Introduction

From the sociological researches and studies results, that there is in mind most of the polish people that the whales on the Baltic Sea region had been never lived but had been perished at least, that concern either other marine mammals mainly the seals [2]. About them existence know only the non-numerous bevy of the scientists and the local population of the seaside cities which citizens are occupied with fishery [3]. The dolphins and porpoises are the marine mammals belong to the Cetacea, which comprise the whales as well. The porpoise was the most common and famous, known whale at the European coasts for eighteen centuries. The first mentions and hints are derived from the Aristotle tenses, whereas the Linne from Pireus has described them in 1758 under name of Delphinus phocoena, and as porpoise final –ly G. Cuvier in 1817 marked out the genus Phocoena (Cousteau) [4]. The harbour porpoise Phocoena phocoena L.1758 is the sole steady occurred species in the Baltic Sea [5]. Very rare noted and observed is white-spot dolphin Lagenorhynchus Albirostris G. 1846. Despite that although there were known and reported the occurrence of the other whales species. The porpoise formerly, in the past occurred in Baltic Sea, also at the polish coasts very often and numerous, at present is considerably less common, the species on perish and threaten of the die, since 1988 in Poland comprise under whole, total law protection (Red Book of Protected Mammals). In the nineteenth centuries was the object of the numerous hunting’s, having on the Baltic region the wide importance carrying economic importance, but the by-caughting of the porpoise was discontinued on the beginning of twenty in result of the decrease the population [6]. Exploitation too much more coastal territories and destruction of the natural marine environment, high pollutions and the big noise in the water may seriously threaten to the whales disturbing of the effectiveness of the sonar-the sensitive organ of the echolocation,
indispensable sense organ of the odontocetes (Protection program of the small cetacean of the Baltic Sea) [7]. A lot of whales experienced heavy stresses in the panic fear and with loss of the care strands on the shallo, runs aground and parish or die. The stress may cause the general weakness and immunity decrease and thus in the consequence may evoke and call out the acute, strong parasitic infestations and secondary bacteriological, viral and fungal infections [8]. Every year most of the porpoise’s parish on the nets, carrying by cutters and choke/suffocate. There were noted the incidents of the findings of the dead animals on the beaches concerned with parasitic infestations [9].

The serious hearing disease—“stenurosis”, caused and evoke by parasitic infestations of the nematode species *Stenurus* minor menaces of the whales health and life decreases the effectiveness of the functioning the echolocation organ, and in the climax causes leads to the hearing loss, by means of that a lot of mammals parish in the nets, which healthy, sound animals can passed by and avoid [10]. The harbour porpoise makes seasonal migrations from Baltic through the Danish straits along the Swedish coasts to the North Sea by the winter and comes back to the Baltic region/area by the spring [11]. The migrations are very significant and play the important role because of that marine mammals being establish the final hosts of many helminths may be the potential vectors parasites for local fish populations (migratory character of the porpoise) [12]. Very important problem is the origin of the marine mammals, that is the whales and dolphins, which whole life spend on the water environment include the breading and they lost the direct contact with terrestrial environment and seals which for the breading need the temporary terrestrial environment with possibility of transmission of the parasites from terrestrial mammals [13,14]. Also, it is very interesting, if birds may play the important role in the transmission the whales’ or seals’ parasites.

There are two general hypotheses of the origin of the whales’ [15]. One suggested that these animals derived from the early forms of artiodactyl based on the morphological and functional criteria of the structure of the stomach. Second, opposite was taking into consideration the genetic correlation which is similarly to the early terrestrial carnivores. (evolution der wale) [16,17]. The evolution of the whales is very important, because it is possible that the parasites may create the special adaptations during evolutional changes with their hosts. At this time, at least recorded two ecto-parasites and 28 endoparasites from the porpoises in the European waters [16]. The parasite fauna of the Baltic porpoise is rather poor; only six species are known [18], of which three taking into consideration during the present study. The few known papers on the porpoises in the Polish part of the Baltic, dealing with its biology and occurrence, are mainly based upon such records [19-21]. In 1939 the polish scientist Łukasiak [21] had carried researches of harbor porpoise *Phocoena phocoena* and report the parasite fauna of Ph. ph. form polish zone. He noted the *Halocercus inflexocaudatus* [22]. The *Pneumo-nematode* situated in the numerous cysts on the lung surface, the invasion of parasite was very intensive. However, quantitative investigations on its parasites are insufficient [17].

