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BACKGROUND PAPER

presented
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TUNA BAITFISHES: BIOLOGY, ECOLOGY, RESOURCES IN NEW CALEDONIA

1. INTRODUCTION

During the 1970s, pole-and-line fishing for tuna developed in the inter-tropical Pacific. In New Caledonia, a survey was carried by ORSTOM between 1980 and 1983 at the request of the Territory. The findings were submitted in a number of reports prepared by the ORSTOM Centre at Noumea and a synthesis of these findings was published by Conand (1987). A tuna-fishing company (Transpêche) began to operate a 300-ton pole-and-liner in August 1981. A year later two identical vessels were added, but in April 1983 the fleet ceased operation. The fishery's results were analysed and presented by Hallier and Kulbicki (1985). The findings presented in this paper are largely drawn from these studies to which no further will be made.

2. BIOLOGY OF THE BAITFISH SPECIES

2.1 Taxonomy

A guide to identification and geographical distribution of bait species in the SPC area has been published (Lewis et al., 1983). This study gives precise figures for New Caledonia. A few problems remain however, in particular with regard to the genera Herklotsichthys and Dussumieria and it would be useful if taxonomists could clarify these.

2.2 Geographical distribution and habitat

In New Caledonia, on account of the relief and morphology of the coast, there are numerous deltas with mangroves and areas of shallow water on the West Coast and in the North. On the East Coast and in the South the bays are much deeper. These factors have an influence on fish stocks. Analysis of correspondences based on the records of 273 experimental night fishing trips shows species to fall into several groups:

- coral-reef species: Spratelloides delicatulus, S. gracilis, Hypoatherina ovalaua, Amblygaster clupeioides.
- estuarine species: Stolephorus indicus, S. devisi, S. insularis, Trissina baelama, Gazza minuta, Leiognathus bindus, Dussumieria spp.
- deep-water species: Decapterus russelli, Rastrelliger kanagurta, Selar crumenophthalmus, Amblygaster sirm.
- species which appear to be ubiquitous: Stolephorus heterolobus, Atherinomorus lacunosus, Herklotsichthys quadrimaculatus, Scomberoides lysan.

2.3 Nutrition

Few studies have been carried out on this subject. Examination of stomach contents proved these fish to be planktivorous but aerial or free-diving observation revealed that some species also feed by grazing on the reef-flats, which means their behaviour is not exclusively pelagic.

2.4 Life cycle (growth, reproduction, mortality)

It is not possible here to give the biological parameters for some twenty species, but they can be roughly covered by two types of life cycles (Figure 1).

Species with a short life cycle

- 3 anchovies: Stolephorus heterolobus, St. devisi, St. punctifer
- 2 sprats: Spratelloides delicatulus, Sp. gracilis
- 1 silverside: Hypoatherina ovalaua

Maximum length: 7.5 to 10 cm Maximum age: 6 to 10 months
First maturity: about to 6 cm Age at 1st maturity: 3 to 4 months
Coefficient of total mortality: 7 to 5
In the whole population there are mature individuals at all times of the year; the maximum number is found between September and December.

Species with an annual life cycle:

- 3 anchovies: Stolephorus indicus, St. insularis, Thrissina baelama
- 2 sprats: Dussumieria sp. A and B (aff. acuta)
- 3 sardines/herrings: Herklotsichthys quadrimaculatus, Amblygaster sirm, A. clupeioides
- 1 silverside: Atherinomorus lacunosus
- 2 ponyfish: Leiognathus bindus, Gazza minuta
- 2 scad: Decapterus russelli, Selar crumenophthalmus
- 1 mackerel: Rastrelliger kanagurta

Maximum length: 10 to 24 cm Maximum age: 2 years
 First maturity: 8 to 20 cm Age at 1st maturity: 9 to 11 months
 Coefficient of total mortality: 1 to 5
 Individuals mature between September and December.

