DIWPA: DIVERSITAS in the Western Pacific and Asia

DIWPA News Letter

Office: Center for Ecological Research, Kyoto University, Otsu, Shiga, Japan

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No. 47

Message from the chairperson

Shin-ichi Nakano

I hope all of you are well during the period of the COVID-19 pandemic since 2020. CER (Center for Ecological Research) has concluded MoU with Research Center for Limnology and Water Resources (RCLWR), National Research and Innovation Agency (BRIN), Indonesia. To make the MoU more active, Dr. Luki Subehi, Head of research group "Hydrodynamics and Biogeochemical Processes of Inland Waters Ecosystem" of RCLWR, has been staying at CER since July 22, 2022. He has successfully got the grant of JSPS for one month staying at CER. During his stay, he is going to conduct some analyses on Indonesian fish samples and discuss with me about future collaboration between Indonesian and Japanese limnologists/aquatic ecologists. He gave a talk about "Overview and finding unique characteristics of various tropical lakes in Indonesia" on July 29 at CER. As you know, the Republic of Indonesia consists of many islands, and each island has many lakes where some/many of them are still pristine and unexplored. To conserve their ecosystem and biodiversity, and to have their better management of fisheries, Indonesian Government should collect limnological, ecological and fisheries information about the lakes as much as possible. Limnologists and aquatic ecologists in Indonesia have been conducting a lot of studies on the lakes. Unfortunately, however, they encounter difficulties to collect data due to limited man-power and shortage of financial resources. In Luki's talk on July 29, he introduced the status quo of Indonesian lakes: lakes with unique ecosystems, eutrophication, cyanobacterial blooms, aquacultures and so on. We were very much impressed with his talk that we would need more research on those lakes having their precious ecosystem and biodiversity.

Message from the Secretary General

Atsushi Ishida

Since the early July 2022, we have been experiencing the 7th of COVID-19 infections caused by the Omicron variant in Japan. No one knows when the 7th wave will subside. Due to the infections, we have not held DIWAP International Field Biology Course (IFBC) during the last two years, unfortunately. Because the covid vaccination is proceeding forward in Japan now, we try to hold DIWPA IFBC in this year, although there is a possibility that it may be cancelled due to the situation of COVID-19 infections. We are unable to predict not only the infection situation in Japan but also the visa acquisition at that time. According to this situation, we will hold the DIWPA IFBC in 2022 for foreign young students and/or researchers who are staying in Japan at the time of October 1, 2022. Please understand that we unfortunately cannot invite them from abroad in this year. Despite the circumstances, we are pleased to be able to resume the DIWPA IFBC. In this year, we are planning to hold the DIWPA IFBC in the Ogasawara (Boini) islands, a World Natural Heritage site in Japan. See more details in page6-7 in this DIWPA Newsletter.

Report 1

Overview and Finding Unique Characteristics of Various Tropical Lakes in Indonesia

Luki Subehi

Research Center for Limnology and Water Resources,
National Research and Innovation Agency (Indonesia)

Indonesia is listed among the 12 megadiversity countries, ranked as the first in Asia in the number of freshwater fish species. As the settling of water volume, it harbors many species of fish communities. Moreover, there are 5,807 inland waters (lakes and reservoirs) in Indonesia, covering about 586,871.64 ha of area. Tropical inland water is one of the unique ecosystems which are usually functioning in both ecological and economic services. Recently, there is an increasing need to conserve and maintain the ecological balance of inland water systems which are subjected to massive pressure.