The lungworm of the harbor porpoise in the Baltic Sea no differ significantly from those in Danish, German waters and the Norwegian Sea, and from other world regions, but there are some differences in the prevalence and abundance of these parasites [23-25]. So far there are some papers concerning the lungworm from Danish, German and Norway waters [26,27]. Only one paper concerns this subject has been written at Polish waters, but it focused only on the helminth fauna of the harbor porpoise. Our studies are very unique because it concerns the white-beaked dolphin as well. The paper written by Rokicki & Wrblewski [28] was dealing with only the stated parasites composition and abundance and prevalence, but not focused on the ecological correlations and the possible of the role of the whales as vectors parasites to the middle-southern Baltic regions [29,30]. The aim of this study was to evaluate the abundance and prevalence data but questions we are being asking about were concerned with the wide characteristics and adaptation strategies of these parasites. This issue carries an entirely new view at this subject [31]. In view of current trend, it is more important to evaluate basis on the previous studies the possible life cycle of lungworm parasite of the marine mammals. The scientists from Norway take trying the comparative tests and analysis on the basis on the mentions of the Anderson who studied the various parasitological correlations in the limit of the Pseudalidae [32]. Already at 1070th, the professor Skrjabin get down the wider with these subjects of the origin of the parasites of the marine mammals and their very interesting aspects of biology [33].

Materials and Method

This study was based on 12 harbor porpoises by-caught in fisheries along the Polish coast from October 1995 to July 1996 and on 3 white-beaked dolphins incidentally by-caught in fisheries net carried by cutters at July of 1989 that was a couple and August 1995 one adult female [34]. That material is very unique because the white-beaked dolphins’ occurrence, are noted at polish waters of the southern Baltic very rarely and incidentally [35]. The animals were deep-frozen and stored for the different biological studies. The examination was carried out on the ground of the technique procedure of Hammond [36]. All specimens were sexed, the age being determined by GLG (Growth Layer Group). The respiratory systems were collected and examined for occurrence of helminthes parasites, total recovery of specimens being attempted [37]. Many other materials were taken for various investigations that are not the subject of this study. The trachea, bronchi and bronchioles were opened and thoroughly were examined for lungworms. The lung parenchyma was inspected both visually and by palpation for encysted nematodes. All nodules detected were excised and the specimens if present collected [38]. The lungs were then washed, the washings being flushed through a 0.25mm mesh. The retained material was scrutinized for helminths that may have been missed in the preceding analyses [39]. Whole specimens of each species in each individual host were counted. Caudal and cephalic fragments of damaged specimens were also counted, the maximum number being added to the number of whole individuals [40]. The nematodes were identified following Arnold & Gaskin [40].

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We detected 676 nematodes specimens belonging to three species in the respiratory and circulatory system of the porpoises and white-beaked dolphins [41]. The lungworms were found in 8 animals. All nematodes’ species were occurred in 7 porpoises and 1 white-beaked dolphin respectively. The only animal apparently devoid of parasites was 0.5-1 year being probably young. At 9 among 12 porpoises which were searched and next dissected we found 401 specimens of parasites [42]. Remaining 3 specimens were free of the parasitological infections. Dimensions of the body mammals which were free of parasitological infection, have indicated, that there were young individuals at the age about one year old and one male which age was determined about 4 [43]. The rest of porpoises were aged between 0.5 to 6 years.

