



State of Black Scorpionfish (*Scorpaena porcus* Linnaeus, 1758) Inhabited Coastal Area of Sevastopol Region (Black Sea) in 1998–2008

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Abstract

Data about scorpion fish population state during 1998-2008 were presented. It was determined that age composition of *Scorpaena porcus* from 1998 to 2008 has been widened. The amount of females and males of different age groups in last years (2007-2008) was optimal, but from 1998 to 2005 females, especially older specimens, dominated. Condition factor increased. However, scorpion fish bodies smaller growth and weight decrease were noticed, that demonstrates negative influence of complex of factors. Such effects may be some result of changing environmental conditions in the study area such as pollution and temperature rise.

Keywords: Age composition, sex ratio, size, weight.

Siyah İskorbit Balığı (*Scorpaena porcus* Linnaeus, 1758) Stoklarının Sivastopol Bölgesi (Karadeniz) Kıyısı Alanında 1998-2008 Yılları Arasında Durumu

Özet

İskorpit *Scorpaena porcus* stoklarının durumu konusunda 1998-2008 dönemine ait veriler incelendiğinde, yaş kompozisyonunda 1998'e göre 2008 yılında daha geniş aralık olduğu belirlendi. Balıkların cinsiyetlerine göre farklı yaş gruplarında son yıllarda (2007-2008) iyileşme oldu, ama 1998'den 2005'e kadar özellikle dişi bireylerde, daha yaşlı örnekler baskındır. Bu dönemde kondisyon faktörü artmakla birlikte, iskorpit bireylerde düşük büyüme ve kilo kaybı faktörlerinin karmaşık olumsuz etkisi belirlenmiştir. Bu tür etkiler çalışma alanında çevre koşulları, kirlilik ve sıcaklık yükselmesi gibi bazı değişkenlerin sonucu olabilir.

Anahtar Kelimeler: Yaş kompozisyonu, cinsiyet oranı, büyüme, ağırlık.

Introduction

There are such transformations in fish population like changes of growth rate, term of maturing, amplitude of sizes and age composition for first matured fish, life duration of matured fish, sex ratio, changes of environmental conditions, etc (Goncharenko, 2001; Kovzova, 1982; Moiseenko, 2002).

At chronic pollution impact such changes are most characteristic for bottom fish and differ by wide variability of expressed symptoms of pathological processes, which take place at different levels of body organization (Moiseenko, 2002; Oven *et al.*, 2000).

In two last decades Black Sea suffered big changes of ecological state. The peak of anthropogenic impact was from the end of 80th to beginning of 90th (Anonymous, 1993). Since 2003 the

tendency of rehabilitation of Black Sea ecosystem and, in particular, Sevastopol bays and their inhabitants was confirmed (Kuz'minova *et al.*, 2009; Oven *et al.*, 2008; Orlova *et al.*, 2007).

Simultaneously, there are data that lately together with chemical pollution of sea physical effects were noticed, expressed in fluctuation of temperature (Nierman *et al.*, 1999) which can modify conditions of water areas and hydrobionts as well.

There are 4 species dominated in the Black Sea coastal area catches—horse mackerel *Trachurus mediterraneus*, high body pickarel *Spicara flexuosa*, red mullet *Mullus barbatus ponticus* and black scorpionfish *Scorpaena porcus* (Oven *et al.*, 2008). Black scorpionfish can be bioindicator of Black Sea ecosystem state because of some biological peculiarities (low mobility and migration, round year presence in catches, high adaptation to water

pollution) (Oven *et al.*, 2000).

The purpose of this study was to investigate the state of one of mass species of Black Sea fish, black scorpionfish (*Scorpaena porcus*) from 1998 to 2008.

Material and Methods

The samples of *Scorpaena porcus* belonging to Scorpaenidae families were caught in Sevastopol bays and open sea area of coastal zone (Figure 1) from 1998 to 2008 using bottom snaring (deep 18-20 m, diameter of net 20 mm). During this time, alive fishes were risen in the morning ones in an each week. The biological analyze of 1,794 fish – 932 female and 862 male was made. The total (TL), standart (SL) lengths, weight of fish and soma weight, sex, stages of sexual maturity, weight of gonads, liver were recorded. Gonadosomatic index (GSI), hepatosomatic index (HSI) and condition factor (CF) were calculated using value of soma weight from the equations:

$$\text{GSI}\% = (W_g/W_s) \times 100 \text{ (Pravdin, 1966; Anisimova and Lavrovsky, 1983)}$$

$$\text{HSI}\% = (W_l/W_s) \times 1000 \text{ (Shwarz et al., 1968)}$$

$$\text{CF}\% = (W_s/100)/(SL^3) \text{ (Anisimova and Lavrovsky, 1983)}$$

1983)

where W_g , W_l , W_s – gonad weight, liver weight and soma weight in grams of fish.

