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INFECTION OF THE PACIFIC SAURY *COLOLABIS SAIRA* BY ACANTHOCEPHALANS IN THE KURIL ISLANDS AREA

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The Pacific saury *Cololabis saira* (Brevoort, 1856) is one of the important target species of commercial fisheries. Food manufacturers and consumers encounter problems due to the infection of the saury by acanthocephalans, which are quite difficult to clean out completely during on-board catch processing. Infection of *C. saira* was not studied on a regular basis, therefore, our knowledge about the parasites of saury is fragmentary. This paper contains infection indices (only acanthocephalans) of the Pacific saury caught in the Kuril Islands area (Russian Exclusive Economic Zone) in 2015.
Key words: *Cololabis saira*, Pacific saury, Acanthocephala, *Rhadinorhynchus.*

ЗАРАЖЕННОСТЬ САЙРЫ *COLOLABIS SAIRA* СКРЕБНЯМИ В РАЙОНЕ КУРИЛЬСКИХ ОСТРОВОВ

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Тихоокеанская сайра *Cololabis saira* (Brevoort, 1856) — один из наиболее важных видов промыслового рыболовства. Зараженность сайры скребнями трудно устранить в процессе переработки улова. Зараженность *C. saira* до сих пор исследована лишь фрагментарно. В данной работе представлены показатели зараженности тихоокеанской сайры скребнями для акватории Курильских островов в исключительной экономической зоне Российской Федерации в 2015 г.
Ключевые слова: *Cololabis saira*, тихоокеанская сайра, Acanthocephala, *Rhadinorhynchus.*

The Pacific saury *Cololabis saira* (Brevoort, 1856) (Beloniformes: Scomberesocidae) is a very popular food product that can be found in several cuisines of the Pacific countries and is one of the important target species of commercial fisheries in the Northern Pacific. In 2015, the total catch of saury in the Russian EEZ exceeded 66 thousand tonnes, and the catch limit adopted in the Russian EEZ for 2016 is more than 180 thousand tonnes (Order of RFFA, 2015). The presence of parasites, even dead and non-pathogenic ones, causes a significant deterioration in canned and chilled saury, affecting their marketable condition and raising concern among health authorities (Mikulich, 2014; Baryshko, 2015). This research is aimed to study the infection rate of the *C. saira* by acanthocephalans and identification the areas where the helminth infection is the lowest, for the benefit of fisheries and consumers.

MATERIAL AND METHODS

Fishes were caught by the fishing vessel «Sterlyad», which was fishing for Pacific saury in the Kuril Islands area (40°37′—41°15′ N; 148°17′—149°40′ E) using luring lights and stick-held dip nets. All of the fish specimens were caught near the surface, over depths of 5320—5456 m, in four localities sufficiently close to each other, between 30 October and 6 November 2015. A sample was taken at each locality and a total of 49 specimens with length of 25.8—32.4 cm (mean 29.78 ± 0.22 cm), weight 60—130 g (mean 95.33 ± 2.37 g) were examined using the standard method of parasitological examination (Byhovskaya-Pavlovskaya, 1985) applied for the acanthocephalan infection. The found parasites were fixed in 70 % ethanol and cleared in 10 % glycerol. Species identification was carried out according to Amin et al. (2011), Petrochenko (1956), and Laurs & McCauley (1964). Prevalence, intensity rate and mean intensity were calculated according to Bush et al. (1997). Data on the stomach contents were collected simultaneously.

RESULTS

Due to all of the fishing localities being separated by several dozen miles at most, a distance which is insignificant when dealing with the open ocean environment, and as the fish were all caught within one week, we summarized the data on infection indices all together (see table). Each fish examined was infected by at least one acanthocephalan, and three of them were infected by two species of the genus *Rhadinorhynchus*. Although prevalence of infection showed no correlation with length, fishes that belonged to the medium size group

Prevalence and intensity of *Cololabis saira* infection by acanthocephalans

Species	Prevalence (%)	Mean intensity (intensity)	Sex ratio (%) ♂ / ♀	Site
Rhadinorhynchus trachuri	91.84	1.53 (1—3)	44.9 / 55.1	Intestine
R. selkirki	6.12	1.00 (1)	33.3 / 66.7	»
R. cololabis	8.16	1.50 (1—2)	50.0 / 50.0	»

(24—29 cm) had a slightly higher mean intensity than those in the large size group (>29 cm) — 1.40 : 1.64. All the fishes fed on euphausiids: 70 % (seven from ten) of the medium size group had distinctive remains of the crustaceans in their stomach, which also detected in 20 specimens among 39 fishes of the large size group. All of the other examined fishes also had full stomachs filled with digested remains.

