# SOME OCEANOGRAPHIC CONDITIONS RELATED TO THE CARIBBEAN RED SNAPPER FISHERY, OFF THE NORTHEAST BRAZIL [1]

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The Caribbean red snapper, *Lutjanus purpureus* Poey, is a demersal species of fish that lives mostly in the vicinity of the continental slope and submerged oceanic banks.

In this paper the authors study some oceanographic conditions in the Caribbean red snapper fishing areas off the Northeast Brazil, and try to establish correlations between each condition and the catch.

## MATERIAL AND METHOD

This work is based on data collected during 32 commercial fisheries, totalling 388 days of fishing, from 1967 through 1969.

The fishing effort was represented by fishing boats with mean overall length of 20 meters. In an average, each fishery lasted 15 days, with 12 fishermen at work, each one using as fishing gear a line with 12 Mustad hooks numbers 3 to 6.

In each day of fishing the following data were taken: geographic position, direction and speed of the current and wind, depth, moon age and total catch, of which 85% was made up of Caribbean red snapper.

The fishing region was divided into three areas: CE — oceanic banks located between the longitudes of 37°30'W and 39°00'W ; MA I — continental slope between the longitudes of 40°00'W and 43°00'W ; MA II — continental slope between the longitudes of 43°00'W and 47°00'W (figure 1). The data obtained will be always presented in the following order of areas, to prevent repetition: CE, MA I and MA II.

The number of records of the current and wind directions was grouped by quadrants, and the corresponding percentages calculated, for each fishing area.

The mean daily catch by classes of current speed, by the Beaufort wind scale numbers and by classes of depth was calculated. Afterwards, the correlation coefficients between each condition and the catch were determined, for each fishing area.

The mean daily catch and the percentage of the total catch by moon phases were calculated, for each fishing area.

## RESULTS AND CONCLUSIONS

The waters off the north coast of the Northeast Brazil are influenced by the northern branch of the South Atlantic Equatorial Current and the Trade Winds.

During the covered period, the current directions belonged to the four quadrants in the CE and MA I areas, and to the third and fourth quadrants in the MA II area, predominating those belonging to the fourth quadrant, in all the areas. The wind directions belonged to the four quadrants in the CE area, and to the first, second and fourth quadrants in the MA I area, predominating those belonging to the second quadrant; in the MA II area, the wind directions belonged to the first and second quadrants, predominating those of the first quadrant (table I).

It can be noted that both the current and wind moved predominantly in parallel direction to the coast, northwest bound, though in the MA II area the wind has blown diagonally, southwest bound.
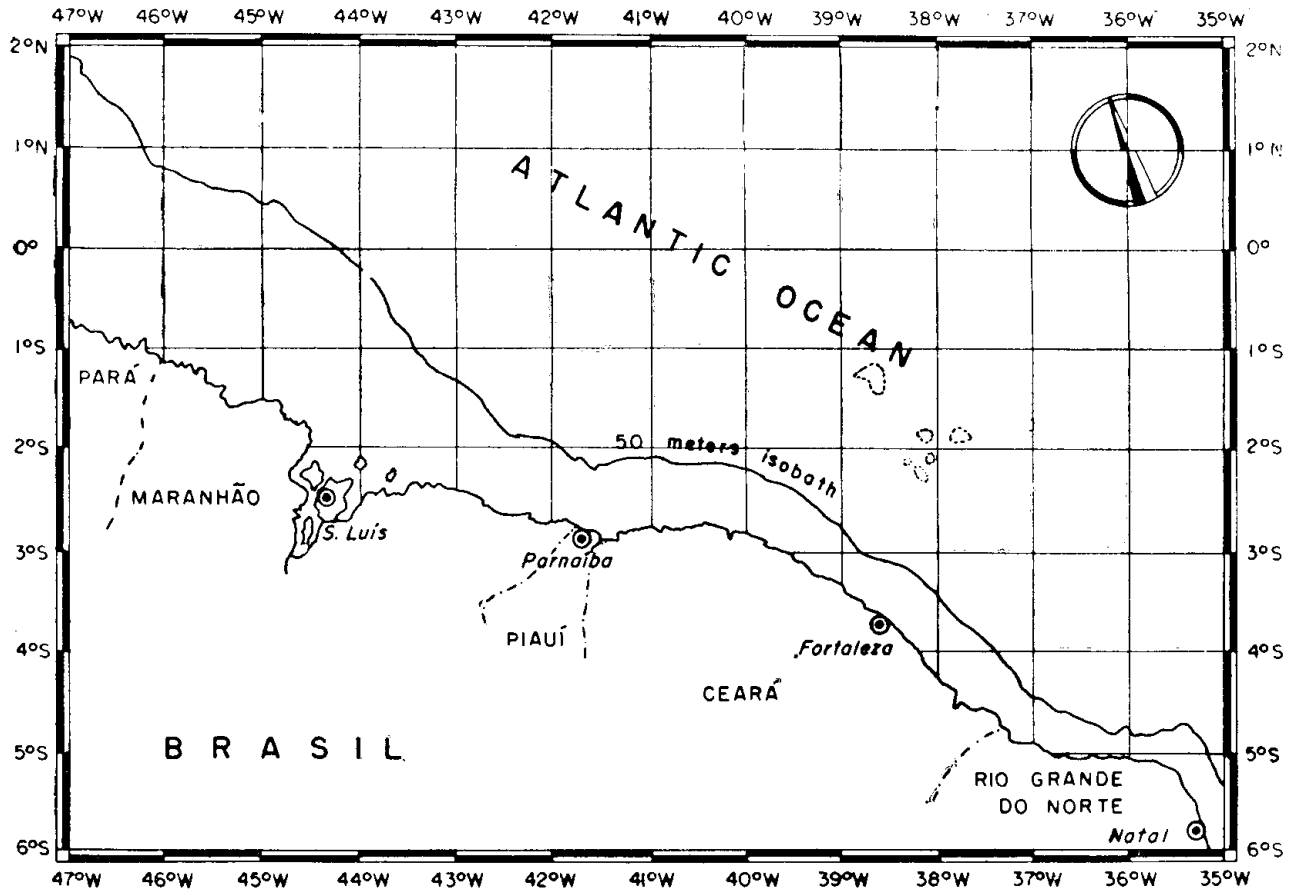
Figure 1 — Oceanic banks and continental slope between 37°30'W and 47°00'W, where the fishing for Caribbean red snapper is carried out.