The water resources problems and some effort to solve them

Generally, the inland water problems in Indonesia are as follows: (1) Change of land use and land covers: degradation of forest land; (2) Water pollutions and environmental qualities; (3) Decrease in water resources availability; (4) The lake basin management challenges; and (5) Eutrophication as threat to lake water resources degradation. Concerning the degradation and environmental damage, especially in Indonesian lakes, the government makes the national Indonesian priority lakes as a part of the focusing and integrating all roles of institutions to protect those lakes. Some criteria of priority lakes are: (1) Lake damage: Level of sedimentation, pollution, eutrophication, highly reduced quality and quantity of water; (2) Lake utilization: Hydropower plant, agriculture, fisheries (aquaculture/floating cage), usable water, religious and culture values, tourism (including lake uniqueness, accessibility, amenity-infrastructure and society condition); (3) Local government's and society's commitment to wisely manage lakes (master plan, local regulation, managing committee); (4) Strategic lake: lakes featuring strategic functions of national interest; (5) Biodiversity (including endemic fish species, aves and vegetation); and (6) Carbon urgency (the challenge against global climate change).

Challenges ahead

Besides Indonesia has a largest caldera lake (Lake Toba, 1,130 km^2 area) in North Sumatra and the deepest tectonic lake (lake Matano, 590 m depth) in South Sulawesi, there are also more than 300 oxbow lakes in Kalimantan Island and some saline lakes (salinity more than 40 ppt) in the eastern part of Indonesia (Rote Island) (Figs.1 and 2). To protect them, the capabilities of the economic values of these inland waters and ecosystem should be balanced. In order to maintain the sustainability of the lakes, basic ecological information is necessary for the next study.

Fig. 1. Lake Hanjalutung – the Oxbow lake in Central Kalimantan

Fig. 2. Lake Oemasapoka – the saline lake in Rote Island (The most southern part of Indonesia)

Report 2

Causes and consequences of host manipulation by parasites in ecosystems

Takuya Sato

Center for Ecological Research,
Kyoto University (Japan)

Understanding the energy flow through food webs is a fundamental issue in ecology because the energy flow regulates the food chain length, strength of the trophic cascade, and biomass distribution of food webs, which ultimately maintain biodiversity and ecosystem functions. Historically, studies have largely overlooked parasites because they are not obvious and thought to be unimportant in food web energetics. However, parasites consist of approximately 40% of known species (Dobson *et al.* 2008) and their biomasses are even larger than those of top predators in some ecosystems (Kuris *et al.* 2008). We now know that parasites are ubiquitous in nature, but still have limited examples of how parasites play roles in ecosystems.

Manipulative parasites as a cryptic driver of ecological processes

A wide range of parasites manipulate the behaviors of their hosts in order to complete their life cycle, in a well-known example of the "extended phenotype" (Dawkins 1999). A noteworthy example is found in nematomorph parasites ("horsehair worms", Phylum Nematomorpha: Family Gordiidae) that inhabit globally, from boreal to tropical regions (Poinar Jr 2008). Larval nematomorphs mature inside a terrestrial invertebrate host, manipulating the host to seek and jump into water so the worm can emerge as an aquatic adult. Infected hosts wriggling at the water surface invariably attract aquatic predators, such as fish and frog. Sometimes predators eat the hosts before the nematomorph can emerge but the worm often escapes through the predators' gills or mouth (unlike many parasites, nematomorphs don't parasitize the predators of their hosts) (Ponton *et al.* 2006). We previously quantitatively demonstrated that orthopteran hosts (camel crickets and some predatory katydids; Fig. 1) that jump into water contributed 60% of the annual energy intake of stream salmonids in a temperate Japanese forested stream (Sato *et al.* 2011) (Fig.2).

Fig. 1. A camel cricket *Diestrammena* sp. infected by a nematomorph parasite *Gordionus* sp.