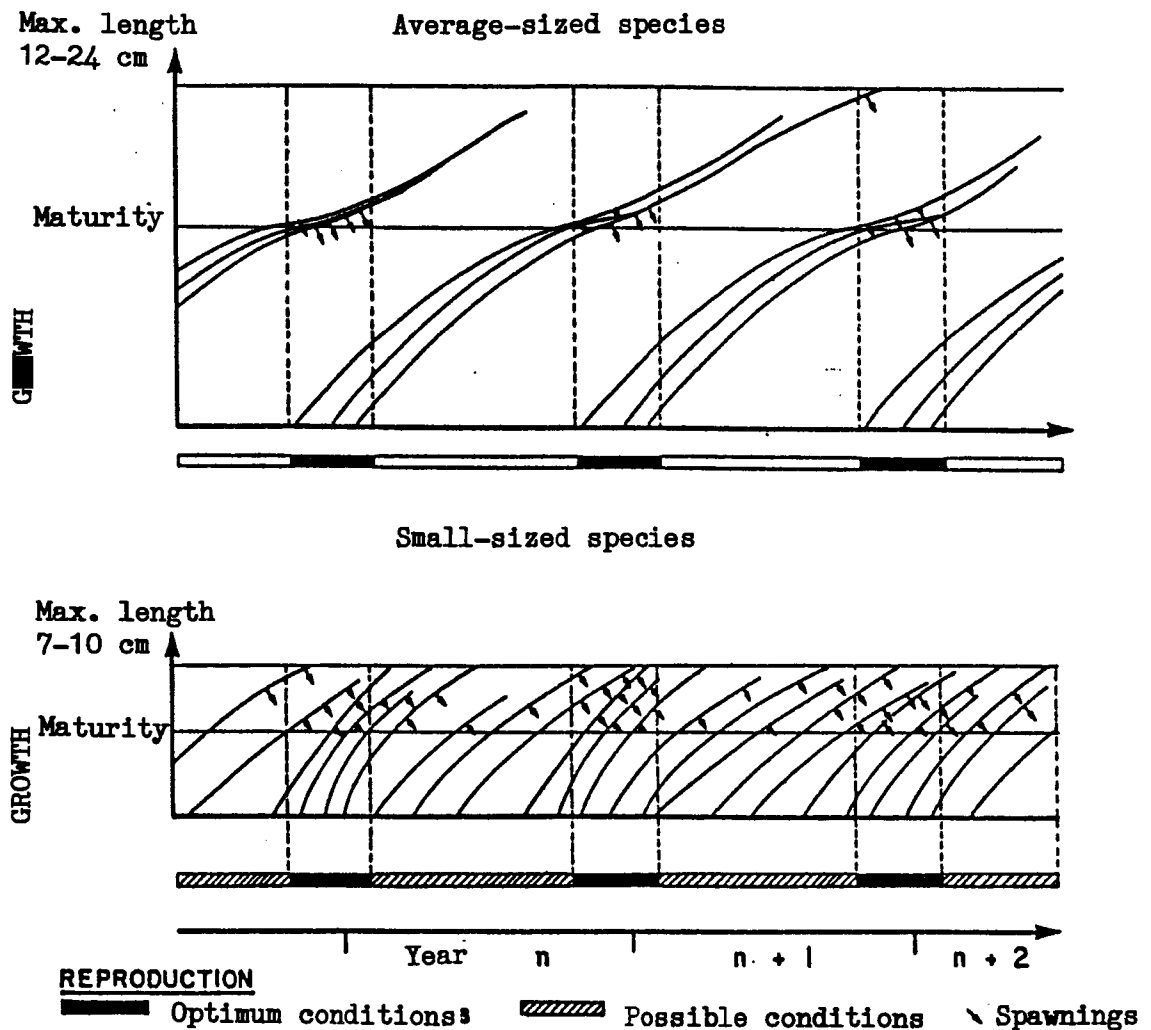


Figure 1. Diagram showing two phenological types, observed among pelagic fishes in the New Caledonian lagoon.

With the possible exception of species whose maximum length is greatest (scad and mackerel), all these fish normally speaking have only one period of reproduction in their life after which they die.