TABLE I

Numbers and percentages of the records of the current and wind directions by quadrants, in the Caribbean red snapper fishing areas off the Northeast Brazil.

| Direction | Current | | | | | | Wind | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CE | | MA I | | MA II | | CE | | MA I | | MA II | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| 1st quadrant | 5 | 4.8 | 4 | 5.4 | — | — | 31 | 32.3 | 19 | 17.9 | 115 | 65.3 |
| 2nd quadrant | 2 | 1.9 | 3 | 4.0 | — | — | 57 | 59.4 | 84 | 79.2 | 61 | 34.7 |
| 3rd quadrant | 8 | 7.7 | 11 | 14.9 | 2 | 3.3 | 7 | 7.3 | — | — | — | — |
| 4th quadrant | 89 | 85.6 | 56 | 75.7 | 58 | 96.7 | 1 | 1.0 | 3 | 2.9 | — | — |
| Total | 104 | 100.0 | 74 | 100.0 | 60 | 100.0 | 96 | 100.0 | 106 | 100.0 | 176 | 100.0 |

In table II are shown the mean, and the total and 70% ranges of the records, for the current and wind speed and the depth. As a rule, for the 70% range of the records, more than 70 per cent of the catch was obtained (table III).

The quadrants that afforded the higher mean daily catches coincide, as a whole, with those where the current and wind directions were predominant (table IV).

With regard to the current speed, the higher mean daily catches were obtained in the classes from 0.1 to 1.5 mph and 2.1 to 3.0 (CE), from 1.1 to 2.5 mph (MA I) and from 2.1 to 2.5 mph (MA II) (table V). No significant correlation was found to exist between the current speed and the catch in any of the areas, what means that the speed of the current did not effect the catch. The correlation coefficients found were: - 0.59 n. s., - 0.50 n. s., and - 0.34 n. s.

As to the wind speed, the higher mean daily catches were obtained at the Beaufort scale numbers from 0 to 3 and 7 (CE), 0 and from 3 to 5 (MA I), and from 0 to 4 and 8 (MA II) (table VI). No significant correla-

## TABLE II

Data on the current speed, wind speed and depth, in the Caribbean red snapper fishing areas off the Northeast Brazil.

| Areas | Number of records | Mean | Total range | 70% range * |
|---|---|---|---|---|
| Current speed (mph) | | | | |
| CE | 104 | 1.6 | 0.2 — 4.0 | 0.4 — 2.3 |
| MA I | 105 | 1.3 | 0.1 — 3.5 | 0.4 — 2.2 |
| MA II | 172 | 1.8 | 0.1 — 4.0 | 0.9 — 2.7 |
| Wind speed (Beaufort numbers) | | | | |
| CE | 104 | 3 | 0 — 7 | 1 — 4 |
| MA I | 104 | 5 | 0 — 8 | 3 — 6 |
| MA II | 179 | 4 | 0 — 8 | 2 — 5 |
| Depth (fathoms) | | | | |
| CE | 103 | 46 | 20 — 70 | 33 — 60 |
| MA I | 101 | 52 | 35 — 70 | 43 — 61 |
| MA II | 104 | 50 | 38 — 65 | 43 — 57 |

* Where 68.26% of the records occur. Obtained from one standard deviation on each side of the mean and here rounded to 70% for convenience.

