

**ANALYSIS OF STOMACH CONTENTS OF  
DOLPHINFISH, *CORYPHAENA HIPPURUS*, LINNAEUS, 1758  
(ACTINOPTERYGII, CORYPHAENIDAE),  
OFF THE NORTHERN COAST OF RIO DE JANEIRO STATE, BRAZIL**

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SUMMARY

*The dolphinfish, Coryphaena hippurus, is a pelagic species that occurs practically in all tropical and subtropical seas of the world. In the two last decades, a significant increase in its catch has been observed due to the use of different fishing gear mainly a multispecific small size fleet. In this study, 409 stomachs were sampled during the period from September 2003 to March 2009, off the northern coast of Rio de Janeiro State, Brazil (22°S to 24°S and 40°W to 44°W). The stomach contents were measured and a quantitative analysis was performed to identify the main, secondary and companions species using the method of Numerical Relative Frequency and Relative Abundance. We observed that 319 contained food (78.0%), 65 were empty (15.9%), 14 contained digested and unidentified fish bones digested (3.4%), six contained various plastic pieces (1.5%), four contained floating algae (1.0%) and one contained fishhook (0.2%). For a sustainable management of a fishery, the knowledge on the connection between trophic and food consumption rates of top predators is required to elucidate the importance of the main predators and fishers in the fishery.*

RÉSUMÉ

*La coryphène commune (Coryphaena hippurus) est une espèce pélagique qui se trouve pratiquement dans toutes les mers tropicales et subtropicales du monde. Au cours des deux dernières décennies, on a observé une augmentation considérable de ses captures en raison de l'emploi d'un engin de pêche différent, essentiellement une flottille plurispécifique de petite taille. Dans la présente étude, 409 contenus stomacaux ont fait l'objet d'échantillonnage entre septembre 2003 et mars 2009, au large de la côte septentrionale de l'état de Rio de Janeiro, Brésil (22°S à 24°S et 40°W à 44°W). Les contenus stomacaux ont été mesurés et une analyse quantitative a été effectuée en vue d'identifier les espèces principales, secondaires et autres à l'aide de la méthode de la fréquence relative numérique et de l'abondance relative. Nous avons observé que 319 d'entre eux contenaient de la nourriture (78,0%), 65 étaient vides (15,9%), 14 contenaient des arêtes de poissons digérées et non-identifiées (3,4%), six contenaient divers morceaux de plastique (1,5%), quatre contenaient des algues flottantes et un contenait un hameçon (0,2%). Pour obtenir la gestion durable d'une pêcherie, il est nécessaire de connaître la connexion entre les niveaux trophiques et les taux de consommation de nourriture des prédateurs au sommet de la chaîne afin d'élucider l'importance des principaux prédateurs et pêcheurs dans la pêcherie.*

RESUMEN

*El dorado, Coryphaena hippurus, es una especie pelágica que se encuentra prácticamente en todos los mares tropicales y subtropicales del mundo. En las dos últimas décadas, se ha observado un aumento significativo en la captura debido al uso de diferentes artes de pesca, principalmente a una flota multiespecífica de pequeño tamaño. En este estudio, se muestrearon 409 estómagos durante el periodo de septiembre de 2003 a marzo de 2009, en la costa norte del Estado de Río de Janeiro, Brasil (22°S a 24°S y 40°W a 44°W). Se midieron los contenidos estomacales y se realizó un análisis cuantitativo para identificar las principales especies, las secundarias y las complementarias, utilizando el método de frecuencia relativa numérica y de*

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*abundancia relativa. Hemos observado que 319 contenían comida (78%), 65 estaban vacíos (15,9%), 14 contenían huesos de peces digeridos y sin identificar (3,4%), seis contenían diversas piezas de plástico (1,5%), cuatro contenían algas flotantes (1,0%) y uno contenía un anzuelo (0,2%). Para lograr una ordenación sostenible de una pesquería, es necesario conocer la conexión entre las tasas de consumo alimentarias y los niveles tróficos de los grandes predadores para deducir la importancia de los principales predadores y pescadores en la pesquería.*

#### KEYWORDS

*Feeding habits, Mahi mahi, South Atlantic, Diet*

### Introduction

The dolphinfish, *Coryphaena hippurus* is a highly migratory species with worldwide occurrence in tropical and subtropical waters with temperatures above 21° C. In Brazil, the genus *Coryphaena* is represented by two species: *C. hippurus* and the rare species *C. equiselis* (Zavala-Camim, 1986; Lessa *et al.* 2009). The occurrence of *C. equiselis* in southeastern and southern Brazil was based on individuals collected in stomach contents of tunas (Zavala-Camim, 1986). In the northern and northeastern coast, its occurrence was recorded during the REVIZEE program by Lessa *et al.* (2009).