Age was determined using otoliths, after their maintenance during 1 week in the glycerin solution (50%).

Comparative analyze of studied indices (age composition, sex relation, SL and weight of fish, HSI, GSI, CF) was estimated for 4 periods inside decade 1998-2008: I – 1998-2000, II – 2002-2003, III – 2004-2005, IV – 2007-2008.

Results of investigation were calculated statistically and presented as $M \pm SE$.

Results

The analyze of distribution of the different age groups' specimens showed that in 1998-2005 two age groups (2^+-3 and 3^+-4) were prevalent in catches. In other years shift of percentage of different age fish was noticed: 3^+-4 and 4^+-5 years fish were dominated and age line was wider because of presence of old scorpion fish (7-10 years) (Figure 2).

At study of sex ratio it was found that in all investigated periods the main percentage of earliest years periods the main percentage of earliest years fish was presented by males, but old fish

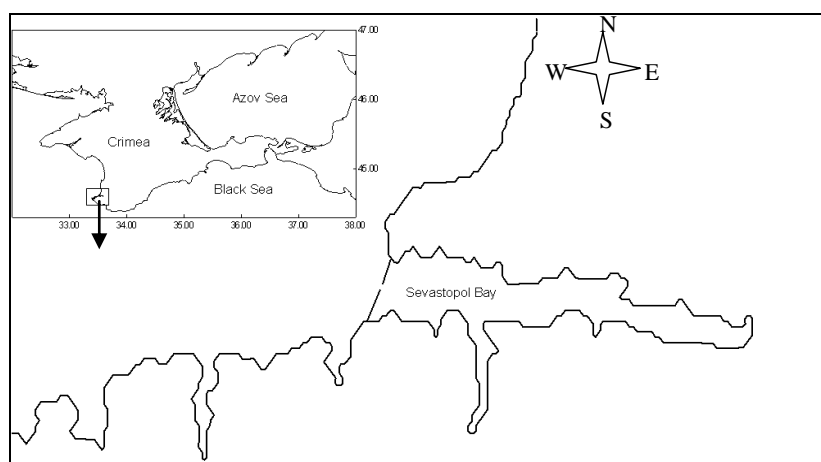


Figure 1. Sampling sites of fish specimens in Sevastopol Bay (Sevastopol, Ukraine, Black Sea).

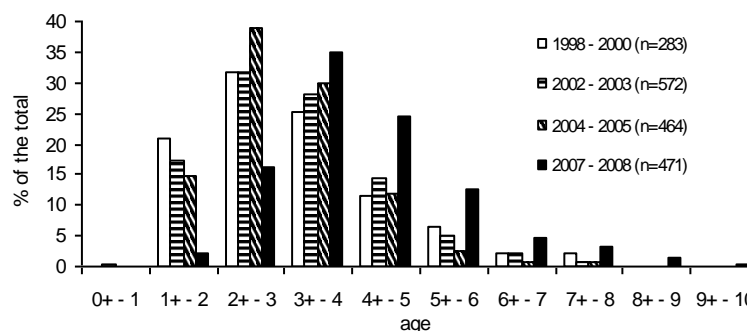


Figure 2. Age composition of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

consisted mainly by female.

The most optimal sex ratio was showed for 2007–2008 (Figure 3).

It is seen that higher values of length of female and male of almost all of fish were in 1998-2000 (Figure 4).

Same data were obtained for weight.

However, fish bodies smaller growth was observed from 1998–2008 for female and male of age from 3 to 8, with some changes in inner years. For fish of age groups 1⁺-2 and 2⁺-3 the increasing of weight from 1998 to 2008 was noticed and such changes were higher for male (Figure 5).