One of the studied specimens was pregnant. At 3 from searched white-beaked dolphins there were 275 specimens of parasites [44]. They were aged about 2 years. That suggests that the porpoises and dolphins are a little bit readily colonized by lungworms [45]. Helminth diversity and the number of helminth individuals were not correlated with host age, but there was a weak correlation between the number of helminth species and host age. Pseudalius inflexus and Torynurus convolutus very often co-occurred with Halocercus invaginatus, but Pseudalius inflexus and Torynurus convolutus occurred together more frequently than expected with Halocercus invaginatus. Differences in prevalence and similarity indices between P. inflexus and T. convolutus were higher than those between these species and H. invaginatus [46]. The number of lungworms detected in the harbour porpoise and white-beaked dolphins were relatively high. A total of 676 parasites, belonging to 3 nematode species were recovered [47].

Nematoda

A. Halocercus invaginatus (Quekett, 1841)
   a. Host: Phocoena phocoena.
   b. Site: lung and cyst on pleural epithelium.

B. Pseudalius inflexus (Rudolphi, 1808)
   a. Host: Phocoena phocoena.
   b. Site: lungs and heart

C. Torynurus convolutus (Kühn, 1829)
   b. Site: respiratory and circulatory systems. In presented material specimens were recovered from larynx, trachea and lungs.
   c. Geographical distributions: N. Atlantic (Europe), the Pacific (Sakhalin)

Three pseudaliids species have been reported in the lungs of harbor porpoises and white-beaked dolphins: P. inflexus, T. convolutus, H. invaginatus [5,37]. The examinations suggest that the porpoises are readily colonized by lungworms, the structure of the component community are the same in all age group structure [48]. The cases of this nematode species invasion were noted at various whales’ representatives, but at harbour porpoise this parasite is the better known. The life cycle and exact ways of invasion with these nematodes is not definitive discovered [49]. Dailey [32] in 1991 stated that one of the manner possibilities of acquiring this nematode may be the vertical transmission from the host mother to the young individuals [50]. Many cases peri-placental transmission of these nematodes to the fetus with mothers’ blood and peri-glandular with mothers’ milk were reported in the British waters [51]. In March 1991 at the California coasts during examinations Moser and Rhinehart noted the case of the pregnant porpoise female infected with Halocercus invaginatus, whereas the foetus was not attacked by the parasites [52]. Maybe that indicates that this is not the common way of infection and presumably had to exist other ways of this process. As that was said previously, the life cycle of the lungworm at the marine mammals is still so far unknown. There is only numerous hypothesis to explain the various possibilities of the completing the life cycle of these parasites [53]. Perhaps prenatal and/or trans-mammary infections might partly account for the infections [54]. This way of transmission seems fairly common among this family of nematodes [55,56] prenatal infections are known in several metastrongyloids [56]. That was noted that trans-placental infections might be an important feature in the transmission of pseudaliids [57]. Only the calves were free of lungworms and that was observed that the number of helminthes species tended to increase with host age and this evidence suggest that other ways of transmission must exist [58]. Wesenberg-Lund (1947) hypothesized monoxenous cycles involving autoinfections and prenatal transmission for the pseudaliids, in the difference to that heteroxenous cycles seem more likely since this is the common way of transmission among the Metastrongyloidea [2,4,59].

