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# Food and feeding habits of a herbivore fish *Sarpa salpa* (L.) (Teleostei, Sparidae) in the southern Adriatic (Croatia)

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*The diet of salema (*Sarpa salpa *L.) (2-3 years old) was studied in the southern Adriatic (the area of Dubrovnik). The gut content analysis showed a great diversity of benthic algae (101 taxa) and one marine phanerogam (*Posidonia oceanica*). The Rhodophyta taxa seem to be most the important component of the diet. Food of animal origin was very poorly represented; it was composed mainly of epibionts, presumably taken by chance.*

## INTRODUCTION

Salema (*Sarpa salpa* L., *Sparidae*), has an oval and elongated body, is of yellowish-silvery color with yellow-green longitudinal bands, and reaches 51 cm in length and 3 kg in weight (BINI, 1968; TORTONESE, 1975; GRUBIŠIĆ, 1982).

It is commonly found throughout the Mediterranean, and occasionally in the Black Sea. It can also be found on the eastern Atlantic coast (from the Bay of Biscay to South Africa, around the Madeira, the Canary Islands and the Azores) and in sporadically along the eastern coast of African (BINI, 1968; FISHER, 1973; TORTONESE, 1975; JOUBERT and HANEKEN , 1980). It is distributed along the entire coastal belt of the Adriatic Sea.

This species lives in schools along rock-bottomed coasts. It is found in depths up to 20 m, where it is covered with vegetation with wich it feeds (GRUBIŠIĆ, 1982). Its teeth and gut length are adapted to this kind of food and feeding behaviour (ONOFRI, 1987; CHRISTENSEN, 1978). This species spawns in September - October and is a permanent hermaphrodite (TORTONESE, 1975).

## MATERIAL AND METHODS

Material was obtained from professional fishermen during 1989. Catches were taken from the southern coast of the Adriatic (the vicinity of Dubrovnik and along the coasts of the Lokrum Island). All fishes were captured early in the morning. In the laboratory, the age of fish, total length (TL) in cm, weight (W) in g, gut length (Gl) in cm, the weight of gut (WG) in g and fullnes index (JR) in % were determined. The age of fish (second and third year) was determined by standard techniques based on annual otolith rings (Table 1). The fullness index (JR) was calculated using the formula:

$$JR\ (\%) = \frac{mc\ (\text{mass of gut contents in g})}{mr\ (\text{fish mass in g})} \times 100$$

(HUREAN, 1970)

Analysis of the gut content was performed microscopically.

## RESULTS AND DISCUSSION

As with other herbivore organisms, the length of the intestine in *Sarpa salpa* (L.) exceeds its body length. The fullness index showed no essential differences in feeding dynamics during the year (Table 1).

Table 1. Age and biometrical data (TL-total length, W-weigth, Gl-gut length, Wg-weight of gut, JR-fullnes index) of analyzed specimens of *Sarpa salpa* (L.)