It is known that morphophysiological parameters of fish depend on season, sex, age. Taking it into account, we calculated hepatosomatic index (HSI),

gonadosomatic index (GSI), condition factor (CF) for fish, which were caught in one period (May-August). Comparing of morphophysiological indices from 1998 to 2008 was made for fish which were at same stage of maturity (prespawning and spawning time – III-IV, IV, IV-V, V stages), same sex and age.

Significant differences of HSI in different years were not obtained, but tendency of HSI decreasing for 3⁺-4 female and male and 4⁺-5 male was observed (Figure 6).

GSI of male and female was decreasing in investigated decade (Figure 7).

The condition factor of male and female of scorpion fish of age of 3⁺-4 years was gradually increasing from 1998 to 2008 (Figure 8).

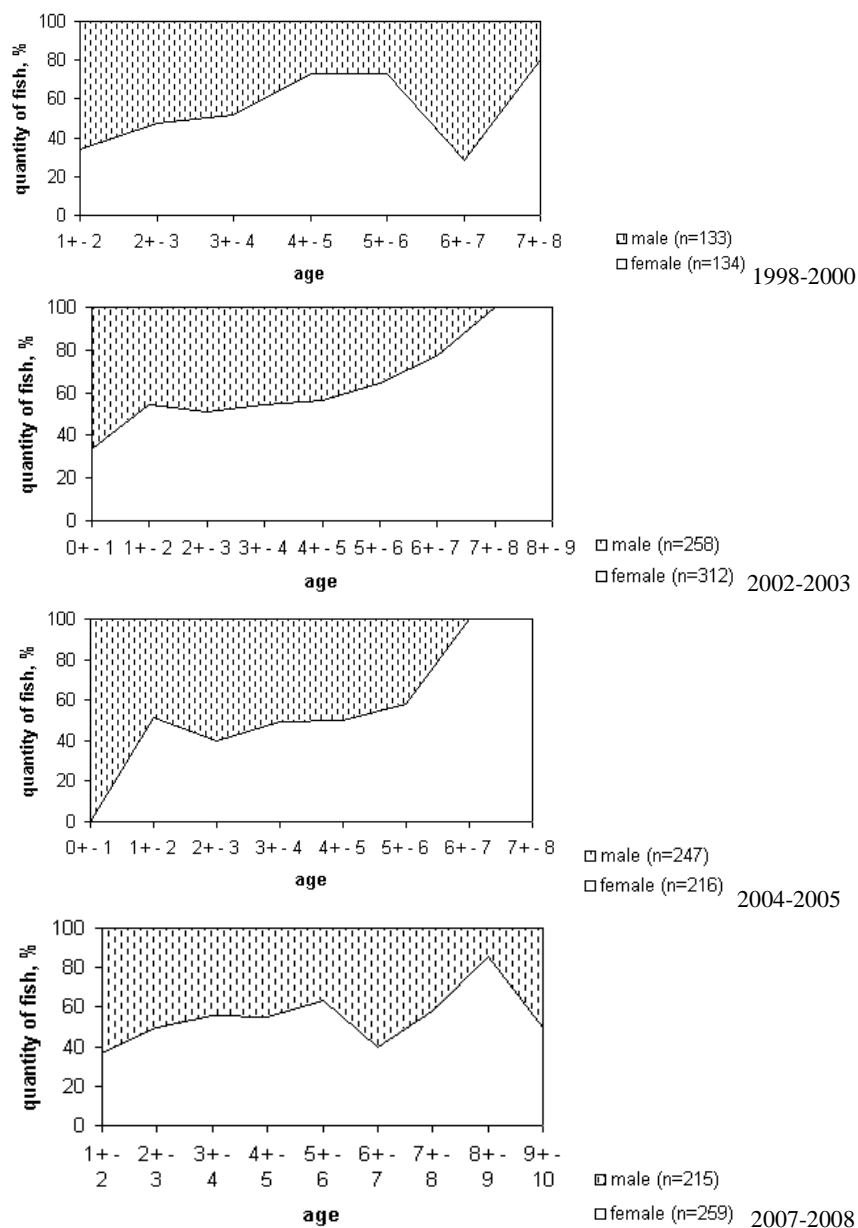


Figure 3. Sex relation of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

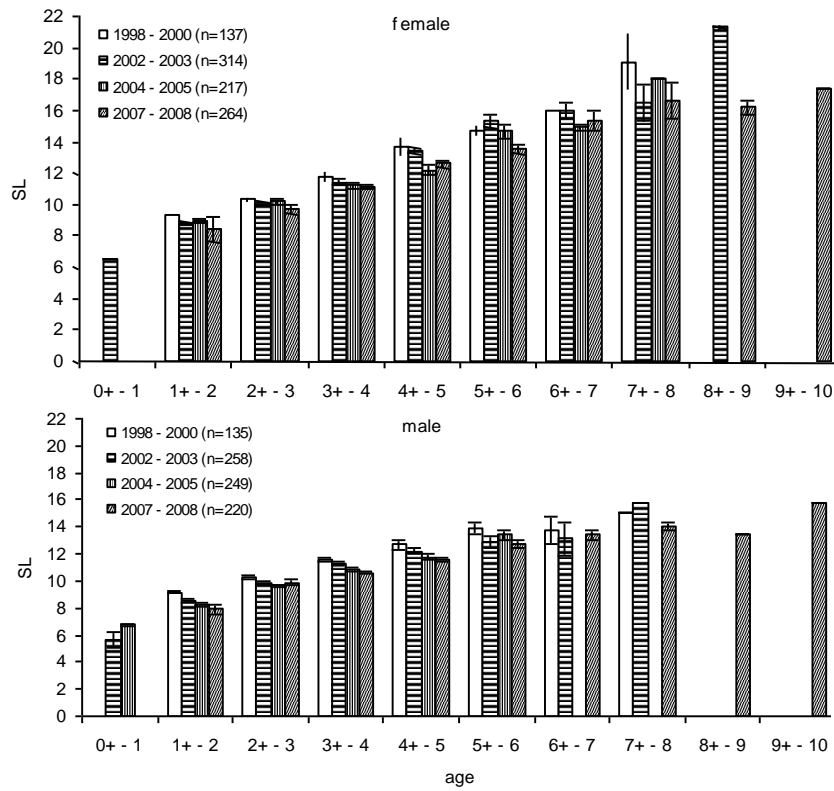


Figure 4. Size (SL, cm) of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

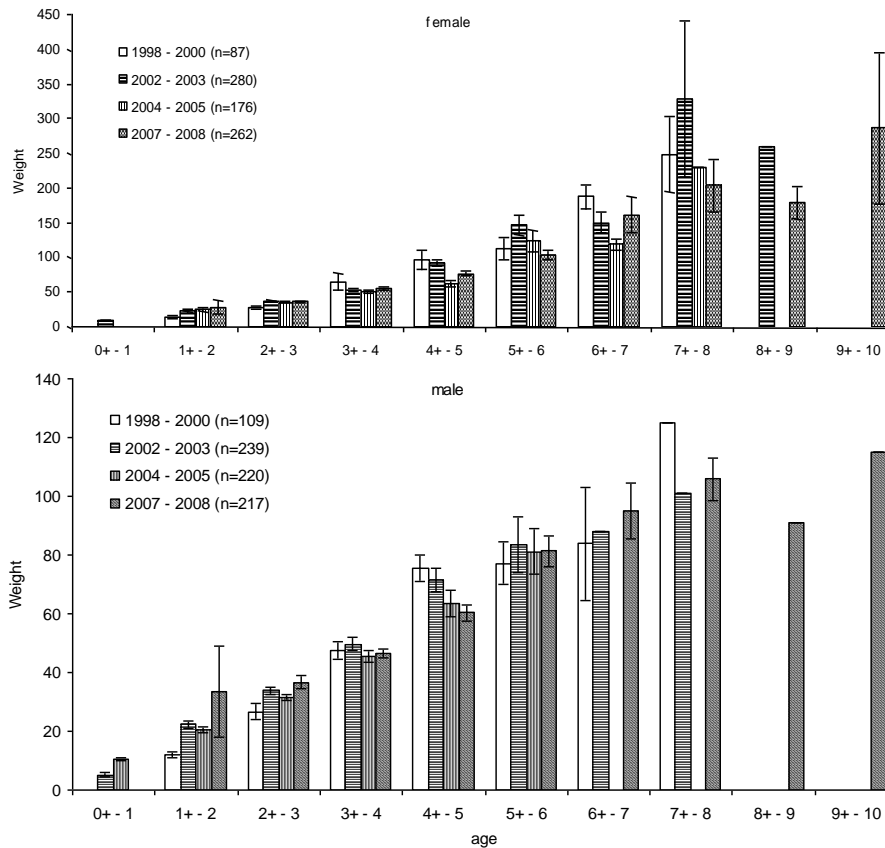


Figure 5. Weight (g) of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

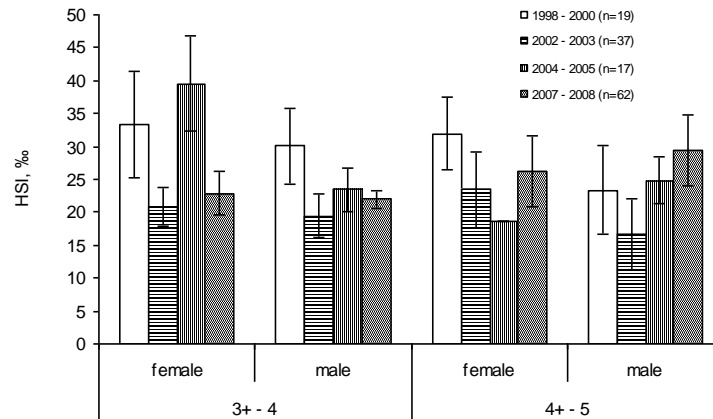


Figure 6. Hepatosomatic index (%) of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

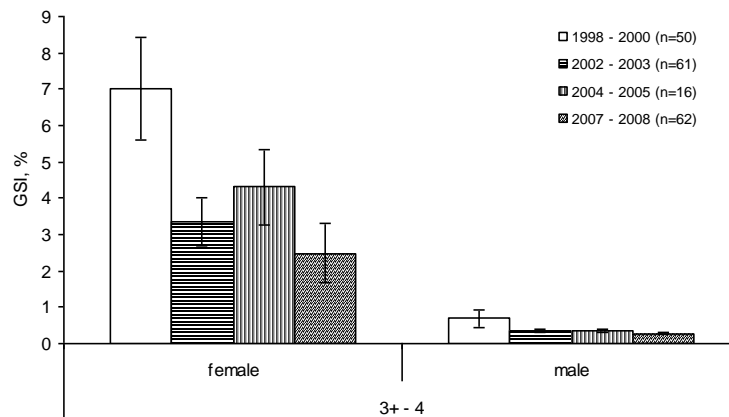


Figure 7. Gonadosomatic index (%) of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

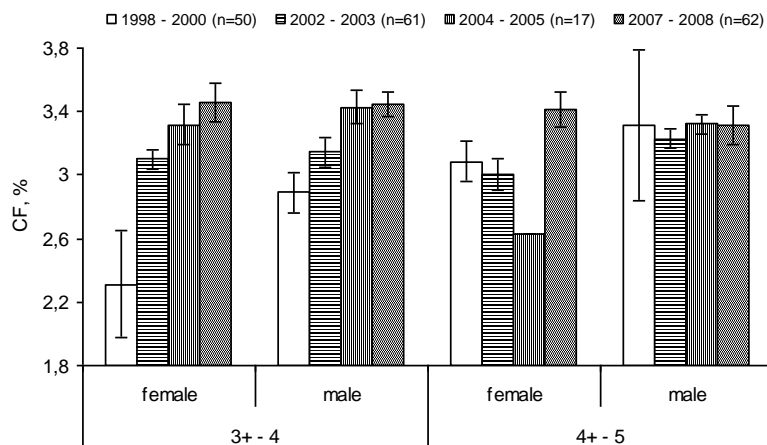


Figure 8. Condition factor (%) of scorpionfish *Scorpaena porcus* L. inhabited in coastal area of Sevastopol region (Black Sea) in 1998–2008.

Discussion

As it has been described above, during decade of investigations we caught fish of 7-9 age groups (Figure 2). The most optimal period is 2007-2008, because fish of 8-10 years of age were caught and fish

in average age group (3⁺–5 years) dominated.

Similar results of study were obtained for scorpion fish in previous period (1989–1997): in coastal area of Caucasus (less polluted area) the main percentage of fish was presented by fish of 4⁺–5 years of age, but in south-west coastal area (more polluted

area) of Crimea – age of 2⁺–3⁺ years (Pashkov *et al.*, 1999). It is known, that to decrease the quantity of older age fish group and «rejuvenation» of whitefish *Coregonus lavaretus* population were shown for subarctic lake polluted for more than 60 years (Moiseenko, 2002).