Perhaps according to Anderson [2] the life-cycles of the Pseudaliidae may be similar to those of Metastrongyloids of terrestrial carnivores [60], involving intermediate and paratenic hosts but there is still the problem with finding and detecting (determined) the exact intermediate-host if there is any, even if it not exist it is possible to short the life cycle of these nematodes [61]. The Anderson was taking into consideration the nematodes of the genus Stenurus, which are found in the frontal sinuses of the mongoose Herpestes ichneumon [2,3]. At the marine mammals in the ear sinuses occurs the nematode Stenurus minor species belonging to the Pseudaliidae [62]. The exception constitutes the species from the Stenuroides, which is find in the cranial sinuses of the terrestrial mammals. All species of Pseudaliidae occur in the lungs and air sinuses of odontocetes, except those mentioned earlier previously [63,64]. The positive overall association among the three lungworm species indicates that colonization by each species is not ran-
dom [65]. There have place the co-existence of the three parasites’ species in the various parts of the respiratory system inside of the host organism. That presents following [66]

_Pseudalius inflexus_: Lumen of the big bronchi, only head part into the wall of the bronchi.

_Torynurus convolutes_: Whole in the lumen of the small bronchi and

_Halocercus invaginatus_: The lung parenchyma inside of the isolated calcified capsule.

Such positive association seems more common than negative ones in communities of both helminthes and free-living organisms-using/utilizing various niche and adaptations despite of the concurrence different accessible niches and co-adaptations despite of concurrence [67,68]. These authors pointed out that phylogenetical determinants can constrain the way organisms utilize resources and thus related parasite species may have similar life cycle requiring the same or similar intermediate and/or paratenic hosts [69]. It is no evident data that intermediate-host eden exist and if there are not any, the life cycle might to be short but life in the water environment established more investigation/research problems of the marine-mammals [70]. That suggests that other communities of lung-worms’ nematodes may be formed by phylogenetical relatives. Most previous surveys give little information on species co-occurrence [71]. Is there the only special, selected example in the group of the parasitic nematodes? Does it exist/ take place only at marine mammals but not at terrestrial mammals? [72]. Although we supposed and assumed, that it is not the only one example of ecological co-relations in the group of parasitological nematodes [73]. And that occurred also at other kind of the hosts, not only at water, that’s at marine mammals, but at terrestrial conditions either [74]. We were taking into consideration If the life cycle can become shorter without of the various intermediate hosts. We suggest, that it would be possible the self-infection in the limit of one the same individual, or the infection between individuals of one the same species of marine mammals or various species of marine mammals [75]. In our study the prevalence of parasite was significantly lower than data stated by Balbuena at Atlantyk [15-17]. We assumed that it is possible, when the marine mammals are at bigger group at social structure meet together seasonally that is a big probability of circulation and transmission of the parasites between the individuals, but at Baltic Sea when the whales occurred very rare this process isn’t able to exist and take place [76]. It seemed interesting if there is the preference to one group of marine hosts or that may comprise the wide group of species [77]. It is difficult to say because only parasite fauna of harbour porpoise is better known, the study of parasites other whales is occasionally and based on that from the harbour porpoise [78]. Delamure stated that larvae moved into the respiratory tract in direction of the upper part and for young individuals of the parasites belonging to the _Pseudaliidae_ is very typical and often/frequently leads to the closing of the host organism by the/through the respiratory/blow hole of the nostrils/anterior nares [45,79].

By this way the parasites are rinsed out outside of upper parts the respiratory system. And then the larvae are eating recurrently by the host [37]. The professor K. J. Skrjabin in 1941 on the example of the lung-worm species from the family _Pseudaliidae-Halocercus kleinernbergi_ created the hypothesis about origin parasites of the respiratory organs-lung-parasites who seemed that lung-parasites derived from the ones of the circulatory system, angio-parasites [80]. The characteristic feature of this helminth is that, its head-part of the body attached to the tiny sinus or blood vessel with diameter up to diameter of this nematode body, and by this way received the host blood [81]. The middle part of the body of this nematode lay in the lung’s parenchyma and back-tail part is short and located in the lumen of the small respiratory canal. This property/attribute and feature of the localisation is very interesting [82,83].