From the ecological perspective, the dolphinfish plays an important role, since it is a highly pelagic fish species, located at the top portion of the food chain, contributing to the balance of the marine ecosystem. However, this species is also caught accidentally by different fishing gear, commercial and sports, especially tuna longliners (*Thunnus* spp.) and swordfish (*Xiphias glaudius*).

The dolphinfish is caught mainly by multispecific small size fleet (Itaipava fleet) and it is one of their major targets off the southern coast in Brazil. Sports fishing using rod and reel catch this species off the coast in Rio de Janeiro, Sao Paulo and Espirito Santo States during recreational tournaments (Paiva and Pires-Junior, 1983; Arfelli *et al.*, 1994; Amorim and Silva, 2005).

This study analyzed stomach contents of *C. hippurus*, caught in southern Brazil, considering species composition and relative occurrence of food items.

### Materials and Methods

We sampled 409 *Coryphaena hippurus* stomachs from September 2003 to March 2009, 343 stomachs (83.8%) were obtained from fish caught on water surface by longline small size fleet and 66 (16.2%) from oceanic sports fishing tournaments the “Iate Clube do Rio de Janeiro-ICRJ” and the “Costa Azul Iate Clube-CAIC”. In this study, stomachs were sampled off the northern coast of Rio de Janeiro State, Brazil (22°S to 24°S and 40°W to 44°W) **Figure 1**.

The fish were gutted at landing to separate stomach contents, which were kept in 10% formalin for later laboratorial analys. The identification of stomach contents was carried out according to Figueiredo (1978), FAO (1978, 1994, 1999); Figueiredo and Menezes (1978, 1980); Menezes and Figueiredo (1980, 1985); Zavala-Camin, (1981, 1982, 1986, 1987).

Quantitative analyses were performed to identify the dominant, abundant, average, scarce and rare occurrence using the methods of Numerical Frequency (NF) in percentage and Relative Abundance (RA), as follow: dominant (> 15%), abundant (7-15%), average (1-6.9%) scarce (0.1-0.9%) and rare (> 0.1%). We carried out a quantitative analysis to identify the main species, secondary and companion species by determining the Numerical Frequency (NF) in % and Relative Abundance (RA).

## Results

Of the total of 409 stomachs examined, 319 contained food (78.0%), 65 stomachs were empty (15.9%), 14 stomachs contained digested and not identified fish bones (3.4%), six stomachs contained various plastic pieces (13 small pieces) (1.5%), four stomachs contained floating algae (1.0%) and one stomach contained a hook (0.2%), totaling 90 stomachs (22%) with atypical contents of the fish diet.

The *Sardinella brasiliensis* and *Hemiramplus brasiliensis* was not computed in the analysis of stomach contents because they were used as bait. The 147 stomachs contained *Sardinella brasiliensis* with a total of 262 units and nine stomachs contained *Hemiramplus brasiliensis* totaling 12 units.

According to 196 stomachs, 41 stomachs contained *Trichiurus lepturus* (20.9%), 31 stomachs contained *Loligo* sp totaling 43 units (15.8%), 20 stomachs contained *Selar crumenophthalmus* (10.2%), 17 stomachs contained *Decapterus punctatus* (8.7%), 16 contained *Exocoetus volitans* totaling 34 units (8.2%), 11 contained *Cylichthys spinosus* (5.6%), eight contained *Auxis thazard thazard* totaling nine units (4.1%), six contained *Tylosurus acus acus* totaling seven units (3.1%), six contained *Argonauta nodosa* totaling 16 units (3.1%), four contained *Lagocephalus laevigatus* (2.0%), four contained *Dactylopterus volitans* (2.0%), four contained *Paratrachichthys atlanticus* totaling 39 units (2.0%), four contained floating algae (2.0%), three contained *Opisthonema oglium* totaling five units (1.5%), three contained *Peprilus paru* (1.5%), three contained *Stephanolepis hispidus* totaling six units (1.5%), two stomachs contained *Lactophrys* sp totaling three units (1.0%), two contained *Decapterus macarellus* (1.0%), two contained *Priacanthus arenatus* totaling four units (1.0%), two contained marine shrimp (1.0%), one contained *Scomber colias* (0.5%), one contained *Acanthurus chirurgus* totaling 40 units (0.5%), one stomach contained *Diaphus dumerilii* (0.5%), one contained *Decapterus tabl* (0.5%), one contained *Pomatomus saltator* (0.5%) and one stomach contained a crab (0.5%) observed in **Table 1**.

