Endoparasitic worms inventory on Skipjack Tuna *(Katsuwonus pelamis)* gastrointestinal from North Sumatera Indian Ocean, Indonesia

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**Abstract.** Skipjack tuna *Katsuwonus pelamis* is one of the commercial fishes in Indonesia. This species is frequently caught by fishermen in Indian Ocean, North Sumatra Province. Therefore, the objectives of the present study were to identify endoparasitic worms and examine the infection level in skipjack tuna *K. pelamis* from North Sumatera Indian Ocean. Sampling was conducted in Horizon Private Fishing Port, Sibolga from 21 June to 5 July 2019. A total of 25 fish samples with weight ranges from 390 g to 670 g and total length from 29.3 cm to 34.6 cm. The identification of the worm was carried out in the laboratory using a stereo microscope. The results showed that there were eight species of worms were found in intestine and stomach of the fish with various levels of incidence, for example *Echinorhynchus* sp. and *Rhadinorhynchus* sp. with 100% intestinal incidences; *Neoechinorhynchus* sp. had 72% intestinal incidences; *Leptorhynchoides* sp. had 56% intestinal incidences; *Pomphorhynchus* sp. with 32% intestinal incidence; and *Acanthocephalus* sp. with 20% intestinal incidence. It is concluded that the *Echinorhynchus* sp. and *Rhadinorhynchus* sp. had higher incidences.

1. **Introduction**

Tuna and cakalang resources have an important role in the capture fisheries sector in Indonesia. The potential of skipjack tuna *(Katsuwonus pelamis)* in the western waters of Sumatra is 64,000 tons per year and is only utilized at 14.6% [1]. During 2011 to 2016 the production of skipjack tuna caught landed in VAT Sibolga varied and experienced a fluctuating increase and decrease. The highest production of tuna fish catch occurred in 2016 as many as 3,501.80 tons with an average production of 87.54 tons [2]. Related to the problem of food needs for the community, the problem of diseases in fish, especially those caused by parasites can cause a decrease in fish quality and health problems in humans. Parasites are not only harm the fishing industry, but also humans if consumed [3]. The presence of parasites in fish will have an impact on reducing consumption, decreasing quality in aquaculture, reducing the body weight of consumption fish, and rejection by consumers due to morphology or abnormal body shape of fish. The type of parasite in marine fish is determined by its geographical distribution, the presence of intermediate hosts, endurance of fish (in the infected host phase), and the length of time they are infected [4].

The influence of parasites on fish not only affects individual fish, some can even affect the migration behaviour of a fish population. In addition to influences on physiological patterns and fish quality,
parasitic influences can also affect humans who consume raw or undercooked fish infected by parasites [5].

The parasitic animals that are often found attacking fish are groups of worms and crustaceans. Worms that are parasitic animals in fish are classes of Trematoda, Cestoda, Nematoda and Acanthocephala. While from crustaceans are children of the Copepoda, Cirripedia and Isopoda and Amphipoda orders [6]. Hence, the objectives of the present study were to identify endoparasitic worms and to examine the incidence level of endoparasitic worms in skipjack tuna (K. pelamis).

2. Materials and methods

2.1. Site and time
This research was conducted in June to July 2019. Sampling conducted in Horizon Fishing Port, Sibolga, Indonesia. Endoparasite worms identification was carried out in the Aquatic Environmental Laboratory, Major of Aquatic Resource Management, Universitas Sumatera Utara, Medan, Indonesia.

2.2. Tools and materials
The main equipments and materials used includes a surgical instrument, cool box (Marina Cooler 18S), ruler 30 cm, manual scale, sample bottles (100 ml), petri dishes (100 mm x 15 mm), object glass (25.4 x 76.2 mm), cover glass (22 x 22 mm), microscope (Olympus CX22), drop pipette, paper labels, erlenmeyer (500 ml), measuring glass (500 ml), and stationaries. While the primary materials used such as skipjack tuna (K. pelamis) with the body weight ranged 390–670g and total length ranged 30–35 cm. The other materials are neutral buffered formalin to preserve the samples, aquadest, alcohol (70%, 80%, 95%), acidic alcohol (alcohol 70% + HCL), alkaline alcohol (alcohol 70% + NaHCO3), aceto-carmine solvent, xylol, and entellan.

2.3. Research procedure
Fish samples were purchasing from local fishermen in Horizon Fishing Port, Sibolga. A total 25 fish samples were collected randomly based on their length class. The fish was measured for total length (cm) and total body weight (g). Then after, the fish was dissected and the digestive tract (intestine and stomach) were taken and then put into the sample bottle then fixed with neutral buffered formalin. Then the samples were storage in an ice box (Marina Cooler 18S) at 4 ºC, then transported to laboratory for further analysis.

