TUNAS AND THEIR FOOD :
A VIEW FROM A LOWER LINK OF THE FOOD CHAIN

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I - Introduction

Part of the EEC funded Tuna Research Program is devoted to the "Biological Environment ot Tunas". This paper presents a few ideas on the ways which could be used to assess the potential richness of oceanic regions with respect to tunas.

II - What is generally accepted about nutrition of Tunas.

Most studies agree about the following three points :

1. The food ration is very high in tunas. OLSON and BOGGS (1986) found daily rations up to 3,9 - 6,7 % of the body mass in yellowfin tuna. Even a short lack of food adversely affects their hunting capabilities (BRILL 1985, BOGGS 1986). These high food requirements suggest that some regions, which otherwise would have been convenient from a physico-chemical point of view, are not suitable for tunas owing to their low food content. This situation is probably very common in oligotrophic tropical seas.

2. Tunas are opportunistic predators, feeding on whatever is available, provided the prey size is acceptable : prey species vary with places and seasons (e.g. BERNARD *et al.* 1985). The exhaustive lists of preys found in tunas stomachs, which abound in the relevant litterature, are therefore not very meaningful.

3. As far as yellowfin (*T. albacares*) and skipjack (*K. pelamis*) tunas are concerned, they live in the upper 200 or 300 m layer (this has been checked by acoustic tagging : DIZON *et al.* 1978, YUEN 1970, CAYRE and CHABANNE 1986), and they feed mainly during the daytime (perhaps this is not entirely true for Bigeye tuna, *T. obesus*). This depth-time definition of the "feeding space" of tunas implies that potential prey species will be restricted to those inhabiting the 0 - 200 or 300 m layer during the light hours. This is exemplified by the kind of fishes which are found in tunas stomachs : most of them belong to typically epipelagic families, such as Gempylidae, Paralepididae, Chaetodontidae, Tetraodontidae, Monacanthidae and others (see for example BLACKBURN and LAURS 1972, DRAGOVICH and POTTHOFF 1972, GRANDPERRIN 1975, BORODULINA 1982). Most of these fishes are too fast swimmers to be caught with plankton nets and micronekton trawls. On the other hand, it is well known that most of the micronektonic fishes found in plankton nets and micronekton trawls are typically vertically migrating fishes (Myctophidae and others) which inhabit the 0-300 m layer only at night when tunas are not feeding and dwell deeper during the daytime (GRANDPERRIN 1975, ROGER and GRANDPERRIN 1976).

These discrepancies between vertical distributions and feeding rhythms of tunas and net caught micronektonic fishes, along with the fast swimming capabilities of epipelagic micronektonic fishes which are the preys of tunas, are the main factors that explain why it is almost impossible to assess tuna forage from net catches.

III - Having a look from a lower link

From the above considerations, it is likely that 1. physical parameters alone are inadequate to explain the distribution and even more the abundance of tunas (see for example CROWDER and MAGNUSON 1981), 2. food abundance is also an important parameter, and 3. tuna forage estimates are not accessible through usual direct methods such as the use of plankton nets and micronekton trawls.

To succeed in the necessary assessment of the potential richness (Rp) of the different oceanic regions with respect to tunas, an indirect approach is thus proposed. We first intend to analyse the stomach contents of the fishes which are found in tunas stomachs (1). These fishes, owing to their size (usually 2-10 cm), feed on zooplanktonic and micronektonic organisms (DRAGOVICH 1970, ROGER 1973 a and b). These small-sized organisms are also satisfactorily sampled with plankton nets ; their abundance in plankton catches will thus provide an assessment of Rp, as they are the food (link 3) of the preys (link 2) found in tunas (link 1) stomachs.

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(1) Such a multistage investigation is not original : see for example KUBOTA 1973

The investigation will thus comprise two parts :

1. Analysis of stomach contents of micronektonic fishes found in tunas stomachs : nature and size range of their preys (link 3)

2. Analysis of plankton samples : distribution and abundance of this link 3, i.e. mapping Rp.

IV - A few potentially useful remarks

1. It is likely that epipelagic fishes which are the preys of tunas are also day-feeders (PARIN 1968, ROGER 1973 a and b, ROGER and GRANDPERRIN 1976), i.e. they feed mainly on those zooplanktonic species that are present in the 0-200 or 300 m layer during the light hours. This will be checked through analysis of stomach contents of these fishes.

2. If such is the case, then Rp will be very simple to assess : it equals the biomass of plankton, within the appropriate size range (that of the preys of fishes eaten by tunas), present in the 0-200 or 300 m layer during the light hours.

3. In fact, it is likely that these day-feeder fishes are to some extent able to feed on migrating zooplankton, at dawn and sunset, when this one is still/yet in the 0-200 or 300 m layer. Thus, Rp could be expressed as :

$$Rp = Bd(s) + b\,Bn(s)$$

where Bd(s) = Biomass of zooplankton, in the size range s, present by day in the 0-200 or 300 m layer.

Bn(s) = Biomass of zooplankton, in the size range s, present by night in the 0-200 or 300 m layer

b = percentage of migrating zooplankton serving as food (at dawn and sunset) for micronektonic fishes preyed upon by tunas.

From investigations performed in the South-West Tropical Pacific in the years 1970-75 (ROGER 1973 a and b, GRANDPERRIN 1975), b should be close to 0.2

4. One could raise an objection against the fact that the Bd(s)/Bn(s) ratio could be more or less constant, and thus, that any zooplanktonic biomass (in the appropriate size range), day or night, could be used as an index of potential richness. This will also be checked, but from ORSTOM cruises in the tropical Atlantic (1978-79) and Pacific (1982-84) oceans, there are indications that this ratio is highly variable, both geographically and seasonaly : the values ranged from 0.15 to 0.49 in the Atlantic and from 0.04 to 0.52 in the Pacific Ocean. HERBLAND and STRETTA (1973) working in the Angola dome region found that the ratio migrating/non-migrating zooplankton varied widely from place to place.

This reinforce the idea that in any region the biomass which supports the food webs leading to tunas is not related to that assessed from plankton or micronekton net samples.

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