2.5 Movements

Two acoustic surveys, each lasting two weeks, were carried out in the New Caledonia lagoon. They produced information about the spatial distribution of the fish. As is well known, fish congregate in schools by day and scatter at night. The small size of the schools (Figure 2) and the fact that they are frequently located in very shallow water are the reasons why fishing is commonly at night using lights. A study of the horizontal distribution shows that, in a bay, the fish are frequently near the shore during the day and scatter all over the bay at night, when they are usually close to the surface.

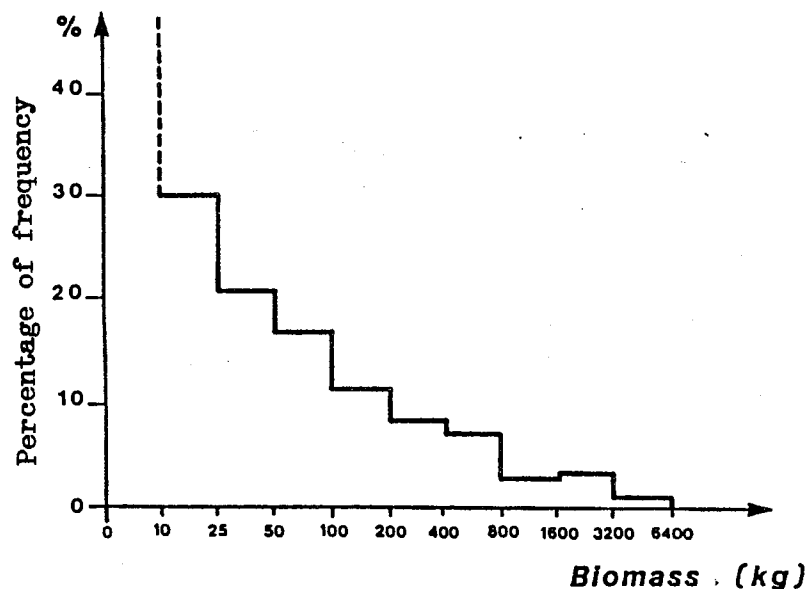


Figure 2. Distribution of the biomass frequency in schools of more than 10 kg, as observed during the acoustic survey carried out in April 1983.

3. FISHING FOR BAITFISH

3.1 Methods and gear

Hallier *et al* (1984) have described in detail various methods of catching tuna baitfish. In New Caledonia, most of the catches recorded during the ORSTOM survey and the Transpêche fishing operations were done with a bouki-ami net.

3.2 Catches in New Caledonia

The sites. Nearly 100 different sites have been surveyed around the island. There are good fishing grounds in all parts, but the muddy mangrove bays on the West Coast and in the North seem to offer the best prospects.

Quantities captured. In the ORSTOM survey, average yields per fishing trip, worked out from 7 reference sites, show a regular seasonal fluctuation. Conditions are favourable from December to July and poor from August to November (Figure 3). The Transpêche ships recorded a slighter seasonal variation, with yields per haul as follows:

December - March:	113 kg
April - July:	162 kg
August - November:	76 kg

We can therefore conclude that conditions are less favourable 4 months in the year but nevertheless allow substantial quantities of live-bait to be caught.

Catch composition. It is quite common to find a dozen different species in a single net haul, and catch composition varies with sites and seasons. Although the records cover three and a half years, it is not easy to see an overall pattern. An inter-annual variation can however be observed. For example, in Dumbéa Bay, 1982 was a good year for Sardinella species whereas in 1983 anchovies (Stolephorus spp.) were clearly dominant (see Figure 4). Dalzell and Wankowski (1980) noted such fluctuations in the specific composition of baitfish catches (Spratelloides gracilis, Stolephorus heterolobus, St. devisi) at Ysabel Passage in PNG.

Size and quality of bait. Anchovies and small sprats are never larger than what is regarded as a suitable size for tuna fishing. They are fairly fragile but very attractive for tuna and thus make very good bait. Gold spot herrings (Herklotsichtys quadrimaculatus), sardines (Sardinella spp.) and silversides reproduce between October and December and juveniles of the right size for fishing can be caught until about June. From July to November the fish of these species are often too large to make good bait.

