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Health Assessment of Water Quality of Madarsoo River (Golestan Province) Using multimetric Biological Index

Mohammad Gholizadeh[1*], Farzaneh Porhamidi[2]

1 Department of Fisheries, Faculty of Agriculture and Natural Resources, Gonbad Kavous University, Gonbad Kavous, Iran
2 Department of Biology, Faculty of Sciences, Gonbad Kavous University, Gonbad Kavous, Iran

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Abstract
The health of rivers can be altered, assessed in the ecological structure of aquatic invertebrates. The purpose of this assessment is the health of Madarsoo River using macroinvetebrate from 4 stations in 2018. 775 specimens of macroinvetebrate were identified from Madarsoo River, Golestan Province. The highest abundance belonged to the family Chironomidae (255, 32.9%), followed by Caenidae (178, 22.97%) and Baetidae (118, 15.23%). Autumn (48%) had the highest and winter (21%) the lowest abundance was observed in this river. The results of the studied indicators in comparison with the control (upstream, without human activities) show that the downstream stations (including agriculture and urban area) are in poor quality categories that need to be changed and planned to quickly reduce the destructive effects. The results showed that the use of bioindicators can provide a more accurate estimate of the health of aquatic ecosystems than costly and time-consuming studies. We conclude that Signal and EQR indices are suitable for assessing river health by macroinvetebrate.

Keywords: Biological index, Biological quality of water, Macroinvetebrate, Madarsoo River

* Corresponding author Email: Gholizade_Mohammad@yahoo.com

Extended abstract

Introduction

There are several ways to monitor macroinvetebrate communities as a biological indicator of river health. One of these methods is a comprehensive method in Australia, the SIGNAL Index (average level of the number of invertebrate streams, SIGNAL) that assesses the degree of susceptibility to contamination for all major species of invertebrates in Australia. Based on the species at each station, the high sensitivity of inanimate invertebrates is used to calculate the water quality rating of streams or other water bodies. Also, the use of the EQR index, which is a multi-criteria indicator, 18 ecological factors from macroinvetebrate, evaluates the ecology of the river. The EQR is the latest multi-criteria indicator for water ecological assessment, first used in the Vietnam River in 2015. This study was conducted with the aim of identifying the macroinvetebrate and also in order to evaluate the efficiency of multi-criteria indicators for determining the biological health of Madarsoo river water, in Golestan forest using macroinvetebrate in large quantities and EQR index.

Materials and Methods

This research was carried out in 2018 from three seasons of spring, autumn and winter (no sampling in summer due to reduced Dubai and in some parts of the river without water) in the upper part of the river of Golestan forest area to the end of the strait in four stations. Sampling was performed using a sampler (30 × 30 cm).

The Biological SIGNAL Index was set to assess water health in Australia. The index measures water quality from 1 (pollution-resistant) to 10 (pollution-sensitive) and gives each family a score between 0 and 10 based on its susceptibility to pollution. In the evaluation method, using a macroinvetebrate, many parameters and taxon richness are combined with the index of species resistant.

The Multi-Indicator Index (MMIF) describes the status of an ecosystem by several basic indices. Each of these variables offers a different combination of ecosystem quality and is evaluated in one indicator. Composite indices were first used for fish communities and later for other index groups such as the macroinvetebrate. The Ecological Quality Ratio Index (EQR) is one of the most recent multivariate indicators in 2014, which evaluates the ecological integrity of a river based on 18 macroinvetebrate ecological parameters.

Discussion of results

River in the Golestan forest area were sampled, identified and counted. The macroinvetebrate of the Madarsoo River is given in Table 5. The most common of the unidentified organisms were Chironomidae (255, 32.9%) and after Caenidae (178, 22.97%) and Baetidae (118, 15.23%) of the order Ephemeroptera. The most diverse groups identified were Diptera (37.5%) and Ephemeroptera (18.75%), respectively. The larvae of aquatic insects accounted for the largest population of invertebrates. Macroinvetebrate were available in all seasons, with only Decapoda (Station 1) and Physidae (Station 2) being observed in the fall. The highest frequency was recorded at station 1 (35%) and 2 (25%) and the lowest frequency was recorded at Station 4 (19%). The study of macroinvetebrate abundance in four stations from Madarsoo River among the study seasons showed that in autumn (48%) the highest abundance and in winter (21%), the lowest abundance in this river.

This river has the largest number of low quality water pollution stations. The results of the SIGNAL index show that most stations are on less pollution class and only Station 4 are on class b in all seasons. The highest value of this index was observed in station 1 (1.5) in spring and the lowest in Station 4 (3.1) in winter. The SIGNAL 2 index also showed that only the Station 1 in the study seasons is higher than 4 and is in the fourth a. However the value of the index in other stations is less than 4 and according to the number of species, this station is in a quarter b. The lowest value of SIGNAL 2 (3.11) was observed at Station 3 in winter.

The results of the MMIF composite index show that the ecological situation and the level of pollution in the mother river in the spring are in better condition. In general, 3 qualitative class (good, medium and bad) of this index were observed in Madarsoo River in 2018. Stations 1 and 2 were on the good class in the spring, Stations 1 and 2 were in the fall, and stations 1 were in the middle class during the winter, and the other stations were on the bad class. Station 1 was on the good quality class and Station 4 was on the bad quality class EQR. The highest value of this index is 0.9 in Station 1 and the lowest value is 0.24 of Station 4.

Conclusions

Higher average SIGNAL rating than Stations 1 and 2 compared to a lower score on Stations 3 and 4 indicates that more infected species such as Baetidae and Heptageniidae live in natural environments. This indicator suggests that susceptible species such as Trichoptera and Ephemeroptera can also live in areas exposed to relative organic pollution with suitable environmental conditions.

The EQR index describes Station 1 as a control station with good quality. Station 2 was also described as of good quality, with recent natural or human activity causing reversible changes at the station. Station 3 is of medium quality and that often human activities disrupt some of the ecological relationships of living societies. Station 4 is also on a poor quality floor, which needs to be rebuilt and planned to reduce the number of works immediately.

Nowadays, aquatic organisms are used as biological indices to assess the quality of ecological water. Therefore, we used multimetrices indicators, including MMI, to assess the water quality of the Madarsoo River. Unfortunately, based on the indicators studied, some stations are in poor quality. In particular, downstream stations are affected by human activities and land use change. These results are important for local river managers studied, as well as other rivers in northern Iran that are under the same land use stress. Monitoring and evaluation tools for water resources management are usually more effective if they are based on a clear understanding of the mechanisms that lead to the presence or absence of species in the environment. The results showed that the SIGNAL and EQR indicators are suitable for assessing river health by macroinvetebrate.