That nematode went over through from the circulatory system to the respiratory organs but not lost simultaneously the contact with blood vessel [84]. To confirm our suggestion, we took the blood samples from each of the individuals from the right part of the hart and pulmonary arteries to look for the eggs circulating with blood flow. Although that, there were no eggs at the circulatory system [85]. But during the precise parasitological researches we were able to indicate and find the mature females with the packages of the eggs [86]. It is very interesting if that was possible the following development of these eggs would be possible and what conditions it would be demand. The individuals find at the circulatory system (heart and pulmonary artery) were at the better conditions as stated in the respiratory system, that may suggest the influence of the indirect action of external environmental factors took play the role, influence hard life condition of parasites [87]. The individual species of the helminths have the different adaptations to the life in the host’s organism [88]. Their presented in the following way: (Table 1)

In case of _Pseudalius inflexus_ the anterior (head) body part is attached to the lung tissue and enclosed by the calcified, hard, piosisiform capsule. The posterior (caudal) body part lay loosely in the bronchi’s and bronchioles’ canals. In the case of strong parasites invasion on the lung surface many concaves were seen like tumourity or outgrowth [89]. Pulling on the posterior part of the body in order to obtain the material, this parasite undergo to breaking off because of the anterior end of the body was high attached in the lungs tissue and can’t be took off in the un-destroying/un-decomposing form through the small capsule’ opening [90]. These helminths are permanent attached to the particular lung parts and can’t going forward to the other parts of the respiratory tract/canals [91]. The big sizes/dimensions of this nematode species seem to be also the adaptation to the different habitation conditions. In the heart of the examined hosts this species occurred in the lumen of the right ventricle, material gained there was less destroyed than that one from the respiratory system [92].

In the case of _Halocercus invaginatus_ it was totally/entirely drilled into the lungs parenchyma and rolled into the ball with some individuals enclosed by the elastic, very delicate capsule composed of the host’s tissues. Watching the lungs lesions outside the
After the incision of the cysts the ball very high confused nematodes was seen, that consists of the 1 to 2 males and 3 to 4 females. In case of the smallest invasion there were only the females longsome. This species is totally isolated from the respiratory canals of the host, the copulation and laying eggs taking place inside the capsule [94]. Comparing to previous helminths this nematode has very different adaptations to the habitation/existence in the respiratory system. It is of the very little dimensions; its body is thin and very long that facilitate rolled up/coiled up oneself [95].

Table 1: The adaptations of the parasites to the existence in the respiratory system.

<table>
<thead>
<tr>
<th>The Size, Length and Colour of the Body.</th>
<th>Torynurus convolutus</th>
<th>Pseudalius inflexus</th>
<th>Halocercus invaginatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium sized, not to thick, the light or dark body, long enough, coming into and penetrate the small bronchi and bronchioles.</td>
<td>Big sized, great and stout, dark brown to light-red and cherry colour.</td>
<td>Small, thin and very long, milk-white colour or light-orange and also may be transparent.</td>
<td></td>
</tr>
<tr>
<td>The mash in the Bronchi’s lumen or the lumen of the small bronchioles.</td>
<td>The head end is hollowed into the lung tissue, and the rest part there is loose in the bigger bronchi’s canal.</td>
<td>Rolled on by some individuals into the transparent, fragile, elastic capsule, totally isolated from the respiratory system.</td>
<td></td>
</tr>
<tr>
<td>The Localization in the Respiratory System.</td>
<td>The most exposed from all three lung-worm species to running out off from the lung.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly isolated from the respiratory system.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Way of Fixation.</td>
<td>Don’t evoke the pathological changes, but only caused the obstruction the respiratory tracts result the lungs filled with the mucus.</td>
<td>By the head part attached into the lung tissue and surround by the hard, rigid capsule formed by the host’s tissues.</td>
<td>Drilled into the lung parenchyma and inside there surround whole by the elastic capsule formed by the host’s tissue in the result of the defense reaction, often filled with the light-yellow liquid.</td>
</tr>
</tbody>
</table>

Adaptations of the 3 nematodes’ species.

