DISTRIBUTION, ABUNDANCE AND POPULATION STRUCTURE OF THE COMMON CUTTLEFISH, *SEPIA OFFICINALIS* LINNAEUS, 1758, IN THE ADRIATIC SEA

SVJETLANA KRSTULOVIĆ ŠIFNER*, ZDRAVKO IKICA**,
MIRKO ĐUROVIĆ**, NEDO VRGOČ***, IGOR ISAJLOVIĆ***,
ALEKSANDAR JOKSIMOVIĆ**

*University Department of Marine Studies, University of Split, Livanjska 5/III, 21000 Split, Croatia

** Institute of Marine Biology, Dobrota b.b., P.O. Box 69, 85330 Kotor, Montenegro

*** Institute of Oceanography and Fisheries, Šetalište Ivana Meštrovića 63, 21000 Split, Croatia

RASPROSTRANJENOST, BROJNOST I SASTAV POPULACIJE OBIČNE SIPE *SEPIA OFFICINALIS*, LINNAEUS, 1758, U JADRANSKOM MORU

Apstrakt

Sipa, *Sepia officinalis*, je glavonožac rasprostranjen u istočnom Atlantiku, od Shetlandskog otočja i južne Norveške do sjeverozapadne Afrike, te u Mediteranu. Obitava na svim dubinama do 200 m, ali najviše je zastupljena na dubinama do 100 m. Vrsta je velikog gospodarskog značaja, poglavito za zemlje u području njezine rasprostranjenosti. Izlovljava se većim brojem ribolovnih alata, u gospodarskom ribolovu najviše pridnenom povlačnom mrežom koćom. Ukupni svjetski ulov ove vrste u 2011. godini iznosio je 26 701 t, a u ukupnim ulovima najviše je zastupljen Tunis u Mediteranu. U radu su korišteni podaci istraživanja provedenih u Jadranu u sklopu programa EU MEDITS u razdoblju od 1996. do 2008. godine. Uzorkovanja su provedena na svim koćarskim područjima Jadrana (GSA 17 i GSA18) korištenjem eksperimentalne pridnene povlačne mreže GOC 73, posebno konstruirane za ovaj tip istraživanja. Srednje vrijednosti indeksa biomase i indeksa brojnosti sipe (N/km^2 i kg/km^2), koji su dobiveni korištenjem "swept area" metode, izračunati su po godinama, po dubinskim stratumima kao i za cijelo razdoblje istraživanja. Srednja vrijednost indeksa biomase i brojnosti ove vrste u Jadranu iznosila je 0,90 kg/km^2 i 11,42 N/km^2. Analiza raspodjele po dubinama pokazala je da vrsta preferira plitka područja te su srednje vrijednosti oba indeksa bile najviše u dubinskom stratumu 10 do 50 m. Ukupno je analizirano 1069 primjeraka sipe,

od toga 500 mužjaka, 352 ženke i 217 jedinki kojima pol nije bilo moguće odrediti. Omjer mužjaka i ženki bio je 1,42, odnosno u uzorcima su dominirali mužjaci što je najvjerojatnije posljedica masovnog pomora ženki nakon razmnožavanja. Raspon dužina plašta lovljenih primjeraka kretao se od 30 do 215 mm, a njihova srednja dužina iznosila je 81,23 mm (st.dev.=33,04). Prosječne godišnje vrijednosti indeksa biomase i brojnosti pokazuju značajne međugodišnje oscilacije što je uobičajeno za kratkoživuće vrste, poput sipe, koje izrazito ovise o uvjetima okoliša. Međutim, kod sipe se uočava i slabi negativni trend indeksa biomase u razdoblju 1996.-2008. godina a takve promjene u populaciji mogu biti posljedica prevelikog ribolovnog napora kojemu je vrsta izložena, posebice uzme li se u obzir i sinergijski učinak većeg broja ribolovnih alata kojima se ova vrsta izlovljava. Stoga je neophodno provoditi monitoring uzimajući u obzir što veći broj relevantnih parametara kao i sve dionike u ribolovu ove vrste radi predlaganja i provođenja mjera kojima će se osigurati dugoročno održivo korištenje ovog važnog ribolovnog resursa u Jadranskom moru.

Ključne reči: obična sipa, Sepia officinalis, distribucija, populacija, Jadransko more

Keywords: common cuttlefish, Sepia officinalis, distribution, population, Adriatic Sea

INTRODUCTION

The common cuttlefish, *Sepia officinalis*, is a cephalopod species distributed in the Eastern Atlantic, from the Shetland Islands and southern Norway to northwestern Africa and in the Mediterranean Sea. It can be found from subtidal waters to 200 m, but it is most abundant in upper 100 m, with larger animals at greater depths (Nesis, 1987; Jereb and Roper, 2005).

