Impact of COVID-19 Lockdown on the Ichthyoplankton community in and around Haldia Port-cum-Industrial complex

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Abstract

We observed a sharp dip in the oil and grease level around Haldia port-cum-industrial complex during our monitoring on 2nd April 2020, the period characterized by complete stoppage of industrial activities/operations and movement of vessels in the region due to COVID-19 lockdown. Simultaneously we observed relatively higher value of Shannon Weiner species diversity index for the ichthyoplankton community inhabiting the estuarine water. We therefore conclude that estuarine water is enriched with ichthyoplankton diversity during the lockdown phase. This may be due to better water quality and total banning of fish and prawn seed collection during the COVID-19 lockdown phase.

Keywords: Ichthyoplankton, Shannon Weiner species diversity index, Haldia port-cum-industrial complex, COVID-19, Lockdown

Introduction

Oil pollution is a burning issue in the domain of environmental science and ecology and is almost an inevitable consequence of the dependence on the increasingly growing oil-based technology. Oil pollution mostly results from oil spills due to accidents of ships and oil tankers. Oil and grease concentrations are not evenly distributed throughout the entire ocean surface; they are more heavily concentrated along the continental shelves in coastal areas and in regions of upwelling waters, the areas of high productivity (Ryther, 1969). In recent years, there has been increasing awareness of potentially harmful effects of world-wide spillage of oils in the marine and estuarine ecosystems. Oil water from refineries, chemical plants and offshore drillings may contain toxic and carcinogenic hydrocarbons such as benzenes, polynuclear aromatics, amines and phenols (Kawahara, 1969; Kawahara and Fiutem, 1983). The toxicity of various oils and oil products (Ottway, 1970) as well as the mode by which they interfere with marine ecosystem varies widely depending on their composition, ambient environmental variables and the biological state of organisms at the time of contamination. Different species and different stages of life cycle of the same species have been found to have different susceptibilities to pollution (Baker, 1970; Crapp, 1970).

In the estuarine region of the lower Gangetic delta the waterbody are mostly contaminated with oil mainly because of regular plying of large number of

fishing vessels and trawlers and also the release of oily wastes from refineries in the Haldia region. However, due to lockdown associated with COVID-19 pandemic, all the activities like operations of oil refinery, movements of oil tankers, ships, fishing vessels and trawlers have stopped due to which a dramatic change has taken place in the water quality and the ichthyoplankton community surviving in this aquatic phase.

The present study aims to determine the COVID-19 lockdown effect of oil and grease on the juveniles of finfish (ichthyoplankton) in and around the Haldia port-cum-industrial complex of the Hooghly estuary, 104 km downstream from the city of Kolkata.

Ichthyoplankton, being a major component of the planktonic community of the Hooghly estuarine complex, are passively floating and drifting in nature. The thin film of oil on the aquatic phase, may not only pose an adverse effect on them by reducing the concentrations of dissolved oxygen, but may also be lethal in extreme case. Hence, a study has been conducted on the oil/grease level and the ichthyoplankton community in the port area during April 2020, the period characterized with complete closure of industrial activities and aquatic transport systems due to COVID-19 lockdown and compare with the past data since 2011 so as to evaluate the effect of lockdown in the study area.

Materials and Methods

The entire network of the present programme consists of the sampling of surface water around Haldia oil jetties during April 2020 for analyzing the oil and grease level. The oil and grease present in the sampling water were extracted in petroleum ether and finally evaporated on a water bath to get the concentration in mg/L (also expressed as ppm) unit through weight difference method. Ichthyoplankton around oil jetties were also collected simultaneously during high tide by fixing nets in the intertidal mudflats for a span of 6 hrs. The collections were randomly mixed to achieve the uniformity of data and finally the number of finfish juveniles for every species from the 100 grams pooled sample was recorded. These data were then used to enumerate the species diversity index (Shannon and Weiner, 1949) for the ichthyoplankton community in and around the Haldia oil jetties using the standard expression:

$$\overline{H} = -\sum \frac{n}{N} \log_e \frac{n}{N}$$

where,

$\overline{H}$ = Shannon Weiner Species Diversity Index

n = No. of individuals per species

N = Total number of individuals of all species

The data obtained were compared with the past data since 2011 on similar abiotic and biotic parameters obtained from the cited works of previous researchers in the same region (Mitra, 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2016; Mitra, 2019).

Results and Discussion

Decadal picture of oil and grease levels along with ichthyoplankton community structure (represented through Shannon Weiner Species Diversity Index) shows significant change in the values during April, 2020 (Fig. 1 and 2), when compared with the previous data sets.