The fact that, older specimens were presented by females (especially in 1998-2005 years) (Figure 3) can confirm high male vulnerability under bad conditions of environment. At the same time, males predominance in young age group reflects population adaptation to regulation of gender relation. Analogous results were described for Prussian carp inhabiting lower reaches of Danube (Goncharenko, 2001). In our opinion, the decreasing quantity of older black scorpionfish does not depend on fisheries, because *S. porcus* is not marketable specie and in Sevastopol coastal zone is not effected by mass catches. Such biological effect for this specie is explained mainly by influence of chronic pollution.

It is known that maximal level of anthropogenic impact on Black Sea was in 1990s in XX century (Anonymous, 1993; Kuz'minova *et al.*, 2009; Nierman *et al.*, 1999). Nowadays, in spite of ecosystem renovation, the negative effects of chronic contamination on Black Sea fish are continued (Kuz'minova, 2006; Kuz'minova *et al.*, 2009; Orlova *et al.*, 2007; Oven *et al.*, 2008, 2009; Shulman and Nikolskii, 2005). Such situation conforms our data obtained about yearly dynamic of biological state changes of *S. porcus* (Figure 2-8).

The fact that, fish bodies smaller growth and possible reasons of this were obtained by different scientists. So, aouthors have explained the reason of body size in Black Sea sprat from 2001 to 2007 by overfishing of this marketable specie (Zuev *et al.*, 2008).

The changes of size of whitefish in Imandra lake from 1960 to 1998 was connected with chronic pollution impact (Moiseenko, 2002). Such reason caused decrease of size-weight indices of Black Sea red mullet *Mullus barbatus ponticus* from 1979 to 2007 (Oven *et al.*, 2009). It is known that, low zooplankton density has effected size decreasing of Japanese salmon *Oncorhynchus keta* (Kamezawa *et al.*, 2006).

In the period of our analyses the concentration of *Mnemiopsis leidyi* was not critical (Nierman, 1999), that is why fish bodies' smaller growth was not connected with quantity of zooplankton for early development stages of fish. Adult scorpion fish is predator, it feeds with small fishes and crustaceans.

Consequently, smaller bodies growth of adult specimens is result of mainly chronic pollution of Sevastopol coastal area.

The decreasing of GSI values of 3⁺–4 females and males in spawning, in different periods including last years' confirmed negative conditions impact, that can lead to population fertility and reproduction ability reductions. The decreasing of HSI values of 3⁺–4 years fish, from 1998 to 2008 can, hand, testify to negative fish physiological state on the one and, on the other hand, stabilization of liver functioning in last years (Kuz'minova, 2006).

The size decreasing of males and females of scorpion fish can be connected not only with direct and indirect pollution influence, but, in our opinion, with changes of water temperature, which were noticed in coastal area of Sevastopol in investigated period, also (Table 1). The data presented by Sevastopol hydrometeorological observatory show that middle year values of air and sea temperature during 2003-2007 are gradually increasing. The difference between min and max values of middle year temperature in 2007 and 2003 was for air 1.7°C, for water -1°C (table 1). The correlation between air and sea temperature from 2003 to 2007 was 0.74.

The HSI values of age of 4⁺–5 years fish in 2007–2008 were higher, than in 2002–2005; condition factor was increasing with the increasing of time. It is, probably, show the better food base in last years, that is proved by positive dynamics of fish weight increasing at 1⁺–2 and 2⁺–3 years of age. The effect of biomass and level of accumulative lipids increase for pelagic Black Sea fish next 90 years was noticed by Shulman and Nikolskii (2005) and explained as a good food provision.

Taking the observed data into consideration, we concluded:

1. Age composition of scorpion fish from 1998 to 2008 has been widened, the amount of females and males of different age groups in last years (2007-2008) was the same while condition factor increased.

2. Simultaneously, scorpion fish bodies smaller growth and weight decrease were noticed, especially for older age fish groups, that demonstrates negative influence of complex of factors, mainly chronic pollution and temperature increase.

References

- Anisimova, I.M. and Lavrovsky, V.V. 1983. Ichthyology: Educational Supply for Agriculture Universities. Visshaya Shkola, Moscow, 255 pp.