## TABLE III

Percentages of the catch obtained within the 70% range of records of the current and wind speed and depth.

| Areas | Percentages of the catch within 70% range | | |
|---|---|---|---|
| | current speed | wind speed | depth |
| CE | 68.1 | 79.7 | 72.9 |
| MA I | 73.0 | 74.4 | 75.4 |
| MA II | 76.5 | 74.? | 69.9 |

## TABLE IV

Mean daily catches (t) of the Caribbean red snapper, *Lutjanus purpureus* Poey, by the current and wind directions grouped in quadrants.

| Direction | Current | | | Wind | | |
|---|---|---|---|---|---|---|
| | CE | MA I | MA II | CE | MA I | MA II |
| 1st quadrant | 2.4 | 0.7 | — | 2.2 | 1.9 | 1.6 |
| 2nd quadrant | 2.0 | 1.6 | — | 2.0 | 1.7 | 1.4 |
| 3rd quadrant | 2.1 | 2.3 | 0.4 | 2.3 | — | — |
| 4th quadrant | 2.2 | 1.8 | 1.5 | 1.7 | 1.9 | — |
| Total | 2.2 | 1.8 | 1.5 | 2.1 | 1.7 | 1.5 |

## TABLE V

Total and daily catches (t) of Caribbean red snapper, *Lutjanus purpureus* Poey, by classes of current speed, in the fishing areas off the Northeast Brazil.

| Speed classes (mph) | CE area | | | MA I area | | | MA II area | | |
|---|---|---|---|---|---|---|---|---|---|
| | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch |
| 0.1 — 0.5 | 17 | 41.2 | 2.4 | 20 | 32.6 | 1.6 | 8 | 10.1 | 1.3 |
| 0.6 — 1.0 | 22 | 48.5 | 2.2 | 32 | 51.2 | 1.6 | 18 | 24.4 | 1.4 |
| 1.1 — 1.5 | 20 | 43.5 | 2.2 | 15 | 28.4 | 1.9 | 36 | 55.7 | 1.5 |
| 1.6 — 2.0 | 9 | 18.5 | 2.0 | 16 | 33.5 | 2.1 | 43 | 65.3 | 1.5 |
| 2.1 — 2.5 | 12 | 26.2 | 2.2 | 11 | 20.2 | 1.8 | 30 | 63.7 | 2.1 |
| 2.6 — 3.0 | 1 | 11.0 | 2.8 | 5 | 6.4 | 1.3 | 18 | 22.6 | 1.2 |
| 3.1 — 3.5 | 12 | 25.5 | 2.1 | 5 | 4.0 | 0.8 | 13 | 17.8 | 1.4 |
| 3.6 — 4.0 | 4 | 7.3 | 1.8 | 1 | 1.5 | 1.5 | 4 | 5.0 | 1.2 |
| 4.1 — 4.5 | 4 | 2.0 | 0.5 | — | — | — | 2 | 2.0 | 1.0 |
| Total | 104 | 223.7 | 2.2 | 105 | 177.8 | 1.7 | 172 | 266.6 | 1.6 |

## TABLE VI

Total and daily catches (t) of Caribbean red snapper, *Lutjanus purpureus* Poey, by the Beaufort scale numbers, in the fishing areas off the Northeast Brazil.

| Beaufort scale numbers | CE area | | | MA I area | | | MA II area | | |
|---|---|---|---|---|---|---|---|---|---|
| | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch |
| 0 | 7 | 17.8 | 2.5 | 1 | 3.2 | 3.2 | 1 | 1.5 | 1.5 |
| 1 | 15 | 42.5 | 2.8 | 4 | 3.3 | 0.8 | 15 | 32.8 | 2.2 |
| 2 | 24 | 54.4 | 2.3 | 8 | 10.2 | 1.3 | 40 | 58.4 | 1.5 |
| 3 | 28 | 63.5 | 2.3 | 18 | 43.4 | 2.4 | 35 | 57.0 | 1.6 |
| 4 | 10 | 17.8 | 1.8 | 14 | 32.4 | 2.3 | 35 | 60.4 | 1.7 |
| 5 | 15 | 20.6 | 1.4 | 20 | 36.2 | 1.8 | 22 | 24.9 | 1.1 |
| 6 | 4 | 4.6 | 1.2 | 17 | 23.8 | 1.4 | 21 | 24.7 | 1.2 |
| 7 | 1 | 2.5 | 2.5 | 17 | 23.0 | 1.4 | 7 | 5.6 | 0.8 |
| 8 | — | — | — | 5 | 7.1 | 1.4 | 3 | 4.8 | 1.6 |
| Total | 104 | 223.7 | 2.2 | 104 | 182.6 | 1.8 | 179 | 270.1 | 1.5 |

