. Imprensa Oficial do Ceará. Fortaleza. 296 p.

Gulland, J.A. 1983. *Fish Stock Assessement. A Manual of Basic Methods*. FAO/Wiley, Chichester, 223 pp.

Hilborn, R.; Walters, C.J. 1992. *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Chapman and Hall. 587 p.

Robson, D.S. 1966. Estimation of relative fishing power of individual ships. *Res. Bull. ICNAF*, **3**, 5 - 14.

Rothschild, B.J. 1977. Fishing effort, *in* J. A. Gulland [ed.], *Fish Population Dynamics*. Wiley-Interscience, New-York, pp. 96 - 115.

Aceito para publicação em 23/02/2000