A. *Torynurus convolutus*

Whole body of the nematode’s in the bronchi’s’ lumen.

B. *Pseudalius inflexus*

By the head end fixed into tissues in the capsule, rest part loses in the big bronchioles.

C. *Halocercus invaginatus*

Totally isolated from the external environment, rolled and closed into the calcified capsule in the lung parenchyma. The various possibilities of the completing the life cycle of the lung-parasites:

It is interesting if are there any intermediate hosts?

A. Trans-placental from mother to the fetus with blood.

B. Trans-mammary/infra-glandular with the mother’s milk.

C. Oneself-infection (autoinfection).

D. Between individuals of the same or different whales’ species.

E. Other ways of the transmission with the one intermediate host or more than one intermediate host.
*Torynurus convolutus* hasn't very specified adaptations facilitated existence in the host body [96]. It was found always in the lumen of the respiratory canals. The nematodes aren't attached into the lung tissue, aren't enclosed into/inside of the capsules [97]. Where as the small dimensions of them facilitate penetration to the very small and thin bronchioles [98]. The numerous concentrations of this species nematodes located around the respiratory canals caused the specific plugging, which protected parasites from the possibilities of throwing off them outside from the respiratory canals/tract during host's breathing out/exhalation [99]. The pathology lesions of the tissues were not noted. The isolation/separation of this nematode species from the respiratory tracts is the less than other obtained lungworms, and it is stronger running a risk of different existence conditions in the respiratory system, that are specific for marine mammals [100]. With regard to feature structure and similar place of existence in the respiratory and blood systems the nematodes, belonged to the family *Pseudalidiae* specific for the whales, seem to be similar to the nematodes belonged to the other families typical for the terrestrial mammals within the limits of the file *Metastrongylidae*.

The origin and genesis parasites from family *Pseudalidiae* from the terrestrial mammals seemed to be very probable, but helminths existed at the marine mammals adapted directly to the marine environment together with their hosts [2]. Acquiring lung-worm parasites from seals seemed to be small probability because the lung-worm parasites of *Pinnipedia/Phocenidae* presented less similarity of the features and the relationship with the whales' parasites [1]. Despite of the genesis of the whales' lung nematodes from the parasites of the terrestrial *Carnivora* [3]. The considerable differences concerned with existence in the very different conditions that are in the whales' respiratory system are visible. In connection with that the parasites had to create the adaptations which facilitate them survive in these atypical conditions [37]. Balbuena reported that parasites may be the indicators of the social structure and of the identification of the population marine mammals [101]. We weren't able to confirm this thesis because of too less samples of the material.

Balbuena et al. [17] claimed that some of the lung-worm species may co-occur. The results of our study confirm this data, but the range of the co-occurrence was significantly less that mentioned by Balbuena. It is very often observed that *Pseudalidius inifexis* and *Torynurus convolutus* always co-occur, but occurrence together of all tree lung-worm species isn't the rule and we stated it only at one white-beaked dolphin [102]. It seemed to be very interesting if there is the special concurrence between *Torynurus convolutus* and *Halocercus invaginatus* inside of the one the same host, despite of the various places of habitation and so-called various *nisches*, is it the concurrence about the host between the parasites? Presented here data concerned that subject and concluded at this paper aspects are on the evolutionary and ecological view still so far to unsolved but the importance of together correlation of the courses of evolution of the hosts and their parasites seemed to be very interesting and demand of the previous detailed analysis and deepen of the knowledge about that subject [103].

**Conclusion**

A. Parasites of the whales-animals secondary adapted to the water environment had to create the special mechanisms to survive at the atypical, unusual conditions.

B. They had to create adaptations during evolutional changes of their hosts.

C. The co-existence of the 3 various lung nematode species isn't incidentally but resulted in the phylo-genetic relationship.

D. In the reason of the high concurrence the parasites used the various separate places in the limits of the one, the same organ.

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