This species has a significant commercial value and it is one of the most important species for cephalopod fisheries in many countries. It is caught with several selective fishing gears in artisanal fishery, and in the industrial fishery it is primarily fished with trawls (Jereb and Roper, 2005). Total world catches in 2011 were 26 701 t with highest catches recorded for Tunisia in the Mediterranean Sea (FAO, http://www.fao.org/fishery).

Although *S. officinalis* is one of the most studied cephalopod species, there are scarce published papers dealing with the biology of this speciesor the impact of fishery on its population in the Adriatic Sea (ManfrinPiccinetti and Giovanardi, 1984; Fabi, 2001; Vrgoč et al., 2004). The paper deals with the series of data from the scientific biological-fishery survey EU MEDITS between 1996 and 2008, comprising data from the whole Adriatic Sea with an attempt to describe the population structure and distribution patterns of this species in the Adriatic Sea and to analyze recent trends of mean annual biomass indices in this period.

MATERIAL AND METHODS

Biological samples used for this study were collected in the whole Adriatic Sea (GSA17 and GSA18), in the period from 1996. to 2006., in the scope of the MEDITS programme. Surveys were conducted each year in spring-summer period, except for the

year 1999 so this year was excluded from the analysis. Sampling stations were chosen based on the depth-stratified sampling scheme, taking into account the surface of each depth stratum: 10-50 m, 50-100 m, 100-200 m, 200-500 m and stratum over 500 m. An experimental synthetic bottom trawl net GOC 73, with a large vertical opening and 20 mm stretched mesh size at cod-end was used (Bertrand et al., 2002). Catches of all species at each sampling station were standardized, using swept area method, as number of individuals and weight per square kilometer (N/km^2, kg/km^2) (Sparre and Venema, 1998).The average annual biomass and density indices for *S. officinalis*were presented and recent biomass trends tested for significance with Pearson's correlation coefficient. All data were stored in a common database using the ATrIS information system (Gramolini et al., 2005) and GIS distribution maps were made using ArcView GIS tools v. 3.2.

RESULTS AND DISCUSSION

The common cuttlefish is distributed along the shelf of the Adriatic Sea both in the Northern and Central (GSA17) and in the Southern part (GSA18) (Fig. 1). The depth range of the distribution of *S. officinalis* in the Adriatic Sea is between 16 and 173 m.

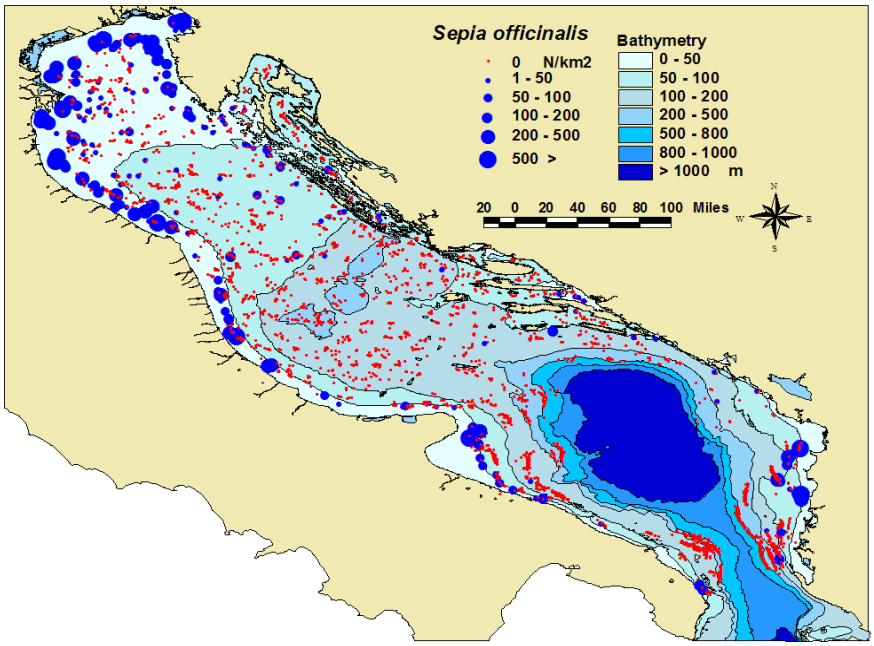

Figure 1. Distribution of the abundance of *Sepia officinalis* in the Adriatic Sea

Comparison of data obtained for the GSA17 and GSA18 prove that this species is more abundant in the Northern and Central Adriatic (1.25 kg/km^2 and 11.21 ind/km^2) than in the South Adriatic Sea (0.44 kg/km^2 and 7.09 ind/km^2). Abundance indices are higher in the northern and north-western part of the investigated area at least in the spring-summer period when surveys were done, and similar was observed for the species in previous studies (Krstulović Šifner et al., 2005, 2011).