TABLE VII

Total and daily catches (t) of Caribbean red snapper, *Lutjanus purpureus* Poey, by classes of depth, in the fishing areas off the Northeast Brazil.

| Classes of depth (fathoms) | CE area | | | MA I area | | | MA II area | | |
|---|---|---|---|---|---|---|---|---|---|
| | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch | Days of fishing | Total catch | Mean daily catch |
| 21 — 25 | 10 | 24.3 | 2.4 | — | — | — | — | — | — |
| 26 — 30 | 10 | 16.5 | 1.6 | — | — | — | — | — | — |
| 31 — 35 | 3 | 6.5 | 2.2 | — | — | — | — | — | — |
| 36 — 40 | 5 | 9.2 | 1.8 | 7 | 11.4 | 1.6 | 5 | 4.5 | 0.9 |
| 41 — 45 | 19 | 33.5 | 1.8 | 21 | 27.8 | 1.3 | 40 | 47.7 | 1.2 |
| 46 — 50 | 14 | 26.5 | 1.9 | 14 | 19.8 | 1.4 | 29 | 41.9 | 1.4 |
| 51 — 55 | 15 | 34.0 | 2.3 | 20 | 35.0 | 1.8 | 32 | 54.1 | 1.7 |
| 56 — 60 | 10 | 19.8 | 2.0 | 15 | 26.1 | 1.7 | 23 | 35.6 | 1.5 |
| 61 — 65 | 14 | 41.1 | 2.9 | 18 | 43.5 | 2.4 | 13 | 26.6 | 2.0 |
| 66 — 70 | 2 | 5.5 | 2.8 | 5 | 6.1 | 1.2 | 2 | 4.8 | 2.4 |
| 71 — 75 | 1 | 3.3 | 3.3 | 1 | 1.5 | 1.5 | — | — | — |
| Total | 103 | 220.2 | 2.1 | 101 | 171.2 | 1.7 | 144 | 215.2 | 1.5 |

TABLE VIII

Percentages of the total catch and mean daily catches (t) of the Caribbean red snapper, *Lutjanus purpureus* Poey, by moon phases, in the fishing areas off the Northeast Brazil.

| Moon phases | CE area | | MA I area | | MA II area | |
|---|---|---|---|---|---|---|
| | catch percentages | mean daily catch | catch percentages | mean daily catch | catch percentages | mean daily catch |
| New moon | 25.6 | 2.1 | 26.5 | 1.4 | 23.5 | 1.7 |
| First quarter | 21.6 | 2.0 | 28.3 | 2.2 | 25.7 | 1.9 |
| Full moon | 24.4 | 2.2 | 26.5 | 1.6 | 17.2 | 1.5 |
| Last quarter | 28.4 | 2.3 | 18.7 | 1.7 | 33.6 | 1.4 |
| Total    % | 100.0 | 2.1 | 100.0 | 1.7 | 100.0 | 1.6 |
| Total    w | 220.3 | — | 181.8 | — | 256.0 | — |

tion was found to exist between the wind speed and the catch in any of the areas, what means that speed of the wind did not affect the catch. The correlation coefficients found were: - 0.57 n.s., - 0.36 n.s., and 0.56 n.s.

As to the depth, the higher mean daily catches were obtained in the classes of 20-25, 31-35, 51-55 and from 61 to 75 fathoms (CE), from 51 to 65 fathoms (MA I) and from 51 to 70 fathoms (MA II) (table VII). Positive significant correlation was found to exist between the depth and the catch in the CE and MA II areas, what means that in those areas the catch increased in proportion to the depth. The correlation coefficients found were: 0.69 *, 0.01 n.s., and 0.95 *.

Carpenter & Nelson (1969) state that the Caribbean red snapper is most abundant down to 50 fathoms, in the Caribbean Sea and adjacent South American coast. Rivas (1970), based in a 18-year exploratory work from

Cape Hatteras (U.S.A.) to Fortaleza (Brazil), found 32 fathoms as mean depth and 22-42 fathoms as 70% range depths. These data are not in agreement to the ones presented in this paper.

The total catch was evenly obtained in the four moon phases. The mean daily catches by moon phases were higher in the last quarter (CE) and in the first quarter (MA I and MA II) ; and lower in the first quarter, new moon and last quarter (table VIII).

## LITERATURE CITED

Carpenter, J. S. & Nelson, W. R. — 1969 — Fishery potential for snapper and grouper in the Caribbean Sea and adjacent South American coast. *FAO Fish. Rep.*, Rome, (71.1) : 149.

Rivas, L. R. — 1970 — Snappers of the Western Atlantic. *Comm. Fish. Rev.*, Washington, *32* (1) : 41-44, 1 fig.