DISCUSSION

In the previous surveys the following acanthocephalan parasites of *C. saira* were found: *Rhadinorhynchus trachuri* Harada, 1935 (Baeva, 1968; Baeva, 1970a), *Echinorhynchus gadi* Zoega in Muller, 1776, *Bolbosoma caenoforme* Heitz, 1920 (Baeva, 1970b, 1972), *Rhadinorhynchus cololabis* Laurs et McCauley, 1964 (Laurs, McCauley, 1964; Baeva, 1970b, 1972; Hughes, 1973), *Rhadinorhynchus selkirki* Van Cleave, 1921 (Yamaguti, 1963 in Love & Moser, 1976, 1983; Kagei, 1976 in Nagasawa, 1984). The latter may be considered as *Rhadinorhynchus pristis* (Rudoplphi, 1802) or *Rhadinorhynchus pristis* in: Gaevskaya (2004). The last species was given by A.V. Gaevskaya in her encyclopaedic compendium without any authorship, so it remains unclear whether it was a detection of the currently valid *R. pristis* (Rudolphi, 1802) or one of the species synonymised recently with *R. dujardini* Golvan, 1969, *R. johnstoni* Golvan, 1969, *R. lintoni* Cable et Linderoth, 1963, *R. ornatus* Van Cleave, 1918, *R. selkirki*, *R. seriolae* (Yamaguti, 1963) or *R. zhukovi* Golvan, 1969, according to Amin (2013). In the review of the Russian Far East fish parasites (Volkov et al., 1999), *C. saira* has been mentioned as the host of *R. pristis* referred to Kihara, 1959; Zhukov, 1960; Kagei, 1976; Kovalenko, 1986. These citations seem to be errors, while none of four publications recorded the infection of *C. saira* by *R. pristis*.

All of the authors concluded that the intensity of infection by acanthocephalans is related to the age of the saury. Older and, accordingly, bigger fish specimens are found with the higher acanthocephalan infection rate (Baeva, 1965, 1970; Yamaguti, Honma, 1992). Researchers mostly divided the host specimens in the following size groups (TL) proposed by Y.V. Novikov (1967): small — <24 cm; medium — 24—29 cm; and large — >29 cm. The small saury specimens were found occasionally non-infected (Davletshina et al., 2014). Baeva (1968) stated that among fish specimens caught in the shore area of Kunashir, Shikotan, and Iturup Islands, the medium size group had 52 % prevalence and (1—9) infection rate of *R. trachuri;* while the large group had the values of 98 % and (1—28), correspondingly. Very similar infection indices for the medium and large size groups were recorded later in the coastal waters of Shikotan Island (Baeva, 1970a). The complete parasitological dissection has been performed on 75 saury host specimens; ten species of parasites were found with the 17.3 % (1) infection indices for *R. trachuri* (Baeva, 1965). The number of helminth taxa decreased with a distance from shore line, from ten to five, the prevalence values of all parasites decreased as well, except cestode larvae and *R. trachuri* (Baeva, 1965). Infection of saury with *R. cololabis* was mostly recorded at the Pacific shores of the USA and Canada (Hughes, 1973); however, in these locations the infection indices (prevalence — 10—90 %; mean intensity

rate — 1.00—7.00) showed a correlation with the age of fish specimens, as it was revealed for the *R. trachuri* infection.

Both datasets are comparable as the studied saury specimens belonged to the medium and large size groups and were almost fully infected by *R. trachuri*, and the prevalence was 1.17 times higher in the large group; furthermore, we found only a nominal presence of *R. cololabis*. On the other hand, in the open ocean, Yamaguti and Honma (1992) recorded almost zero infection, and Baeva (1965) recorded prevalence of only 40 %; therefore, our data are quite different from other evaluations. The difference can be explained by saury migration and natural variability. According to Ito et al. (2004), who summarized data on the migration and feeding of the saury in the Northwestern Pacific, the large-scale horizontal migrations were typical of the host. According to Sugisaki and Kurita (2004), *Euphausia pacifica* Hansen, 1911 is an important food source for the migrating Pacific saury. In summer and autumn, 35—70 % of the wet weight of the gut content is formed by euphausiids with the highest percentage recorded at the northern part of *C. saira* habitat, where fish feed in the Kuril Islands area. Other food items — chaetognaths and copepods dominate in the saury diet in the southern area. Although the acanthocephalans transmission in the ocean was studied insufficiently, the euphausiid species *Nyctiphanes couchii* (Bell, 1853) is known as the intermediate host of acanthocephalans *Rhadinorhynchus* sp. (Gregori et al., 2013) and *Bolbosoma balaenae* (Gregori et al., 2012). With a positive correlation of acanthocephalan infection and the size of *C. saira* specimens, the transmission of *Rhadinorhynchus* sp. with *E. pacifica* and other euphausiids can be supposed.

Saury fishing in open waters distanced from the shore line and in the southern part of the saury habitat seems to be the best way to avoid parasites; however, this conclusion needs further study. According to helminths' infection data, processing of the small size group of the saury, which are used rarely in canning product manufacturing (Davletshina et al., 2014), may be recommended.

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