Length frequency distribution of the species was obtained measuring 1069 individuals of *S. officinalis*, including 352 females and 500 males and 217 individuals of undetermined sex. The sex ratio was 1.24 in favor of males, which is probably a result of the postspawn mass mortality among adult females (Jereb and Roper, 2005). The average mantle length of all caught individuals was 81.23 mm (st.dev.=33.04). Mantle length in females ranged between 35 and 195 mm with average 93.14 mm (st.dev.=32.78), while in males ranged between 30 and 215 mm, with mean ML 80.06 mm (st.dev.=31,12) (Fig. 2). The highest mantle lengths in the sample were lower than the maximum values recorded in other areas: 490 mm in temperate waters and 300 mm in the subtropics (Jereb and Roper, 2005).

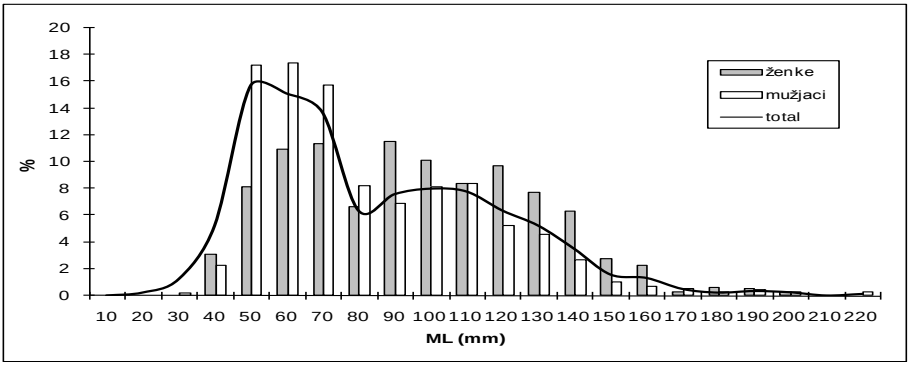

Figure 2. Length-frequency distribution of *S. officinalis* in the Adriatic Sea

The highest values of abundance and biomass indices were recorded in the shallowest stratum (2.98 kg/km^2 and 37.31 ind/km^2) (Figs. 3 and 4). Catches were much lower in stratum 50-100 m (0.24 kg/km^2 and 3.33 ind/km^2) and in stratum 100-200 m the common cuttlefish was caught only sporadically with low values of both indices (0.04 kg/km^2 and 0.74 ind/km^2).

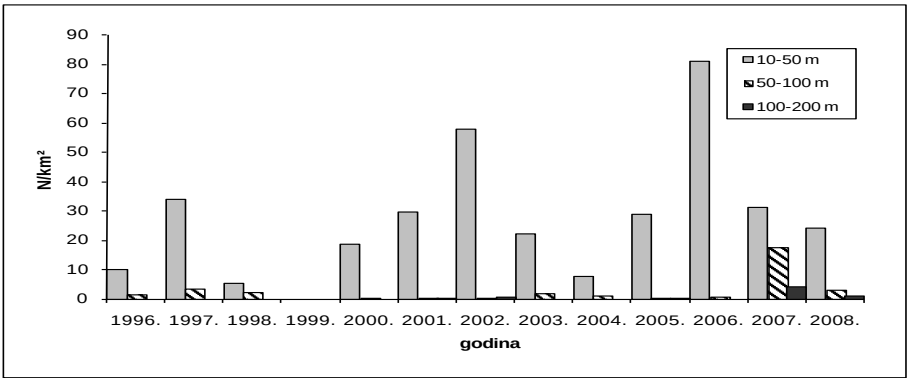

Figure 3. Mean annual abundance indices (ind/km^2) of *S. officinalis* in three depth strata

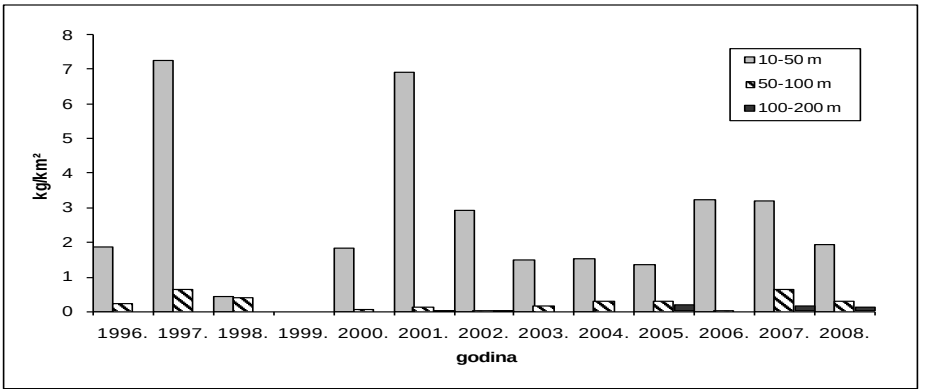

Figure 4. Mean annual biomass indices (kg/km^2) of *S. officinalis* in three depth strata