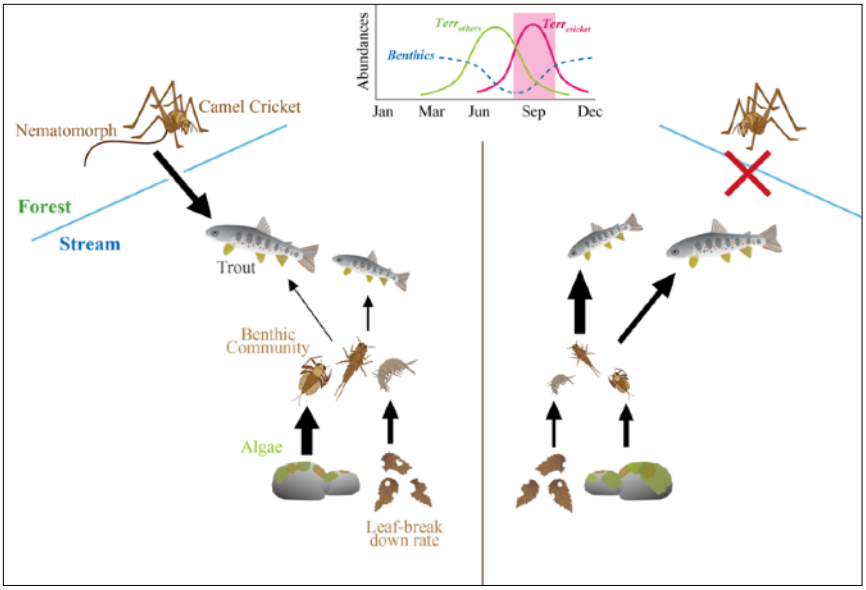

Fig. 2. Trophic interactions and ecosystem functions modified by a prey subsidy mediated by parasites. Black arrows, except for the cricket-trout link, denote direct consumptive interactions; the thinness of arrows shows the strengths of each interaction. The upper graph shows the seasonal dynamics of potential prey abundances for stream salmonid fish around the study site (Sato *et al.* 2011). $Terr_{cricket}$ and $Terr_{others}$ represent cricket hosts and other terrestrial invertebrates, respectively.

Clearly, streams are not typical orthopteran habitats. Therefore, such cross-ecosystem energy flow (i.e., the energy utilized by a consumer in an ecosystem is generated in the other ecosystems) would be less likely to occur without host manipulation by nematomorphs. Furthermore, the cross-ecosystem energy flow mediated by the nematomorphs indirectly decreased the predation of aquatic invertebrates by salmonid fish, which in turn weakened the trophic cascade and increased the leaf-decomposition rate in the stream ecosystem (Sato *et al.* 2012) (Fig.2).

Solving a mystery: How parasites manipulate their hosts?

A series of our researches are one of the best examples of how parasites can have large ecological impacts within and across ecosystems. However, there is a missing piece for the researches; the key mechanism triggering the hosts' entry into water has long been wrapped in mystery. A previous study reported the nematomorph-induced positive phototaxis, which may increase the encounter rate of hosts and water bodies (Ponton *et al.* 2011). However, luminous environments are ubiquitous in nature, such as right sandy habitats or grassland/ foliage reflecting sunlight or moonlight. Thus, a simple alteration of the positive response to light intensity may not be enough for hosts to effectively find water and jump into it. Contrary to the previous studies, we recently solved the mystery by focusing on "polarized light". The reflection of sunlight off water bodies is horizontally polarized, which is unique polarized light in nature and is used by many arthropods to either seek out or avoid water habitats (Heinloth *et al.* 2018). In the two-choice experiment, arboreal mantids (*Hierodula patellifera*) infected by nematomorph parasites (*Chordodes* sp.) were attracted to horizontally polarized light but not to vertically polarized light, whereas uninfected mantids were not attracted to either (Fig.3A). In a field experiment, most of the infected mantids (14 out of 16 mantids) entered a deep pool (Fig.3B), where the water surface strongly reflected horizontally polarized light (Fig.3C). By contrast, only 2 mantids entered a shallow pool (Fig.3B), where the surface reflection had higher light intensity but weaker polarization (Fig.3C). This is the first study demonstrating that a manipulative parasite can take advantage of its hosts' ability to perceive polarized light stimuli to alter host behavior (Obayashi *et al.* 2021).