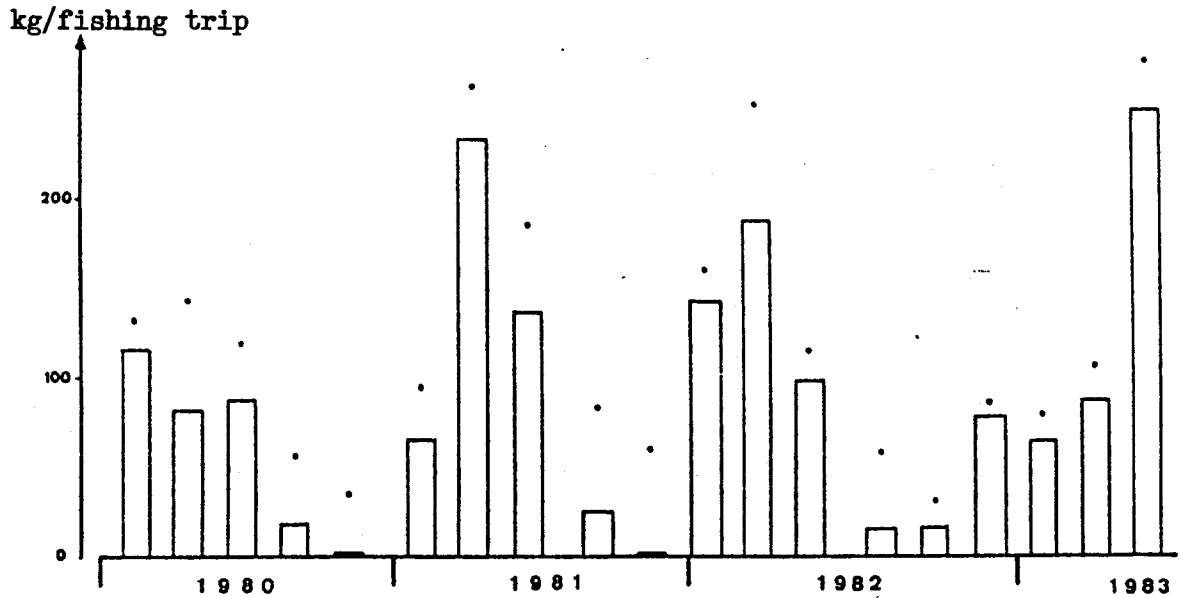


Figure 3. Yield per fishing trip, calculated from seven reference sites. The histograms show catches of species that can be used as bait; dots show total catches.

3.3 The fishery in New Caledonia

The Transpêche company operated for only 20 months. During that time it caught 79 tonnes of baitfish. No significant decrease in CPUE was observed during the period of operation.