Seasonal migrations have been described for this species, with adults migrating in shallow waters in spring–summer period, while in colder season they migrate in deeper waters (Grubišić, 1982), so in autumn-winter season distribution of this species probably shows different pattern, being more concentrated at medium shelf grounds. The average biomass and density indices calculated for the whole period were 0.90 kg/km^2 and 11.42 ind/km^2, respectively. The highest value of biomass index was recorded in 1997. (2.25 kg/km^2) and the highest abundance index in 2006. (22.89 ind/km^2), in latter year survey being performed much later which explains the larger number of smaller individuals and high mean abundance index. Regarding mean biomass indices in the investigated period for this species a negative trend was observed, with no statistical significance (r=-0.194, p=0.545). *S. officinalis* is a short living organism, very much dependent on environmental conditions and also a species exposed to a very high fishing effort with synergistic impact of several fishing tools used for its exploitation in commercial and artisanal fishery of the Adriatic Sea. It is additionally vulnerable as it prefers shallow waters where it is more exposed to the human fishing activities and furthermore its fecundity is much lower than in some other commercially important cephalopods (e.g. squids). These changes in population abundance and structure should be carefully monitored using all available data on biology and fishery of this species.

CONCLUSIONS

S. officinalis is a neritic, benthic species distributed in shallow waters along the coasts of the Adriatic Sea, with higher abundances in the Northern and Central (GSA17) than in the Southern Adriatic Sea (GSA18). This species is very important in the fishery of the Adriatic Sea but it is exposed to the high fishing effort with synergistic effect of several fishing gears. The results indicate some negative changes in the period between 1996 and 2008, so the population of *S. officinalis* should be carefully monitored and fishing activities properly regulated to ensure the long-term sustainable exploitation of this species in the Adriatic Sea.

ACKNOWLEDGEMENTS

The study was done in the scope of the ADRIJA project (bilateral scientific cooperation between Croatia and Montenegro) and EU MEDITS programme.

REFERENCES

Bertrand, J.A., Gil de Sola, L., Papaconstantinou, C., Relini, G.,Souplet, A. (2002) :The general specifications of the MEDITS surveys. *Scientia Marina*, 66(Suppl. 2), 9-17.

Fabi, G. (2001):*Sepia officinalis*: impact of three set of fishing techniques in the Adriatic and the Ligurian Sea. Study contract No. 98/069. IRPEM-C.I.B.M., 119 pp

Gramolini, R., Mannini, P., Milone, N.,Zeuli, V. (2005): AdriaMed Trawl Survey Information System (AtrIS): User Manual. FAO-MiPAFScitenic Cooperation to Support Responsabile Fisheries in the Adriatic Sea.GCP/RER/010/ITA/TD17.AdriaMed Technical Documents, 17, 141 pp

Grubišiæ, F. (1982): Ribe, rakovi i školjke Jadrana. ITRO Naprijed, 239 pp

Jereb, P., Roper, C.F.E. (2005): Chambered nautiluses and sepioids (Nautilidae, Sepiidae, Sepiolidae, Sepiadariidae, Idiosepiidae and Spirulidae). FAO Species Catalogue for Fishery Purposes. No. 4, Vol. 1. Rome, FAO. 262p

Krstulović Šifner, S., Peharda, M., Vrgoč, N., Isajlović, I., Dadić, V., Petrić, M. (2011): Biodiversity and distribution of cephalopods caught by trawling along the Northern and Central Adriatic Sea. Cahiers de biologie marine. 52, 291-302.

Krstulović Šifner, S., Lefkaditou, E., Ungaro, N., Ceriola, L., Kavadas, S., Vrgoč, N. (2005): Composition and distribution of the cephalopod fauna in the eastern Adriatic and eastern Ionian Sea. Israel Journal of Zoology. Vol. 51, 315-330.

Manfrin Piccinetti, G., Giovanardi, O. (1984): Données sur la biologie de *Sepia officinalis* L. dans l'Adriatique obtenues lors de expéditions Pipeta. FAO, Fish. Rep., 290, 135-138.

Nesis, K. (1987): Cephalopods of the world. Neptune city, TFH Publications, 351p

Sparre, P., Venema, S.C. (1998): Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No.306/1, Rev. 2.

Vrgoč, N., Arneri, E., Jukić-Peladić, S., Krstulović-Šifner, S., Mannini, P., Marčeta, B., Osmani, K., Piccineti, C. Ungaro, N. (2004): Review of current knowledge on shared demersal stocks of the Adriatic Sea. FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea.GCP/RER/010/ITA/TD-12.AdriaMed Technical Documents, 12, 91 pp.