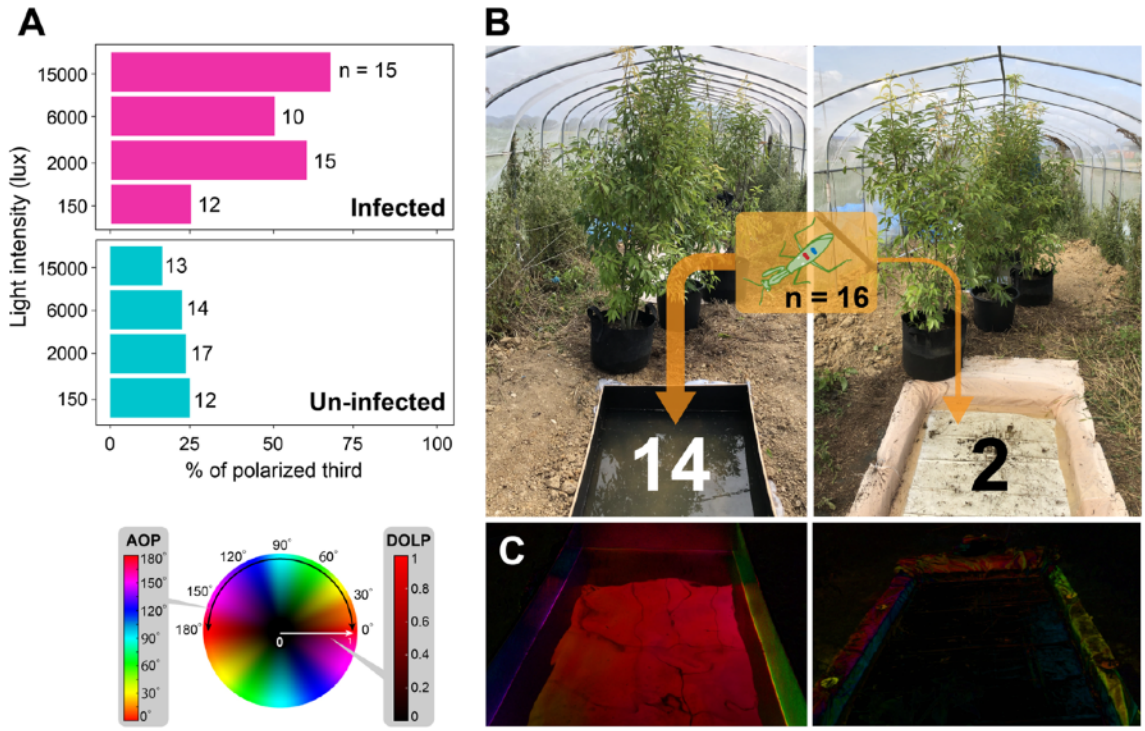

Fig.3. Induced positive polarotaxis and water entry of *Hierodula patellifera* infected by *Chordodes* sp. (A) Proportions of infected and uninfected mantids that located the horizontal polarization third in the choice experiment at four different light intensities; number of mantids used in each treatment (infection status and light intensity) is shown on right side of each bar. (B) Overview of the field experiment and the number of infected mantids that jumped into each pool. (C) Polarization images of the water surfaces of each pool; left pool (reddish surface) strongly reflected horizontally polarized light, whereas right pool (blackish surface) reflected less polarized light. In a color chart synthesized with angle of polarization (AOP, left bar) and degree of linear polarization (DOLP, right bar), color indicates angle of polarization direction, and brightness shows degree of polarization. The polarization images were taken at an angle of 35°, from which the infected mantids often jumped into the water.

Conclusions

Animals have evolved a diversity of photosensitive visual systems, which allow them to detect intensity, color, contrast and polarization of light (Kooi *et al.* 2021). During their co-evolution with those animals, parasites might have evolved to take advantage of the diverse visual systems of their insect hosts to enhance the host manipulations. Therefore, our finding of parasite-induced positive polarotaxis may be one of many examples of host manipulation strategies in illuminated environments. As a next step for our research, we are currently uncovering molecular and neural mechanisms behind the enhanced polarization, which may ultimately help to understand temporal and spatial variations in energy flow mediated by the nematomorphs.