| Month: | Age | TL(cm) | W(g) | Gl(cm) | wg (a) | JR(%) |
|---|---|---|---|---|---|---|
| January | | | | | | |
| Fish No. 1 | 1+ | 14.5 | 42.5 | 34.0 | 4.0 | 9.4 |
| Fish No. 2 | 1+ | 15.0 | 50.8 | 34.0 | 5.0 | 9.8 |
| February | | | | | | |
| Fish No. 1 | 1+ | 15.5 | 50.4 | 42.0 | 7.1 | 14.1 |
| Fish No. 2 | 1+ | 14.8 | 43.1 | 41.2 | 5.9 | 13.7 |
| March | | | | | | |
| Fish No. 1 | 2+ | 23.0 | 170.2 | 42.0 | 13.0 | 7.6 |
| Fish No. 2 | 2+ | 21.5 | 150.3 | 43.0 | 19.1 | 12.7 |
| April | | | | | | |
| Fish No. 1 | 2+ | 20.0 | 128.3 | 48.0 | 22.2 | 17.3 |
| Fish No. 2 | 2+ | 23.2 | 165.8 | 42.0 | 22.7 | 16.4 |
| May | | | | | | |
| Fish No. 1 | 2+ | 21.5 | 151.2 | 42.0 | 21.5 | 14.2 |
| Fish No. 2 | 2+ | 21.2 | 138.6 | 60.0 | 18.9 | 13.6 |
| June | | | | | | |
| Fish No. 1 | 2+ | 23.0 | 182.8 | 40.0 | 31.8 | 17.4 |
| Fish No. 2 | 2+ | 22.0 | 175.8 | 50.0 | 34.8 | 19.8 |
| July | | | | | | |
| Fish No. 1 | 2+ | 20.0 | 105.3 | 40.0 | 10.9 | 10.4 |
| Fish No. 2 | - | - | - | - | - | - |
| August | | | | | | |
| Fish No. 1 | 1+ | 18.5 | 109.1 | 50.0 | 20.5 | 18.8 |
| Fish No.2 | 1+ | 16.0 | 60.3 | 48.0 | 11.5 | 19.1 |
| October | | | | | | |
| Fish No. 1 | 1 | 12.0 | 28.3 | 28.0 | 4.2 | 14.8 |
| Fish No. 2 | 1 | 13.0 | 33.9 | 33.0 | 5.1 | 15.0 |
| November | | | | | | |
| Fish No. 1 | 1 | 13.7 | 46.4 | 43.0 | 7.6 | 16.4 |
| Fish No. 2 | 1 | 14.0 | 47.5 | 47.0 | 7.6 | 16.0 |
| December | | | | | | |
| Fish No. 1 | 2 | 18.0 | 81.2 | 34.0 | 4.8 | 5.9 |
| Fish No. 2 | 2 | 17.5 | 71 1 | 38.0 | 5.2 | 7.3 |

A total of 101 taxa (species and infraspecific) of benthic algae and one marine phanerogam (*Posidonia oceanica*) were determined (Cyanophyta and Diatomeae were not included).

The Rhodophyta dominated in number (60 taxa) and percentage (59.6 %). They are followed by Phaeophyta (25 taxa or 24.8 %) and Chlorophyta (16 taxa or 15.8 %) (Table 2).

Table 2. List of determined benthic algae and marine phanerogams in gut contents of *Sarpa salpa* L. in the southern Adriatic