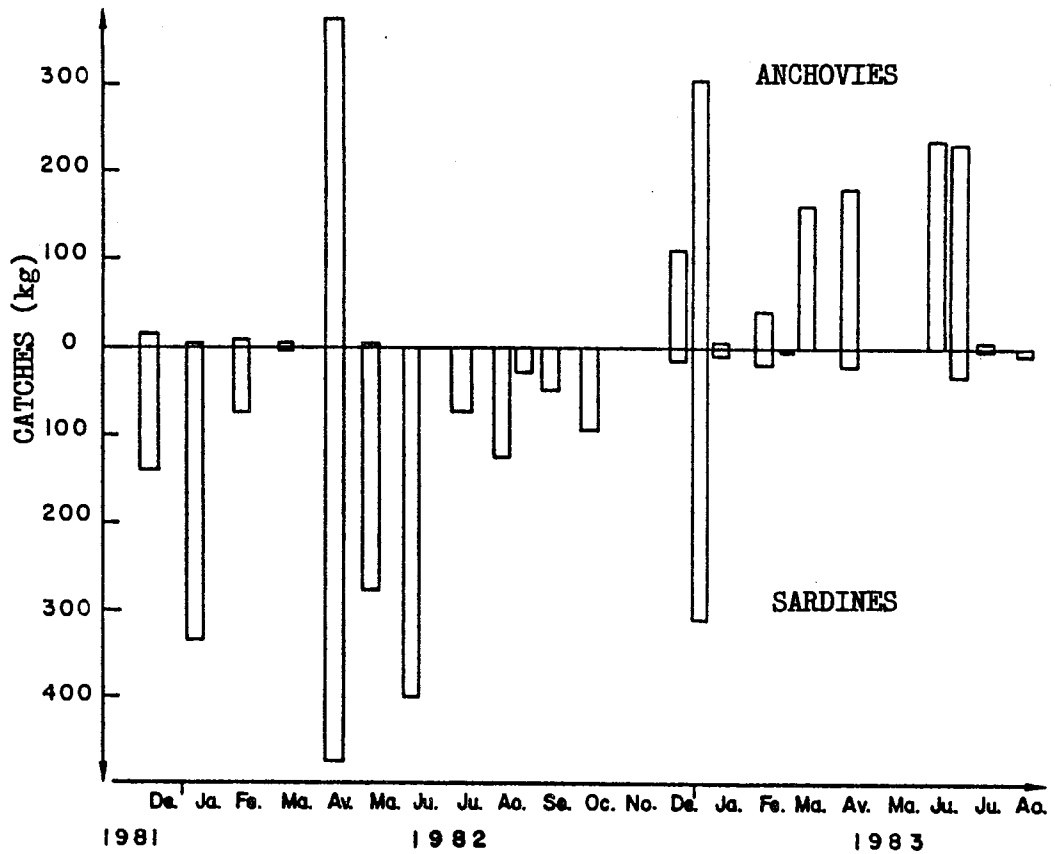


Figure 4. Comparative abundance of sardines and anchovies in catches made in Dumbéa Bay.

4. RESOURCES

4.1 Stock assessment

In the absence of sustained exploitation, it is not possible to apply production models as was done, for example, by Dalzell (1984) in PNG in the area of Ysabel passage. Estimation of the stock of small pelagic fishes in the lagoons of New Caledonia (excluding areas north of latitude 20°S as well as the Isle of Pines and South-West reefs) was done using an echo-integrator. As the method is still experimental, the results must be regarded as merely indicating orders of magnitude. In April, the stock was estimated to be about 4,900 tonnes; this is the season where it would be close to the maximum. In October, the stock would not exceed about 1,000 tonnes.

4.2 Management, conservation

Since stocks of these baitfish species are at present affected only by subsistence fishing which is quantitatively negligible, Gulland's equation: $C = 0.5 M.B.$ can be applied. Assuming a natural mortality rate of 2, we would have a balanced sustainable catch of 2,500 tonnes which is 480 kg/km².

In the case of a tuna fishery, using a tuna/baitfish ratio of 20/1 and an annual pole-and-line tuna catch of 500 to 1,000 tonnes, the baitfish potential would be enough for nearly 50 pole-and-line vessels, or, if one wants to remain very much on the safe side, at least 10. On the other hand, depletion of baitfish stocks could easily occur in bays that are too intensively fished. Should this happen, moving the fishery to other sites would allow recovery to take place in one or two years (or even in a few months for species with a short life-cycle) through immigration of larvae or adults from neighbouring bays and from areas that are inaccessible to the fishery.

5. CONCLUSION

The New Caledonian lagoon has a multi-species stock of small sized pelagic fish. These species are characterised by a short life cycle and an almost total mortality after a single period of reproduction (spawning season). For each of the species, the populations are divided into a large number of sub-populations. Because of this there is relatively little risk of the sort of collapse that might occur in a more uniform population as a result of massive mortality in the larvae or of overfishing of the adults. Even when the population of a bay has been decimated, recovery is fairly rapid.

These species make good-quality tuna baitfish. There would be no supply problem for one or two dozen pole-and-liners. The larger of the species: sardines, herrings, mackerels and scads, could also be fished in considerably larger quantities for human consumption, but New Caledonia is sparsely populated and has a total lagoon area that is very large indeed (Figure 5). In the lagoon ecosystem, these small pelagic fish, and in particular the small sized species, constitute a very important source of "fodder" for the larger pelagics and even for the more or less bottom-dwelling species.

