学 位 論 文 の 要 旨

論文題目　Ecological studies on parasitic copepods infecting fish fins, with special references to the life cycle and infection-site specificity
(魚類の鰭に寄生するカイアシ類の生態学的研究、特に生活史と寄生部位特異性について)

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Chapter 1　General introduction

Fundamental of parasitology need a vast knowledge of many associated field such as biology, ecology and molecular. In chapter 1, basic introduction of the concept parasitism, site-specificity and some brief information about two species of parasitic copepods studied in the thesis were described. This recent study involved basic information on life cycle and ecology of *Peniculus minuticaudae* (Pennellidae). More advance study was carried out as an effort to understand the mechanism underlying the site-specificity to the fins of *Caligus fugu* (Caligidae).

Chapter 2　Complete life cycle of a pennellid *Peniculus minuticaudae* Shiino, 1956 (Copepoda: Siphonostomatoida) infecting cultured threadsail filefish

The complete life cycle of a pennellid copepod *Peniculus minuticaudae* Shiino, 1956 was proposed based on the findings of all post-embryonic stages together with the post-metamorphic adult females infecting the fins of threadsail filefish *Stephanolepis cirrhifer* Temminck and Schlegel, 1850 cultured in a fish farm at Ehime Prefecture, Japan. The hatching stage was observed as infective copepodid. The life cycle of *P. minuticaudae* consists of six stages separated by moults prior to adult: copepodid, four chalimi and adult. In this study, adult males were observed frequently in precopulation amplexus with various stages of females however, copulation occurs only between adults. Fertilized pre-metamorphic adult female carrying spermatophores may detach from the host and settle again to undergo massive differential growth to become post-metamorphic adult female. Comparison in the life cycle of *P. minuticaudae* has been made with three known pennellids; *Lernaeocera branchialis* Linnaeus, 1767*, Cardiodectes medusaeus* Wilson, 1917 and *Lernaeenicus sprattae* Sowerby, 1806. Among the compared species, *P. minuticaudae* is the first ectoparasite pennellid was discovered to complete life cycle on a single host without any infection site preferences between infective copepodid and fertilized pre-metamorphic female stage.

Chapter 3　Ecology of *Peniculus minuticaudae*

Seasonal ecology aspect of *Peniculus minuticaudae* infecting threadsail filefish *Stephanolepis cirrhifer* cultured in a fish farm at Ehime Prefecture, Japan was documented.

The study was carried out from September 2011 to August 2012. A total of 120 host fishes were examined for parasites infection. Prevalence, mean intensity, composition of parasites based on life cycle stages, distribution of parasite on host, and reproduction parameters were investigated. Prevalence of *P. minuticaudae* infection relatively high all year rounds but decreased during the last two months of sampling period. Adult females (post-metamoprhic, ovigrous, metamorphing and pre-metamorphic) contribute to the highest composition of the parasite population throughout the study period. Only adult females were found attached on the fins, and they show preference to the second dorsal fins. Based on the abundance of post-metamorphic females carrying egg strings, the hatching stage (copepodid) and the count of pre-copulation couples, it is assumed that the spawning season of *P. minuticaudae* was during spring with the peak reproductive capability in mid-spring.

Chapter 4 Site-specificity of infective copepodid stage of *Caligus fugu* to the fins of puffer fish: molecular evidence

Caligus fugu (Yamaguti, 1936) is parasitic copepod from the family Caligidae (Copepoda: Siphonostomatoida) which is highly host-specific to puffer fishes such as *Takifugu* spp. In Japan *C. fugu* was recorded to infect several species of pufferfish including the tiger puffer *Takifugu rubripes* (Temminck & Schlegel, 1850), grass puffer *Takifugu niphobles* and the panther puffer *Takifugu pardalis* (Temminck & Schlegel, 1850) (Yamaguti, 1936; Ikeda et al., 2006; Ohtsuka et al. 2009). Pufferfish industry in Japan has been nowadays facing an economic problem from the heavy infection of parasites on high value fish, the tiger puffer *T. rupripes* (Ohtsuka et al., 2009; Maran et al., 2011). Towards constructing an effective parasite management I tried to investigate the chemical substances involved in host and site recognition of infective stage of *C. fugu*, the copepodid using behavioral and molecular approach. In the present study behavioral observation using Y-tube bioassay showed that copepodid *C. fugu* positively responded to the stimulation of puffer-conditioned water by actively swimming upward and toward the arm containing stimulus water. The active and directional swimming activity was reduced after the FCW was heated, suggesting that the semiochemical candidate(s) might be in a form of water-soluble protein. The SSH cDNA library of *T. rupripes* pectoral fin has been successfully constructed. Copepodids showed activation and directional response when stimulated using a series of diluted culture medium that may contain the secreted chemical substances from cells transfected with the *T. rupripes* pectoral fin SSH cDNA library.

Chapter 5 General Discussion

In chapter 5, several parasites shows the preference to infect the host's fins were listed. The factors influencing these preferences also were discussed. The results from chapter 2 and 3 shows that for some copepods, all stages in the life cycle can be spent on the fins while for some other copepods, infection site or host switching might occur at the later stage of the life cycle particularly among adult females, where they will find a new infection site which provide them a better survival and fecundity. From chapter 4, we can concluded that site-recognition in copepods might involve the recognition of specific chemical cues released from the host to the environment. However, more efforts are required to understand the mechanism leading to site –specificity which is not yet fully explained by the recent discovery.