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FISH AS PARATENIC HOSTS PARASITE

RYBY JAKO ŻYWICIELE PARATENICZNI PASOŻYTÓW

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Celem niniejszej pracy było przedstawienie roli ryb jako żywicieli paratenicznych w cyklach rozwojowych pasożytów. Pasożytnictwo parateniczne występuje u wszystkich grup helmintów, ale nie jest szeroko rozprzestrzenione. Porównanie cykli rozwojowych dwóch spokrewnionych gatunków tasiemców z rodzaju Bothriocephalus pokazuje, jaki wpływ wywiera żywiciel parateniczny na kształtowanie infrapopulacji pasożytów. Żywiciele parateniczni, na przykładzie Anguillicola crassus, pomagają w adaptacji pasożyta w obcym ekosystemie. Udział żywicieli paratenicznych w cyklach rozwojowych może być tak duży, że uważani są za ,,naturalnych żywicieli paratenicznych". W cyklach morskich kolcogłowów żywiciel parateniczny pomaga w zamknięciu cyklu rozwojowego pasożyta. Ponadto żywiciele parateniczni pełnią swego rodzaju rolę inkubatorów stadiów inwazyjnych. Cykl rozwojowy pasożyta ulega wydłużeniu oraz zostaje wprowadzony czynnik różnorodności.

Two major categories are connected with parasites' ontogeny, namely, intermediate and final host. In a life cycle there might be one or more intermediate hosts [Pojmańska 2005]. Sometimes the parasite's larva is eaten by an inappropriate host in which it survives it cannot develop. The parasite does not undergo any life changes in that host or changes only slightly. This intermediate host is called a paratenic host (reserve) [Złotorzycka et al.1998].

Parasites' ability to adapt to a long-term dwelling in paratenic hosts plays an important role in spreading of the species and, at the same time, it increases the chances of preserving it [Niewiadomska 2005].

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Cycles including paratenic hosts appear in many helmints. Paratenic hosts may join parasites' life cycles creating an additional link in the place where the cycle of obligatory hosts is closed and where the presence of the paratenic host constitutes the additional element of the cycle. This is the case in, for example, the life cycle of *Diphyllobothrium latum*, which has three hosts.

In a life cycle of *Diphyllobothrium latum,* copepods as well as fish, human beings or piscivorous mammals are important hosts obligatory for closing of the life cycle [Pojmańska 1991].

In case when a fish is eaten by a predatory fish, plerocerkoid survives and retains invasiveness towards the final host. This process may be repeated many times until the proper host is infested. Invasion of paratenic host that is not necessery for ending of the life cycle lengthens the process and, as a result, the factor of diversity is introduced [Combes 1999].

One may distinguish closely related species of parasites which have differing life cycles with or without the presence of paratenic hosts. One such for example is *Bothriocephalus gregarius*, the parasite of turbot, and *Bothriocephalus barbatus*, the parasite of brill are tapeworms related in taxonomy. Turbot (*Psetta maxima*) and brill (*Scophtalmus rhombus*) are also related and live in the same environment [Morand et al. 1995]. Infection of these fish by two tapeworms in the Atlantic Ocean and Mediterranean Sea was investigated. Tapeworms' life cycles were analyzed with the focus on such parameters as: prevalence, intensity and density. The results have clearly shown that the parasite of turbot (*B. gregarius*) reaches higher parameters of infection both in Atlantic and the Mediterranean than the parasite of brill (*B. barbatus*) [Robert et al.1988]. One might explain this phenomenon by life cycles of these tapeworms. *Bothriocephalus barbatus* has a cycle typical of *Bothriocephalidae* [larva (koracidium) hatches from an egg and is swallowed by copepod and turns into procerkoid and after that into an invasive plerocerkoid; when the fish swallows the copepod, the plerocerkoid becomes a mature parasite], while *Bothriocephalus gregarius* is able to „skip" since copepod may be eaten by small fish from *Gobiidae* family which constitute the role of paratenic hosts. As a result, plerocerkoid survives and turbot becomes infected by eating goby [Morand et al. 1995]. This avoidance significantly increases the possibility of transmission since gobies eat many copepods while the turbots eat many gobies. On the basis of performed analysis life cycles conclusions were drawn the share of additional host in a life cycle enhances the chances of its closing one may assume that including paratenic host in brill would cause a growth of tapeworms' infrapopulation [Combes 1999].

The presence of paratenic hosts in life cycles of tapeworms may be such big that they are regarded as „natural paratenic hosts". This was the case when the population of European bullhead (*Cottus gobio)* was infected with tapeworm larvae of *Proteocephalus longicollis* in the Czech Republic, where the prevalence of infection of fish amounted to 60%.

This parasite in mature form exists in the salmonidae in Europe and the bullhead constitutes an important element of their diet [Moravec 2001].

Kennedy [1994] claims that parasites include new paratenic hosts into their cycle since they find themselves in a new (foreign), host environment. Such example is the *Anguillicola crassus,* an Asian nematode which parasitizes in fish swimmbladder of Far East eels*, Anguilla japonica*.

It was brought to Europe together with imported fry. In the Far East this nematode is not as strongly pathogenic for eels as opposed to the European eel *Anguilla anguilla,* in which it reaches a high prevalence (up to 100%) and, with a massive invasion and high density, causes their death. The number of fish – paratenic hosts is big and includes such species as: ruffe, bass, brown bullhead, three-spined stickleback, zander, perch, gudgeon, common bleak, common rud, common roach, tench, ide, wells catfish, amur bitterling [Własow 1995].

Facilitating contact with the final host illustrates the life cycle of *Dioctophyme renale*. It is a nematode parasitizing in kidneys of mammals that eat fish. According to Karmanova [1963] the eggs, after getting out of kidneys develop in water and later in the digestive tract of annelid. Very often it happens that annelids stick to crayfish' gills. Then the crayfish are eaten by fish such as *Ameiurus melas*, which are paratenic hosts. When the fish is eaten by a predatory mammal the life cycle of nematode is ended.

Another example is nematode *Streptocara crassicauda*. Its imago form resides in stomach of various *Anseriformes* as well as other water birds. The intermediate host is gammarus, in the body of which invasive forms of parasite develop. The role of paratenic hosts play the following fish: the stone loach - *Barbatula barbatula*, the common minnow - *Phoxinus phoxinu*s, the common roach - *Rutilus rutilus*. In the body of fish, larvae incistate under the serous membrane of an intestine and increase the intensity of infection in the final host [Czapliński 1963].

In the group of acanthocephales there are families among which paratenic host is widely spread. In sea cycles of acanthocephales the paratenic host helps to close the life cycle of the parasite. In the sea environment contact between the intermediate and final host is hindered. For instance *Corynosoma strumosum* is a parasite of seals [Niewiadomska 2005]. The intermediate hosts of this parasite are crustacea *Pantoporeia,* in which acanthocephalan frees from the acanthella and develops until the cystacanth stage when it is surrounded with a cyst. Direct transmission between copepoda and seal is not very probable. Consequently, the chance of ending the cycle is enhanced by numerous paratenic hosts including herring, viviparous blenny and the European flounder which eat crustacean. In fish the larvae move to the abdomen and become surrounded by the host cyst [Grabda 1981].

According to Combe´sa [1999] „paratenic host is an option which fits into the genotype plasticity while an additional host is a necessity conditioned by genes".

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