## Discussion

Several stomachs contained more than one shrimp specimen from the same or different species in their content. The specimens were identified and counted by species, determining the fish feeding preference in all stomachs examined. We observed the large number of individuals of the same species in two distinct stomachs, one containing 40 individuals of *Acanthurus chirurgus* and another 39 individuals of *Paratrachichthys atlanticus*.

Several specimens identified were in juvenile stage of development, such as *Trichiurus lepturus*, *Lagocephalus laevigatus*, *Stephanolepis hispidus*, *Lactophrys* sp, *Pomatomus saltator*, *Cylichthys spinosus*, *Peprilus paru* and *Arenatus arenatus*.

*Sardinella brasiliensis* is the main feeding source of *Coryphaena hippurus* (NF 35.9% and RA = dominant). The study site is one of the most representative for the occurrence and capture of *Sardinella brasiliensis* in Brazil, which is also considered the main bait used by operant extractivist fleet of surface. *Hemiramplus brasiliensis*, on the other hand, is the main bait used by ocean fishing boats to catch sailfish, corroborating the fact the five of the 12 specimens (*Hemiramplus brasiliensis*) were found with a hook device, which consists of a bait arrangement used by sports fishermen to maximize catches in fishing tournaments promoted by the abovementioned fishing clubs.

The six stomachs containing 13 small plastic pieces added to four stomachs containing floating algae and one stomach containing a crab are associated with the *accumulation lines*, another important food source, when *Coryphaena hippurus* visit tangles on the edge of ocean currents for nibbling floating algae and end up eating garbage disposed from boats and ships. These *accumulation lines* serve as a shelter for countless juveniles and decapode crustaceans, complementing their diet.

The significant increase in the number of offshore oil platforms has aggravated the situation once they are located close to the slope edge and in deep waters, adding a new component to the scenario described in the study site (Carneiro *et al.*, 2000). These platforms create a shelter for juveniles of a number of species serving as food source for oceanic pelagic species that regularly visit the offshore structures to find food, which explains the high occurrence of juvenile specimens in the stomach contents of *Coryphaena hippurus*.

The occurrence of squid specimens (*Loligo* sp) in 31 stomachs and marine octopus (*Argonauta nodosa*) in six stomachs, totaling 37 stomachs with occurrence of mollusks, has already been registered in the stomachs of other oceanic species in the same area (Pimenta *et al.*, 2004). Squids dwell in deep waters and come to surface for reproductive needs, when they become another important food source for *Coryphaena hippurus*. The sum of the mollusks (squid, 15.8% and octopus, 3.1%) represent 18.9% of *Coryphaena hippurus* diet (**Table 1**).

*Trichiurus lepturus* (NF 20.9% and RA = abundant) presents itself as the only main species in *Coryphaena hippurus* diet, *Loligo* (NF 15.8% and RA Abundant), *Selar crumenophthalmus* (NF 10.2% and RA = medium), *Decapterus punctatus* (NF 8.7% and RA = medium), *Exocoetus volitans* (NF 8.2% and RA = medium), *Cylichthys spinosus* (NF 5.6% AR = medium), *Auxis thazard thazard* (NF 4.1% and RA = medium), *Tylosurus accuses cus* (NF 3.1% and RA = medium) and *Argonauta nodosa* (NF 3.1% and RA = medium) present themselves as secondary species of *Coryphaena hippurus* diet (**Table 1**).

*Lagocephalus laevigatus* (NF 2.0% and RA = rare), *Dactylopterus volitans* (NF 2.0% and RA = rare), *Opisthonema oglium* (NF 1.5% and RA = rare), *Paratrachichthys atlanticus* (NF 1.5% and RA = rare), *Peprilus paru* (NF 1.5% and RA = rare), *Stephanolepis hispidus* (NF 1.5% and RA = rare), *Lactophrys sp* (NF 1.0% and RA = rare), *Decapterus macarellus* (NF 1.0% and RA = rare), *Priacanthus arenatus* (NF 1.0% and RA = rare), *Scomber colias* (NF 0.5% and RA = rare), *Acanthurus chirurgus* (NF 0.5% and RA = rare), *Diaphus dumerilii* (NF 0.5% and RA = rare), *Decapterus tabl* (NF 0.5% and RA = rare) and *Pomatomus saltator* (NF 0.5% and RA = rare) present themselves as companion species of *Coryphaena hippurus* diet (**Table 1**).