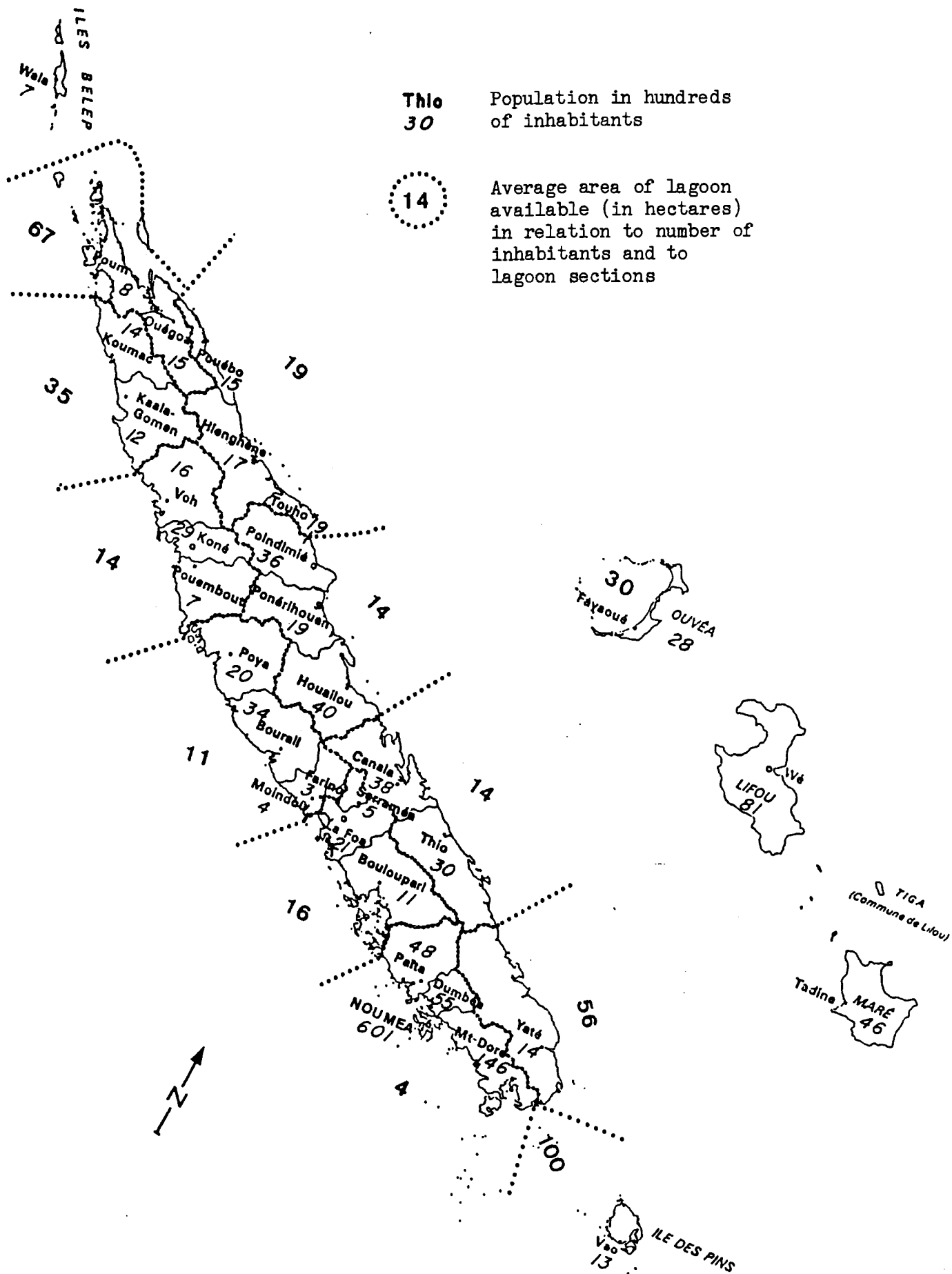


Figure 5. Population of New Caledonia by municipality (1983 census) and average lagoon area available in relation to the number of inhabitants per section of lagoon.

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