Table 1. Middle year temperature of air and sea in Sevastopol Region (Black Sea)

	2003	2004	2005	2006	2007
Air temperature, °C	11.9	12.7	13.1	12.3	13.6
Sea temperature, °C	14.5	14.9	15.5	15.4	15.5

- Anonymous 1993. Ichthyofauna of Black Sea Bays at Anthropogenic Pollution Impact. 1993. Naukova Dumka, Kiev, 144 pp.
- Goncharenko, N. 2001. Peculiarities of sex structure of population of Prussian carp in lower reaches of Danube. *Vestnik zoologii*, 35(2): 89-92.
- Kamezawa, Y., Azumaya, T., Nagazawa, T. and Kishi, M.J. 2006. Bioenergetics Model of Japanese Chum Salmon (*Oncorhynchus keta*) Growth. Pices XV. Book of Abstracts: 79 pp.
- Kovzova, M. 1982. Size-age structure and sex relation of population of Barents marine flounder *Pleuronectes platessa* L. *J. of ichthyology*, 22(4): 608-618.
- Kuz'minova, N. 2006. Investigation of Toxic Influence of Domestic Wastewater on Marine Organisms: Diss. Cand. Biol. Scien.: 03.00.16., Moscow, 168 pp.
- Kuz'minova, N., Kostova, S. and Plotizina, O. 2009. Mercury concentration in tissues of fish inhabiting coastal area of Sevastopol in 2005-2007. *Ribne gospodarstvo Ukraini*, 2-3 (61-62): 29-36.
- Moiseenko, T. 2002. Changes of strategy of fish life cycle at chronic water pollution influence. *Ecology*, 1: 50-60.
- Niermann, U., Kideys, A.E., Kovalev, A.V., Melnikov, V. and Belokopytov, U. 1999. Fluctuation of pelagic species of the open Black Sea during 1980-1995 and possible teleconnections. S. Besiktepe, Ü. Ünlüata, S. Bologa, (Eds.), *Environmental degradation of the Black Sea: Challenges and Remedies*. Kluwer Academic Publishers, 147-173.
- Orlova, I., Pavlenko, N.E., Ukrainskiy, V.V. and Popov, Yu.I. 2007. Eutrophication conditions of the north-west Black sea area according to the results of many ears monitoring. Book of scientific works, Ecological safety in coastal and shelf areas and complex using of shelf resources, 15: 32-43.
- Oven, L.S., Rudneva, I.I. and Shevchenko, N.F. 2000. Response reactions of scorpion fish *Scorpaena porcus* (Scorpaenidae) at anthropogenic impact. *J. of ichthyology*, 40(1): 75-79.
- Oven, L.S., Salekhova, L.P. and Kuz'minova, N.S. 2008. Many years dynamic of the Black Sea fish species composition and abundance in Sevastopol region. *Ribne gospodarstvo Ukraini*, 4(57): 15-18.
- Oven, L.S., Salekhova, L.P. and Kuz'minova, N.S. 2009. Modern State of the Blunt-Snouted Mullet *Mullus barbatus ponticus* Population Dwelling in the Coastal Zone near Sevastopol. *J. of ichthyology*, 49(2): 183-192.
- Pashkov, A.N., Shevchenko, N.F., Oven, L.S., Giragosov, V.E. and Kruglov, M.V. 1999. Distribution, quantity and basic population indices of scorpion fish *Scorpaena porcus* in Black Sea under anthropogenic pollution influence. *J. of ichthyology*, 39(5): 661-668.
- Pravdin, I.F. 1966. Handbook for study of fish. Pitschevaya Promishlennost, M., 376 pp.
- Shulman, G.E. and Nikolskii, V.N. 2005. Study of influence of climatic and anthropogenic factors on Black Sea pelagic fish state. World scient. conf. „Modern state of Black and Azov Seas ecosystems”. Crimea, Donuslav: 158-159.
- Shwarz, S.S., Smirnov, V.S. and Dobrinskiy L.N. 1968. Method of Morphophysiological Indicators in Ecology of Terrestrial Animals. Trudi Instituta Ecologii Plants and Animals, 58: 386 pp.
- Zuev, G., Guzal, D., Melnikova, E. and Bondarev, V. 2008. Modern data about structure of Black Sea sprat marketable stock, its state and rational using in Ukrainian water. *Ribne gospodarstvo Ukraini*, 1: 8-12.