

LONG TERM EFFECTS OF AGENT ORANGE/ DIOXIN ON AQUATIC INVERTEBRATE FAUNA IN MA DA AREA, DONG NAI PROVINCE, SOUTHERN VIETNAM

Nguyen Xuan Quynh, Ngo Xuan Nam, Nguyen Quang Huy, Nguyen Thai Binh, Nguyen Thanh Son, Tran Anh Duc

Hanoi University of Science (Vietnam National University)

Abstract

Survey results show that in Ma Da (Dong Nai province, southern Vietnam), there are still certain areas with dioxin levels at 6.04-19.1ppt and TEQs value at 35.162ppt. Forty years ago, after the US Army widely sprayed Agent Orange in southern Vietnam, Ma Da forest was destroyed. Water bodies in this area were also strongly affected. Many aquatic invertebrates have vanished from this area. Hitherto, based on our extensive field surveys, only 163 aquatic invertebrate species have been found from this area so far, that is 22 species fewer than in Cat Tien National Park, the area was not affected by Agent Orange (with 185 species). The abundance of each species in Ma Da is also much lower than that in Cat Tien, reflecting in the Shannon – Weiner Index (H') calculated: from Ma Da stream was 0.918 and from Cat Tien stream was 3.408. Therefore, the overall aquatic invertebrate biodiversity of Ma Da is very low and much lower than that of Cat Tien National Park.

Introduction

During the Vietnam War, the US Army used more than 100,000 tons of chemical toxins on a total area of about 17 million hectares in southern Vietnam from 1961 until 1971³. Based on the data by Westing and other scientists in an international conference in Ho Chi Minh City in 1983, there was an estimated 170kg of dioxin had been sprayed in southern Vietnam, equivalent to an average concentration of 25pg of dioxin/ 1g of soil^{4,5,6}. Chemical war deployed by the US Army have serious consequences to Vietnamese civilians, not only with immediate, exterminating effects, but also with long term effects to the nature, ecological environment and Vietnamese people. Ma Da area (also known as “Vietnam Base D” or “Chien khu D” in Vietnamese) in Dong Nai province is one of the five areas received the most chemical toxins. Most forests in Ma Da were destroyed and nearly 40 years later they have yet been recovered.

Materials and methods

Samplings of aquatic invertebrates were carried out both quantitatively and qualitatively. Qualitative samplings of zooplankton were carried out with the help of plankton nets of size 57. In quantitative samplings of zooplankton, at each site, 10 litres of water were filtered through the plankton net. Quantitative benthic samplings were done with the help of the Peterson grab. Qualitative samplings of zoo-benthos were done mostly pond nets and hand nets with different techniques suitable for different habitats. For some benthic invertebrates that use bottom rocks or aquatic vegetation as shelters, “kick-sampling” and “sweeping” techniques were deployed using pond nets. Sometimes, bottom rocks were overturned for searching invertebrates hanging on these rocks. The Shannon-Weiner index (H') (Shannon-Weiner, 1949) was calculated to determine the biodiversity of aquatic invertebrates.

Results and Discussion

1. Existence of dioxin in soil and sediment in Ma Da area

Analyses of soil from the studied area by Do Quang Huy (2005) detected the existence of remaining dioxin at certain level. For example, from Bo Cai of Ma Da plantation area, dioxin was found at the concentration of 6.04ppt, and the TEQs value at 35.162ppt¹. The dioxin in soil from northern part of Ma Da was detected at even higher concentration, 19.1ppt and the TEQs value at 20.33ppt¹. At the moment, we are still taking and analyzing more soil and sediment samples from the area to update the status of dioxin existence in Ma Da area.

2. Effects of deforestation by chemical toxins to environmental conditions of water bodies

At the time when chemical toxins were sprayed by US airplanes, tree leaves were stripped down forcing trees to die, causing deforestation, especially in upstream areas. As a result of the removal of primary forests, shrubs, cogon grass (*Imperata cylindrica*) and mission grass (*Pennisetum polystachyon*) took over (Figs. 1, 2). The consequences were the exposure of forest soil to direct sunlight and rain, then severe erosion. The rain water was eroding the soil and sweeping chemical toxins in the soil to water bodies in the area. These water bodies had been already affected by chemical toxins directly sprayed from US airplanes. The appearance of these chemical toxins dramatically changed physical, chemical conditions of the aquatic environment, made them unfavorable for inhabiting aquatic organisms.



Figure 1. Vegetation affected by chemical toxins in Ma Da (photo by Nguyen Anh Duc)



Figure 2. A patch of mission grass (*Pennisetum polystachyon*)



Figure 3. A stream during rainy season



Figure 4. A stream during dry season

During dry seasons, because forests were no longer there to keep water, streams and some small water bodies even become dry out quickly, leaving only some small water pools in these streams. Therefore, the habitats for aquatic invertebrates were significantly reduced, forcing them to die or easily be eaten their predators. During rainy seasons, water level arising quickly, causing strong floods of murky water, sweeping many aquatic invertebrates away. All these conditions discussed above are disadvantageous for the existence and development of aquatic invertebrates (Figs. 3, 4).

3. Aquatic invertebrate fauna of the studied area

Hitherto, based on our extensive field surveys, only 163 aquatic invertebrate species have been found from Ma Da area so far (the area heavily affected by the Agent Orange). Whereas, in Cat Tien National Park (the area was not affected by Agent Orange), 185 aquatic invertebrate species have been found, that is 22 species more than in Ma Da area.

The abundance of each species in Ma Da is much lower than that in Cat Tien, reflecting in the Shannon – Weiner Index (H') calculated: from Ma Da stream was 0.918 (low) and from Cat Tien stream was 3.408 (relatively high). Therefore, the overall aquatic invertebrate biodiversity of Ma Da is very low and much lower than that of Cat Tien National Park. These findings suggest that environmental conditions in Ma Da are not as favorable for aquatic invertebrates as in Cat Tien National Park.

Conclusion

Almost 40 years after the last sprays of chemical toxins in southern Vietnam, including Ma Da area of Dong Nai province, the Ma Da forest has yet recovered or been recovering very slowly. It would take a very long time for the Ma Da forest to recover to almost the same as that in Cat Tien National Park. The diversity as well as the abundance of aquatic invertebrates in Ma Da area are much less than those in Cat Tien National Park. Among many reasons for such difference between the two areas, the most significant one could be the long term effects caused by chemical toxins used during the Vietnam War created by the USA.

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