In the laboratory, the intestine and stomach were opened using a scissor and the intestine and stomach contains were put in the glass plate. The worms found were then stained with carmine solution and dehydrated with multilevel alcohol. Then, the worm-resistant preparation was identified by observing the head to the tail using a stereo microscope (Olympus CX22).

2.4. Data analysis
The data of parasite species, prevalence were analysed descriptively. The incidence calculated using the formula [7]:

\[
\text{Incidence} = \frac{\sum \text{Fish}_{infected}}{\sum \text{Fish}_{examined}} \times 100\%
\]

While, the incidence levels were calculated as presented in the Table 1.
### Table 1. Category of incidence of endoparasitic worms [8]

| Infection Category       | Range of Values (%) |
|--------------------------|---------------------|
| Almost never             | <0.01               |
| Very rarely              | <0.1–0.01           |
| Rarely                   | <1–0.1              |
| Occasionally             | 1–9                 |
| Often                    | 10–29               |
| Commonly                 | 30–49               |
| Frequently               | 50–60               |
| Usually                  | 70–89               |
| Almost always            | 90–98               |
| Always                   | 99–100              |

### 3. Results

Based on the results of examinations during research on the inventory of endoparasitic worms in skipjack, as many as 25 fishes with an average weight of fish examined, namely 522.2 g/sample, found six types of parasitic worms namely *Echinorhynchus* sp., *Acanthocephalus* sp., *Pomphorhynchus* sp., *Leptorhynchoides* sp., *Rhadinorhynchus* sp., and *Neoechinorhynchus* sp. (Table 2) (Figure 1-6). The incidence data of each parasitic worm is presented in Table 3.

#### Table 2. Identification of endoparasitic worms.

| Class                  | Ordo              | Family               | Genus               | Total ind. |
|------------------------|-------------------|----------------------|---------------------|------------|
| Palaecanthocephala     | Echinorhynchida   | Echinorhynchidae     | *Echinorhynchus*    | 283        |
|                        |                   |                      | *Acanthocephalus*   | 7          |
|                        | Pomphorhynchidae  | *Pomphorhynchus*     | 9                   |
|                        | Rhadinorhynchida  | *Leptorhynchoides*   | 30                  |
|                        | *Rhadinorhynchus* | 94                   |
| Eocanthocephala        | *Neoechinorhynchida* | *Neoechinorhynchus* | 46                   |

Based on Table 3, each endoparasitic worm attacks the intestinal organs of skipjack fish but is not found in the stomach. The highest incidence rate is found from worm of *Echinorhynchus* sp. and *Rhadinorhynchus* sp. which attacked all samples examined (25 fishes) with an incidence rate of 100%.

#### Table 3. Incidence of parasitic worms.

| No | Species              | Incidence |
|----|----------------------|-----------|
|    |                      | Intestine | Stomach |
| 1  | *Echinorhynchus* sp. | 100.00    | 0       |
| 2  | *Acanthocephalus* sp.| 20.00     | 0       |
| 3  | *Pomphorhynchus* sp. | 32.00     | 0       |
| 4  | *Leptorhynchoides* sp.| 56.00    | 0       |
| 5  | *Rhadinorhynchus* sp.| 100.00   | 0       |
| 6  | *Neoechinorhynchus* sp.| 72.00    | 0       |

Furthermore, also found *Neoechinorhynchus* sp. attacked 18 of 25 intestinal samples with an incidence rate of 72%. Then *Leptorhynchoides* sp. worm attacked 14 of 25 intestinal samples with an...
incidence rate of 56%, while the *Pomphorhynchus* sp. attacked eight of 25 samples in intestinal organs with a prevalence rate of 32%. Finally, there are the worms of *Acanthocephalus* sp. which attacks five of 25 intestinal samples with an incidence rate of 20%.

**Figure 1.** *Echinorhynchus* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis, 40x (a, b) and 100x (c) magnification

**Figure 2.** *Acanthocephalus* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis) 40x magnification

**Figure 3.** *Pomphorhynchus* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis, FN: False Neck) 40x magnification
Figure 4. *Leptorhynchoides* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis, CG: Cement Gland) 40x (a) and 100x (b, c) magnification

Figure 5. *Rhadinorhynchus* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis, CG: Cement Gland, T: Thorn) 40x (a, c) and 100x (b) magnification

Figure 6. *Neoechinorhynchus* sp. (a. Anterior, b. Female Posterior, c. Male Posterior, P: Proboscis) 40x (a,c) and 100x (b) magnification

4. Discussion
A total six species of endoparasitic worms were found during the analysis, namely; *Echinorhynchus* sp., *Acanthocephalus* sp., *Pomphorhynchus* sp., *Leptorhynchoides* sp., *Rhadinorhynchus* sp., and *Neoechinorhynchus* sp. These parasites are belonging to Acanthocephalans. This phylum of acanthocephalans is characterized by ‘thorny’ or ‘spiny headed’.