Empty stomachs had NF 15.8% and RA relatively abundant. Digested fish bones, mainly vertebrae and some head bony plates had NF 3.4% and RA medium. Small plastic pieces in stomachs had NF 3.1% RA medium.

Floating algae in stomachs associated with *accumulation lines* on the edges of ocean currents had NF 2.0% and RA rare. The only crab occurrence (NF 0.5% and RA rare) in stomach contents is associated with *the accumulation lines* represented by tangles on the edge of ocean currents composed of floating algae and garbage disposed from boats and ships, which also houses juvenile specimens similarly to the structure of offshore oil platforms. The two stomachs with marine shrimp had NF 1.0% and RA rare.

The bait slice, probably from Scombridae, with knife-precision cut, had NF 1.0% and RA rare. The hook found in one stomach, which is used as a catch device, had NF 0.5% and RA rare.

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**Table 1.** Numerical Frequency in percentage and Relative Abundance of stomach content: dominant (DO), abundant (AB), average (AV) scarce (SC) and rare (RR) of *Coryphaena hippurus*.

<b>No.</b>	<b>Species</b>	<b>Numerical Frequency %</b>	<b>Relative Abundance</b>
41	<i>Trichiurus lepturus</i>	20,9	DO
31	<i>Loligo sp</i>	15,8	DO
20	<i>Selar crumenophthalmus</i>	10,2	AB
17	<i>Decapterus punctatus</i>	8,7	AB
16	<i>Exocoetus volitans</i>	8,2	AB
11	<i>Cylichthys spinosus</i>	5,6	AV
8	<i>Auxis thazard thazard</i>	4,1	AV
6	<i>Tylosurus acus acus</i>	3,1	AV
6	<i>Argonauta nodosa</i>	3,1	AV
4	<i>Lagocephalus laevigatus</i>	2,0	AV
4	<i>Dactylopterus volitans</i>	2,0	AV
4	Floating algae	2,0	AV
4	<i>Paratrachichthys atlanticus</i>	2,0	AV
3	<i>Opisthonema oglium</i>	1,5	AV
3	<i>Peprilus paru</i>	1,5	AV
3	<i>Stephanolepis hispidus</i>	1,5	AV
2	<i>Lactophrys sp</i>	1,0	AV
2	<i>Decapterus macarellus</i>	1,0	AV
2	<i>Priacanthus arenatus</i>	1,0	AV
2	Camarões oceânicos	1,0	AV
1	<i>Scomber colias</i>	0,5	SC
1	<i>Acanthurus chirurgus</i>	0,5	SC
1	<i>Diaphus dumerilii</i>	0,5	SC
1	<i>Decapterus tabl</i>	0,5	SC
1	<i>Pomatomus saltator</i>	0,5	SC
1	Crab	0,5	SC

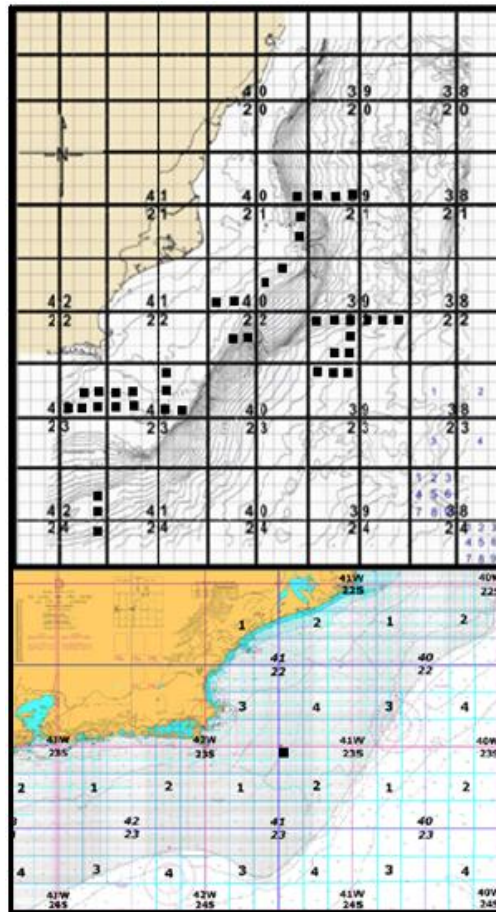


Figure 1. Fishery area off northern coast of Rio de Janeiro State, Brazil.