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2022 DIWPA International Field Biology Course in Ogasawara Islands will be held!!

APPLY NOW!!

DIWPA Office is pleased to announce that we will have DIWPA International Field Biology Course (IFBC) in this autumn for the first time in three years. However, there are still difficulties in opening the gate to foreign researchers/students from abroad because of COVID-19. Thus, for this 2022 DIWPA IFBC, **we can accept only foreign young researchers/students residing in Japan at the time of October 1, 2022.** We ask for your kind understanding.

DIVERSITAS in the Western Pacific and Asia (DIWPA) is an international network for the promotion of cooperative studies and information exchange on biodiversity in the Western Pacific and Asia which aims to connect existing networks of people working on biodiversity and research projects in Asia and the Western Pacific. One of the main functions of DIWPA is “capacity building of scientists in particular young scientists from developing countries”. In the autumn of 2022, the International Field Biology Course will take place in the Ogasawara Islands, a World Natural Heritage site, in Japan.

DIWPA accepts an application for a scholarship to attend the International Field Biology Course.

Details

1. Date and schedule:
   10:00 a.m. November 17, 2022 (PCR test at Takeshiba ferry terminal in Hamamatsu-cho, Tokyo)
   November 18-23, 2022 (6 days trip)

   - At JR Hamamatsu-cho station in Tokyo at 10:00 a.m. on November 17 for PCR test
   - At Takeshiba ferry terminal in Hamamatsu-cho at 10:00 a.m. on November 18 for boarding
   - IFBC will break up in Takeshiba ferry terminal at approximately 15:30 on November 23.
     (There is a possibility that the arrival time of ship in Tokyo delays due to sea conditions.)

2. Accommodation and Station :
   Chichi-jima island (Research station of Tokyo Metropolitan University)

3. Site:
   The islands are in Pacific Ocean, 1,000km south of Tokyo. The climate is subtropical and the area of Chichi-jima island is 24km^2.

4. Financial support:
   DIWPA provides a scholarship to cover his/her expenses for accommodations and travel from Takeshiba ferry terminal in Hamamatsu-cho, Tokyo. Please cover the cost of the trip to/from Takeshiba by your own.

5. Application:

Applicants should be talented researchers/graduate students who belong to DIWPA or whose supervisor is the DIWPA member.

Applicants should prepare the following documents.

(1) CV
(2) Inform whether you need to stay at a hotel in Hamamatsu-cho (Tokyo) in the night on November 16, 2022. Note that you must take the PCR test at the ferry terminal in the morning on November 16. If not, your boarding will not be allowed.
(3) A statement of their interests in the field of ecology
(4) A recommendation letter written by the supervisor

6. Application submission and deadline:

Submit applications to DIWPA office by e-mail **before September 11, 2022**.
DIWPA Office : diwpa@ecology.kyoto-u.ac.jp

7. Others:

It takes 24 hours in one way between Tokyo and Chichi-jima island by ship. There is a restaurant in the ship, but you need to pay some money when you use it. Some researchers and students will use the accommodation together. A shower room and a kitchen are shared by the accommodation members. We are unable to guarantee 100% for sure to correspond his/her food restrictions or other matters for the religious reasons, though we would positively work on these matters as much as possible. Just before getting on the ship, your body temperature will be taken. If it is too high, you will not be allowed to board. Please be aware that this IFBC may be suddenly cancelled due to the situation of COVID-19 infections and typhoon or sea conditions. And your cancellation fee for a ferry will be charged if you call off your attendance at the IFBC at your convenience after October 31, 2022.

Only successful candidate(s) will receive the details by September 16, 2022 by e-mail.

If you have any question, please feel free to contact us.

DIWPA OFFICE

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