The *Echinorhynchus* sp. and *Rhadinorhynchus* sp. was infected all of fish samples, where this parasite was occurred in 25 intestine samples. The both worm of *Neoechinorhynchus* sp. and *Leptorhynchoides* sp. each were infested 18 and 14 fishes in the intestine. In addition, *Pomphorhynchus*
sp. and *Acanthocephalus* sp. each were infected eight and five fish samples in the intestine. The worm was found to be dependent and attaching the proboscis to the intestinal wall, the majority of worms are pink, orange, or white.

Skipjack tuna is a carnivorous [9]. The presence of Acanthocephalans in the gastrointestinal of fish, maybe comes from an intermediary hosts such as arthropods, crustaceans, small fishes and the other that fed by fish. In general, the rate of endoparasitic worm infections in skipjack tuna is classified as ‘always’ because all fish are infected by endoparasitic worms [8]. Therefore, this worm infection is likely to endanger the skipjack population in the future.

Based on observation showed that proboscis of *Echinorhynchus* sp. was attached to the inner wall of the intestine of fish sample. This worm is characterized by a short cylindrical proboscis shape, and has a short neck [10]. Its incidence is 100% which is mean it always found in skipjack. Also with the higher incidence, *Rhadinorhynchus* sp. has a small body, curved backward, rotating forward in two planes separated by a thornless zone, but the upper part of the body is wider and equipped with spines. The proboscis is much longer and that is connected to the head near its centre [11][12].

*Rhadinorhynchus* sp. is somewhat similar to *Leptorhynchoides* sp. According to [10] *Rhadinorhynchus* sp. has thorny stems and two cement glands, while *Leptorhynchoides* sp. has a thornless stem with eight cement glands. In addition, the worm *Neoechinorhynchus* sp. having a small proboscis and rounded shape [13]. The body is short with hooks in three circles and each circle has six hooks [10]. The infection level of *Neoechinorhynchus* sp. are categorized as ‘usually’ found in skipjack while *Leptorhynchoides* sp. is categorized as ‘frequently’ here.

Contrastingly, the *Acanthocephalus* sp. had a long neck and swollen proboscis. *Pomphorhynchus* sp. has a very long proboscis and neck (> 1 mm) or also called pseudo neck [10], this worm was also found attached to the inside of the intestinal wall. *Acanthocephalus* spand *Pomphorhynchus* sp. have the incidence rate of 20% and 32% which is included in the ‘often’ and ‘commonly’ found category.

Parasitized fish may be emaciated with inflamed intestinal tracts and tissue necrosis in areas where worms are attached to the intestinal wall. The existence of these parasitic worms is closely related to the aquatic environment of these living and aquatic fish. [6] Opined that Acanthocephala worms found in marine fish are usually found in larval and adult stages. These worms are often found in the digestive tract and fish body.

Infection of the Acanthocephala caused a serious effect on the fish host. In heavily infected fish by Acanthocephalans may perforate the stomach wall and cause considerable severe damage and local inflammatory reaction. In the past few decades, the attention of ecologists and environmental toxicology to Acanthocephala parasites has continued to increase [14]. The reason, [15] argued that various certain parasites, especially worms in fish intestines originating from Acanthocephalans are known to be able to accumulate heavy metals with higher concentrations than those found in host tissues or the environment. The occurrence of metal build-up in these worms makes acanthocephalans that infect fish can be used for environmental monitoring purposes. Those possible to transmit into the definitive host like skipjack then harmful for human that consumed that infected fish. However, besides that, because of its ability to absorb heavy metals, acanthocephalans can be used as bioindicators for heavy metal pollution in waters. Currently, fish helminth parasites, especially cestodes and acanthocephalans, are regarded as sentinel organisms to elucidate metal pollution in aquatic ecosystems [16]. Laboratory studies on the accumulation of lead suggest that acanthocephalans take up the metal in the form of bile-metal complexes. They can accumulate metals like Ag, Cd, Cu, Fe, Mn, Pb, Zn, Cr, Cu, Hg, As, Ni, Se, V, Sn and Co [17].

5. Conclusions
It is concluded that the skipjack tuna from North Sumatera Indian Ocean has infested by six species of Acanthocephalans, namely *Echinorhynchus* sp., *Acanthocephalus* sp., *Pomphorhynchus* sp., *Leptorhynchoides* sp., *Rhadinorhynchus* sp., and *Neoechinorhynchus* sp. All endoparasitic worms are infected intestinal organs and no worm was found in the stomach. The *Echinorhynchus* sp. and *Rhadinorhynchus* sp. had higher incidence and always found in the intestine of skipjack. The increased
presence of these worms in the future can affect the productivity of the host. Since the capture area in general is still under the management of the North Sumatra government and the presence of parasites is closely linked to potential pollution, it is hoped that the government, stakeholders and the community can cooperate to reduce waste disposal which can increase pollution in the region. Further research on the source of pollution in the waters must be carried out to optimize management.

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