| Month: | Jan. | | Feb. | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish No. | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| **RHODOPHYTA** | | | | | | | | | | | | | | | | | | | | | | |
| *Acrosorium venulosum* (Zan.) Kylin | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Apoglossum ruscifolium* (Turn.) J. Ag. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Audouinella daviesii* (Dillw.) Woelk. | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Audouinella sp.* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Botryocladia botryoides* (Wulf.) J. Feldm. | - | - | - | - | + | + | - | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - |
| *Botryocladia microphysa* (Hamel) Kylin | - | - | - | + | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Ceramium ordinatum* Kütz. | - | - | + | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Ceramium ciliatum* (Ellis) Ducl. | - | - | - | + | - | + | + | + | - | - | - | - | - | - | + | - | - | - | + | + | - | - |
| *Ceramium circinatum* (Kütz.) J. Ag. | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Ceramium diaphanum* (Lightf.) Roth | | | | | | | | | | | | | | | | | | | | | | |
| var. *diaphanum* | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | + | - | - |
| var. *strictum* (Kütz.) Feldm.-Mazoy. | - | - | - | + | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Ceramium echionotum* J. Ag. | - | - | - | - | - | - | - | + | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Ceramium rubrum* (Huds.) C. Ag. | | | | | | | | | | | | | | | | | | | | | | |
| var. *barbatum* (Kütz.) Ardiss. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | + | - | - |
| *Ceramium tenuissimum* (Roth) | | | | | | | | | | | | | | | | | | | | | | |
| J. E. Aresch. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Champia parvula* (C. Ag.) Harv. | - | - | + | + | - | - | - | - | + | + | - | - | - | - | + | - | - | - | - | - | - | - |
| *Chondria tenuissima* (With.) C. Ag. | - | - | - | - | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Chroodactylon ornatum* (C. Ag.) | | | | | | | | | | | | | | | | | | | | | | |
| Drew *et* Ross | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Chylocladia verticillata* (Lightf.) Blid. | - | + | - | - | + | - | - | - | - | + | - | - | - | - | - | - | - | - | + | - | - | - |
| *Crouania attenuata* (C. Ag.) J. Ag. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Dasya hutchinsiae* Harv. | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | + | - | - |
| *Erythrotrichia carnea* (Dillw.) J. Ag | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Gastroclonium clavatum* (Roth) Ardiss. | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - |
| *Gelidium crinale* (Turn.) Lamour. *in* Bory | - | + | - | + | - | + | - | + | + | + | - | - | - | - | + | + | - | - | + | - | - | - |
| *Gelidium latifolium* (Grev.) | | | | | | | | | | | | | | | | | | | | | | |
| Born. *et* Hauck | | | | | | | | | | | | | | | | | | | | | | |
| var. *latifolium* | + | + | - | - | - | - | + | + | + | - | - | - | - | - | + | - | - | - | + | - | - | - |
| var. *hystrix* (J. Ag.) Hauck | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| var. *luxurians* Crou. et Crou. | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | + | - | - | - | - |
| *Gelidium melanoideum* Schousb. *ex* Born. | | | | | | | | | | | | | | | | | | | | | | |
| var. *filamentosum* Schousb. *ex* Born. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - |
| *Gelidium pusillum* (Stackh.) Le Jolis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | + | + | - |
| *Griffithsia phyllamphora* J. Ag. | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Halymenia sp.* | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Hypoglossum hypoglossoides* (Stack.) | | | | | | | | | | | | | | | | | | | | | | |
| Coll. *et* Harv. | - | - | + | + | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Hypnea musciformis* (Wulf.) Lamour. | + | + | + | + | + | + | - | + | - | + | + | + | - | - | + | + | + | + | + | + | + | - |
| *Herposiphonia secunda* (C. Ag.) Ambr. | | | | | | | | | | | | | | | | | | | | | | |
| *f. secunda* | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *f. tenella* (C. Ag.) Wynne | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - |
| *Laurencia obtusa* (Huds.) Lamour. | - | - | + | + | - | - | - | - | + | + | - | - | + | - | - | - | - | - | - | + | + | + |
| *Laurencia papillosa* (C. Ag.) Grev. | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Table 2. continued 1