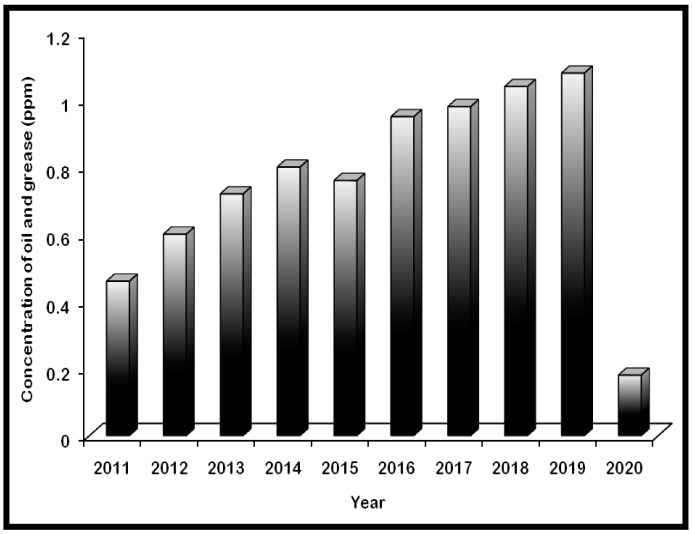

Fig. 1: Temporal variations of oil and grease level (ppm)

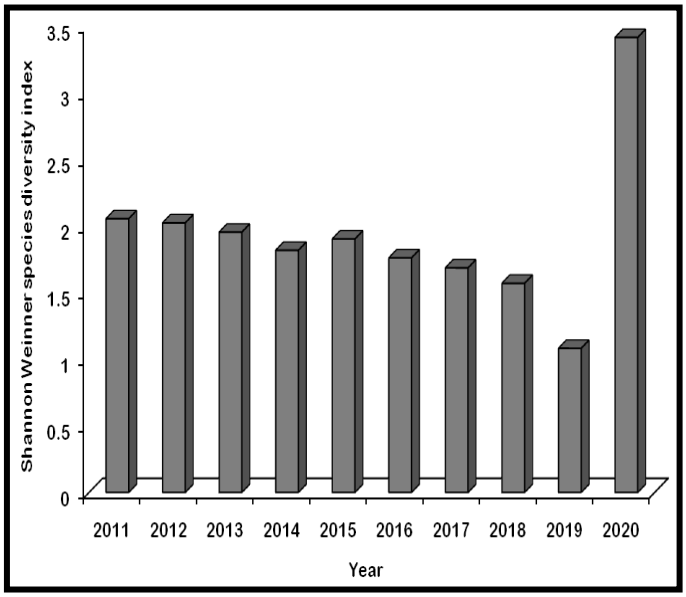

Fig. 2: Temporal variations of Shannon Weiner species diversity index of ichthyoplankton

In general, high concentrations of oil and grease level were recorded during 2011 to 2019 - the period characterized by regular and normal industrial activities and movement of fishing vessels, trawlers, oil tankers and ships along the estuaries of the maritime state of West Bengal. The high levels of oil and grease in the water bodies may be attributed to huge run off from the adjacent Haldia industrial belt. In fact, oil in the water bodies around Haldia port-cum-industrial complex, enters through several sources like tanker operations dry docking, marine terminals, refineries, municipal and industrial wastes, urban and river run off *etc*. The green belt channel adjacent to Indian Oil Corporation (IOC) also contributes appreciable amount of oil in the water bodies.

The Shannon Weiner species diversity index value for ichthyoplankton also showed strong temporal variability with relatively lower values during 2011 to 2019 and highest during 2020 (Fig. 2). This picture depicts two important findings namely (i) oil and grease level has adverse impact on the ichthyoplankton community of this mangrove dominated estuarine complex, and (ii) Lockdown effect associated with COVID-19 helped to eco-restore the situation in terms of biodiversity (more specifically ichthyoplankton diversity).

To sum up it can be stated that oil and grease level has a negative impact on the ichthyoplankton community of the estuary as revealed from the significant negative correlation value computed considering the data sets of 2011 to 2019 (r =-

0.9098; $p < 0.01$), and the aquatic health can be improved if proper treatment is carried out before releasing the oil in the ambient aquatic phase. The COVID-19 lockdown phase is a litmus test that confirms the adverse impact of pollutants (mostly released from point sources) on the planktonic community of the estuaries and coastal waterbody.

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