| Month: | Jan. | | Feb. | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish No. | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| *Laurencia pinnatifida* (Huds.) Lamour. | - | + | + | + | + | + | - | - | - | + | - | - | - | - | - | - | + | - | - | + | + | + |
| *Lomentaria chylocladiella* Funk | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Lomentaria clavellosa* (Turner) Gaill. | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Lomentaria verticillata* Funk | - | - | - | - | - | + | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Lomentaria sp.* | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Lophosiphonia obscura* (C. Ag.) Falk. | - | - | - | + | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Peyssonnelia rubra* (Grev.) J. Ag. | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Polysiphonia elongata* (Huds.) Spreng. | - | - | - | - | + | + | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Polysiphonia fruticulosa* (Wulf.) Spreng. | - | - | + | + | + | + | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Polysiphonia opaca* (C. Ag.) Zan. | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Polysiphonia sp.* | - | + | + | + | - | + | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Pterocladia capillacea* (Gmel.) Born et Thur. | - | + | - | - | - | - | + | - | - | - | - | + | - | - | + | + | - | - | + | - | - | - |
| *Pterosiphonia pennata* (C. Ag.) Falk. | - | + | + | - | - | - | + | + | - | - | - | - | - | - | + | + | - | + | + | - | + | - |
| *Pterothamnion plumula* (Ellis) Nag. var. *crispum* (Ducl.) Nag. *ex* Hauck | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Rhodophyllis divaricata* (Stackh.) Papenf. | + | + | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Rodriguezella strafforellii* Schm. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Rytiphloaea tinctoria* (Clem.) C. Ag. | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Sebdenia dichotoma* Berth. | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Spermothamnion johanis* Feldm.-Mazoy. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Sphondilothamnion multifidum* (Huds.) Nag. | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Spyridia filamentosa* (Wulf.) Harv. | - | - | + | + | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Stylonema alsidii* (Zanard.) Drew | - | - | - | + | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Stylonema cornu-cervi* Reinsch | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Taenioma nanum* (Kütz.) Papenf. | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **PHAEOPHYTA** | | | | | | | | | | | | | | | | | | | | | | |
| *Cladosiphon mediterranneus* Kütz. | - | - | - | - | + | + | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Cutleria multifida* (Smith) Grev. | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Cystoseira compressa* (Esp.) Ger. *et* Nizam. *f. rosetta* (Erceg.) Corm. *et al.* | - | - | - | - | - | + | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - |
| *Cystoseira corniculata* (Wulf.) Zan. ssp. *laxior* Erceg. | - | - | - | - | - | - | - | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - |
| *Cystoseira spinosa* Sauvag. | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Cystoseira sp.* | - | - | + | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Dictyopteris polypodioides* (D. C.) Lamour. | - | - | - | - | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Dictyota dichotoma* (Hudson) Lamour. var. *dichotoma* | + | + | - | - | + | - | - | + | - | + | - | - | - | - | - | - | - | - | + | - | - | - |
| var. *intricata* (C. Ag.) Grev. | + | + | - | - | - | - | + | + | - | - | + | + | - | - | + | - | - | - | + | - | + | - |
| *Dictyota linearis* (C. Ag.) Grev. | - | - | + | - | - | + | - | + | - | - | - | - | + | - | - | - | - | - | - | - | - | - |
| *Dilophus fasciola* (Roth) Howe | - | - | - | + | + | + | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - |
| *Ectocarpus siliculosus* (Dillw.) Lyng. | - | - | + | + | - | + | + | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Feldmannia caespitula* (J. Ag.) Knoep.-Peg. var. *lebelii* (Aresch. *ex* Crou. et Crou.) Knoep.-Peg. | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Feldmannia irregularis* (Kütz.) Hamel | - | - | - | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Halopteris filicina* (Grat.) Kütz. | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | + | - | - | - |

Table 2. continued 2

| Month: | Jan. | | Feb. | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish No. | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| *Halopteris scopara* (L.) Sauv. | - | - | + | + | - | - | - | + | + | - | - | - | - | - | + | + | - | - | - | + | - | - |
| *Hincksia dalmatica* (Erceg.) Corm. *et* Furn. | - | - | - | - | - | - | - | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - |
| *Nereia filiformis* (J. Ag.) Zan. | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Padina pavonica* (L.) Thivy | - | - | - | - | - | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Sargassum vulgare* C. Ag. | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | + |
| *Sphacelaria cirrosa* (Roth) C. Ag. | - | + | + | + | + | + | - | + | + | + | - | - | + | - | + | - | + | - | + | + | - | + |
| *Sphacelaria fusca* (Huds.) S. F. Gray | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Sphacelaria plumula* Zan. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - |
| *Stilophora rhizodes* (Turn.) J. Ag. | - | - | + | + | + | + | - | + | - | - | - | - | + | - | - | - | - | - | - | - | - | - |
| *Zanardinia prototypus* (Nardo) Nardo | - | - | - | - | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - |
| **CHLOROPHYTA** | | | | | | | | | | | | | | | | | | | | | | |
| *Acetabularia acetabulum* (L.) Silva | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Bryopsis cupressoides* Kütz. | + | + | - | - | - | - | + | - | - | - | - | - | - | - | - | - | + | + | - | - | - | - |
| *Bryopsis duplex* De Not. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | + | - | - |
| *Bryopsis hypnoides* Lamour. | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Bryopsis sp.* | - | - | - | - | + | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Chaetomorpha aerea* (Good. *ex* Dillw.) Kütz. | + | + | + | - | - | - | + | - | - | - | - | - | - | - | + | - | + | + | + | + | + | - |
| *Cladophora coelothrix* Kütz. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Cladophora lemhmaniana* (Linden.) Kütz. | - | + | + | + | - | + | + | + | - | - | + | - | - | - | + | + | + | - | + | + | + | - |
| *Cladophora pellucida* (Huds.) Kütz. | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Cladophora prolifera* (Roth) Kütz. | - | - | - | + | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Cladophora sp.* | - | - | - | - | + | - | + | + | + | + | - | - | - | - | - | - | - | - | - | - | - | - |
| *Enteromorpha compressa* (L.) Nees | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Enteromorpha multiramosa* Blid. | - | - | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Enteromorpha prolifera* (Mull.) J. Ag. | - | - | - | - | - | - | - | - | - | - | - | + | - | - | + | - | + | - | - | - | - | - |
| *Rhizoclonium tortuosum* (Dillw.) Kütz. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - | - |
| *Ulva rigida* C. Ag. | + | + | + | - | - | - | + | + | - | - | + | + | - | - | + | + | + | + | + | + | + | - |
| **ANGIOSPERMAE** | | | | | | | | | | | | | | | | | | | | | | |
| *Posidonia oceanica* (L.) Delile | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | + |

A single analysis of the gut contents of *Sarpa salpa* (L.) from the island area of the middle Adriatic showed the presence of 15 algal taxa, with the domination of *Laurencia obtusa* (Rhodophyta) and *Cystoseira compressa* (Phaeophyta) (PELIVAN,1981).

The analysis of gut contents of very young *Sarpa salpa* (L.) from southern Adriatic (SKARAMUCA and SANKO-NJIRE, 1988), showed the presence of 32 benthic algae taxa. The Rhodophyta taxa was dominant by number (21 taxa or 65.0 %) but the Chlorophyta dominated the biomass (*Ulva rigida, Enteromorpha prolifera* and *Cladophora sp.*). Epibiontic species, mostly diatoms, were also found.

VERLAQUE (1990) studied the feedeng of *Sarpa salpa* (L.) from the Mediterranean (Corsica, Bouchesdu-Rhone, Var) and determined 138 taxa of benthic algae (Rhodophyta 75 taxa or 54.3 %, Phaeophyta 50 taxa or 36.4 %, Chlorophyta 13 taxa or 9.4 %). Young fish (7.5 - 15.0 cm in length) showed a marked preference for epiphytic algae and algal "turfs" Rhodophyta and Phaeophyta, whereas the food of adults (15.0 - 22.0 cm and over) was composed of mainly erect Phaeophyta and Chloro-

phyta algae, and of epiphytic algae on *Posidonia oceanica* leaves.

In our investigations, the total number of benthic algae taxa per fish specimen varied from 4 to 35 (mean value 15.7). In Rhodophyta, the number of taxa per fish specimen varied from 1 to 25 (mean value 8.5) and the percentage from 22.2 to 76.7 %. In Phaeophyta, the number of taxa per fish specimen varied from 1 to 10 (mean value 4.1) and the percentage from 11.1 to 77.8 %, whereas in Chlorophyta the number of taxa varied from 1 to 8 (mean value 3.1) and the percentage from 5.9 to 55.6 % (Table 3).

Table 3. Numbers (N) and percentage (%) presence of principal systematic groups (Rhodophyta, Phaeophyta and Chlorophyta) of benthic algae in gut contents of *Sarpa salpa* (L.) from the southern Adriatic

| Month: | Rhodophyta | | Phaeophyta | | Chlorophyta | | TOTAL |
|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N |
| January | | | | | | | |
| Fish No. 1 | 3 | 37.5 | 2 | 25.0 | 3 | 37.5 | 8 |
| Fish No. 2 | 13 | 61.9 | 4 | 19.0 | 4 | 19.0 | 21 |
| February | | | | | | | |
| Fish No. 1 | 25 | 71.4 | 6 | 17.1 | 4 | 11.4 | 35 |
| Fish No. 2 | 23 | 76.7 | 5 | 16.7 | 2 | 6.7 | 30 |
| March | | | | | | | |
| Fish No. 1 | 9 | 47.4 | 8 | 42.1 | 2 | 10.5 | 19 |
| Fish No. 2 | 14 | 53.8 | 10 | 38.5 | 2 | 7.7 | 26 |
| April | | | | | | | |
| Fish No. 1 | 4 | 33.3 | 2 | 16.7 | 6 | 50.0 | 12 |
| Fish No. 2 | 9 | 36.0 | 10 | 40.0 | 6 | 24.0 | 25 |
| May | | | | | | | |
| Fish No. 1 | 9 | 52.9 | 7 | 41.2 | 1 | 5.9 | 17 |
| Fish No. 2 | 12 | 52.2 | 9 | 39.1 | 2 | 8.7 | 23 |
| June | | | | | | | |
| Fish No. 1 | 1 | 25.0 | 1 | 25.0 | 2 | 50.0 | 4 |
| Fish No. 2 | 2 | 40.0 | 1 | 20.0 | 2 | 40.0 | 5 |
| July | | | | | | | |
| Fish No. 1 | 2 | 22.2 | 7 | 77.8 | - | - | 9 |
| Fish No. 2 | - | - | - | - | - | - | - |
| August | | | | | | | |
| Fish No. 1 | 15 | 57.7 | 3 | 11.5 | 8 | 30.8 | 26 |
| Fish No.2 | 4 | 57.1 | 1 | 14.3 | 2 | 28.6 | 7 |
| October | | | | | | | |
| Fish No. 1 | 3 | 33.3 | 1 | 11.1 | 5 | 55.5 | 9 |
| Fish No. 2 | 3 | 50.0 | - | - | 3 | 50.0 | 6 |
| November | | | | | | | |
| Fish No. 1 | 10 | 55.6 | 4 | 22.2 | 4 | 22.2 | 18 |
| Fish No. 2 | 9 | 60.0 | 2 | 13.3 | 4 | 26.7 | 15 |
| December | | | | | | | |
| Fish No. 1 | 6 | 54.5 | 2 | 18.2 | 3 | 27.3 | 11 |
| Fish No. 2 | 2 | 50.0 | 2 | 50.0 | - | - | 4 |
| Mean values | 178/21=8.5 | | 87/21=4.1 | | 65/21=3.1 | | 330/21=15.7 |

The diet of the examined fish was dominated by the Rhododphyta taxa (in 12 specimens or 57.1 %). The same number of Rhodophyta and Chlorophyta taxa was recorded in 3 specimens (or 14.3 %), and the same number of Rhodophyta and Phaeophyta taxa was recorded from 1 specimen (or 4.8 %). Phaeophyta taxa were numerically dominant in 2 specimens (or 9.5 %) and the largest number of taxa of Chlorophyta was established in 3 specimens (or 14.3 % of the total).

The occurrence of individual taxa of benthic algae in guts, wich were 88 taxa (or 87.1 %) of the 101 studied were found in less than 30.0 % of gut contents analyzed (21). The remaining 13 taxa (or 13.0 %) of the total number determined, was found in more than 30.1 % of the gut contents analyzed.

The qualititative analysis showed that it is possible to separate the benthic algae taxa most commonly found in the gut contenets. In 7 or 33.3 %, and in 8 or 38.1 % analyzed gut contents, 4 taxa of benthic algae (*Gelidium latifolium* var. *latifolium, Ceramium ciliatum, Laurencia obtusa* and *Stypocaulon scoparium*) were recorded. In 9 or 42.9 %, and in 10 or 47.6 % of analyzed gut contents, 5 taxa of benthic algae (*Gelidium crinale, Laurencia pinnatifida, Pterosiphonia pennata, Dictyota dichotoma* var. *intricata* and *Chaetomorpha aerea*) were found. In 13 or 61.9 %, and in 14 or 66.7 % of analyzed gut contents, 3 taxa of benthic algae (*Sphacelaria cirrosa, Chladophora lehmaniana* and *Ulva rigida*) were identified. The species *Hypnea musciformios* (Rhodophyta) was recorded in almost all of the analyzed gut contents (17 or 81.0 %) (Table 2).

Quantitative analysis showed that the highest biomass of *Gelidium latifolium* var. *luxurians, Ceramium diaphanum* var. *diaphanum, Ceramium diaphanum* var. *strictum, Polysiphonia fruticulosa, Chondria tenuissima* and *Laurencia pinnatifida* (Rhodophyta), and *Cystoseira corniculata* ssp. *laxior* (Phaeophyta) was dominant in 4.8 % of the total number of analyzed gut contents (21). In 9.5 % of the total number of analyzed gut contents, determined the highest biomass of *Gelidium latifolium* var. *latifolium, Gelidium pusillum, Pterocladia capillacea, Hypnea musciformis, Ceramium rubrum* var. *barbatum* and *Spyridia filamentosa* (Rhodophyta), and *Sphacelaria cirrosa* (Phaeophyta) were identified. The species *Laurencia obtusa* (Rhodophyta) and *Ulva rigida* (Chlorophyta) dominated by biomass in 19.0 % and 66.7 % of total number of analyzed gut contents.

The high diversity of food of plant origin may be due to the fact that the fish examined came from an area with rich benthic algae and marine phanerogam flora and vegetation. According to the results of ŠPAN et al. (1989), the flora of benthic algae and marine phanerogams around the Lokrum Island is relatively rich in taxa (280). However, not all the consumed plant forms participate in the structure of the benthic plant community in an identical way. The bigger forms represent the epilithic portion of the developed benthic vegetation, while a number of smaller forms partake in the development of phytocoenose as epiphytes. Epilithes are important quantitatively while epiphytes dominate qualitively in diets. Furthermore, research showed that partically all taxa of higher biomass found in the gut contents studied belonged to the epilithic portion of the developed benthic phytocoenoses. However, taxa whose frequency was rather high, also belonged to the epilithic forms. All of this information supports the conclusion that *Sarpa salpa* (L.) is a selective feeder that picks-up mainly epilithes, and also takes smaller taxa quite by chance (mainly epiphytes) along with other food.

The food of animal origin was present in very small quantities. Few pieces of chitin parts of Harpacticoid copepods, some copepodite stages, an Apendicularian and a Chaetognath were found. This fact was confirm by results of the earlier investigations of feeding a herbivore fish *Sarpa salpa.*

TORTONESE (1975) reported that *Sarpa salpa* (L.) feeds on plant food and during its younger stages on small crustaceans. Specimens of up to 30 mm in length feed on plant and animal resources: phytoplankton, mainly diatoms, and zooplankton, predominantly copepods (BINI, 1968). Fish of greater length feed exclusively on plant food, such as algae and littoral diatoms (LO BIANCO, 1909). Feeding behaviour of *Sarpa salpa* (L.) changes with fish size (CHRISTENSEN, 1978). Small fish of 10-25 mm in length mainly take Harpacticoid copepods. Diets of bigger fish (25-35 mm in length), mainly consists of diatoms and red algae (Rhodophyta) with a small proportion of food of animal origin, mainly Hydrozoa. *Sarpa salpa* (L.) is

quite easily adaptable to food of exclusively animal origin (SKARAMUCA and SANKO-NJIRE, 1988).

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# Hrana i ishrana biljojede ribe *Sarpa salpa* (L.) (Teleostei, Sparidae) u južnom Jadranu (Hrvatska)


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## KRATKI SADRŽAJ


U ovom se radu iznose podaci o hrani i ishrani biljojede ribe *Sarpa salpa* (L.) u južnom Jadranu (područje Dubrovnika) stare izmedu 2 i 3 godine. Pregledom sadržaja crijevnog kanala ukupno je određena 101 svojta bentoskih alga (Rhodophyta 60 svojti ili 59.6 %, Phaeophyta 25 svojti ili 24.8 % i Chlorophyta 16 svojti ili 15.8 %) i jedna vrsta morske cvjetnice (*Posidonia oceanica*). U hrani se mogu izdvojiti svojte bentoskih alga koje svojom nazočnošću i biomasom najznačajnije sudjeluju u njenom sastavu. Hrana životinjskog podrijetla je vrlo skromno zastupljena i to uglavnom kao epibionti.