Artifical neural network: A case study of isapur water for diatoms (Bacillariophyceae)

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Abstract

Bacillariophyceae (Diatoms): The species of Cyclotella, Fargilaria, Mastigloia, Gyrosigma, Navicula. Pinnularia, Cymbella, Rhopalodia, Nitzschia and Surirella are found during investigation at all sites of study area. Diatoms showed luxuriant growth in winter and summer seasons. Water of Isapur is the home to a very rich biodiversity that constitute part of natural resources. However, over the past years, there has been an observed decline in aquatic biodiversity in most of water bodies. The phytoplankton has great significance in the biology of the creek as they provide the food for the organisms, especially for Zooplankton. The phytoplankton has a great significance in the biology of an estuary as they provide the food for other organisms, especially the zooplankton. Further, physicochemical factors of water are directly related to their production. The present investigation is an attempt to study the Phytoplankton community of Isapur dam water, the present dam is situated on the river, namely Upper Painganga and Lower Painganga. Also this dam is known as 'Isapur Dam'. This dam is administered by the 'Pusad' taluka. Nearby talukas are Kalamnuri, Pusad, Umarkhed and Hadgaon. During the study the total number of Phytoplankton was counted about 100 species were recorded. The Bacillariophyceae were found to be dominant throughout the study.

Keywords: Isapur dam, Bacillariophyceae, Phytoplankton

1. Introduction

Study of Phytoplankton carried out by Somani and Pejaver (2003), in Masunda Lake from April, 1999 to June, 2000. *Pediastrum sp.* was observed to be the consistent and dominant genera in clorococcales contributing to the peak of Chlorophyceae. It exhibitted high positive correlation with temperature, light penetration, dissolved oxygen and total alkalinity. *Scenedesmus sp.* and *Cosmarium sp.* were other dominating genera. The physicochemical characteristic of the aquatic ecosystem generally depends on the types, distribution of aquatic biota and their activities. Hence, the importance of the study of water quality is obvious. Sreenivasan has conducted extensive limnological investigations in south Indian waters. Data on dial cycle of various aboitic parameters of Ganjer Lake, Bikaner were collected and studied by Bahura (2001). He recorded a positive correlation between water temperature and dissolved oxygen. Electrical conductivity varied with the total dissolved solids. Nandan and Kumavat (2003) made an attempt to find out the relationship of algae communities and physico-chemical parameters of Aner dam of Maharashtra. Influence of temperature variation on the level of dissolved oxygen, free carbon-dioxide and pH in Takhat sagar lake, Jodhpur (Rajasthan) was recorded by Rawat and Jakher (2002). This dam is administered by the 'Pusad' taluka. Nearby talukas are Kalamnuri, Pusad, Umarkhed and Hadgaon. In the present study, an attempt has been made to quantify the present ecological status of the present dam is situated on the river, namely Upper Painganga and Lower Painganga. Also this dam is known as 'Isapur Dam'. A New method, called Artificial Neural Network (ANN) is introduced here. ANN is largely used in engineering field for classification, prediction and decision making problem. ANN is one of powerful method in Artificial Intelligence. Here, ANN is used to classify the quality of water in drinkable or non-drinkable status.

2. Artificial neural network: A brief introduction

Artificial neural systems function as distributed computing networks. Their most basic characteristic is their architecture. Only some networks provide instantaneous responses. Other networks need time to respond and are characterized by their time-domain behavior, which often referred to as dynamics. Neural network also differ from each other in their learning modes. There are varieties of learning rules that establish when and how the connecting weights change. Networks exhibit different speeds and efficiency of learning. As a result, they also differ in their ability to accurately respond to the cues presented at the input. The application of artificial neural networks to various decision-making, forecasting and classification problems has gained a lot of attention recently. ANN's are able to learn the relationship among past, present and future variables ANN always learns by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons.

Feed-forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straightforward networks that associate inputs with outputs. They are extensively used in pattern recognition. This type of organization is also referred to as bottom-up or top-down. Fig. 1, shows one such typical feed forward network. Feedback networks can have signals traveling in both directions by introducing loops in the network. Feedback architectures are also referred to as interactive or recurrent, although the latter term is often used to denote feedback connections in single-layer organizations.

In order to train a neural network to perform some task, we must adjust the weights of each unit in such a way that the error between the desired output and the actual output is reduced. This process requires that the neural network compute the error derivative of the weights (EW). In other words, it must calculate how the error changes as each weight is increased or decreased slightly. The back propagation algorithm is the most widely used method for determining the EW.

3. Material and methods

The present investigation is an attempt to study the Phytoplankton community of Isapur dam water, the present dam is situated on the river, namely Upper Painganga and Lower Painganga. Also this dam is known as 'Isapur Dam'. This dam is administered by the 'Pusad' taluka. Nearby talukas are Kalamnuri, Pusad, Umarkhed and Hadgaon. During rainy season, it is filled to its maximum capacity and excess water goes through waste weir, located on west shore of the reservoir. However, from last five years this lake has not achieved the high flood level. Five different spots were selected for water samplings. Monthly water samples were taken for continuous 18 months, starting from January - 2010 to June-2011. The water samples were taken from the lake usually in morning hours preferably between 9 am to 10 am with the help of Ruttners water sampler from a depth of 3 feet each time. Water temperature, pH, conductivity and dissolved oxygen were measured at the spot with the help of digital water analysis kit. Total dissolved solids, free CO_2, Phenolphthalein alkalinity, total alkalinity, total hardness, hardness as calcium carbonate, calcium hardness, magnesium contents, sulphate, phosphates, nitrates and chlorides were analyzed in the laboratory on the same day. BOD was estimated after 3 days of incubation. Similarly for the study of whole lake water, samples from all the five different spots were carefully mixed without bubbling for further analysis at field as well as in laboratory.

4. Results and Discussions

Artificial Neural Network has the ability to learn from the experience. Here, the experimental datasets is used to train the 6-20-20-16-feedforward neural network. Two hidden layers having twenty neurons each with input and output layer with 0.05 MSE provides better prediction capabilities. Here, adaptive learning is used to train the network.

Once the network weights and biases have been initialized, the network is ready for training. The network can be trained for function approximation pattern association, or pattern classification. The training process requires a set of examples of proper network behavior-network inputs p and target outputs. During training the weights and biases of the network are iteratively adjusted to minimize the network performance function net performance. The default performance function for feed forward networks is mean square error MSE - the average squared error between the networks outputs and the target outputs. The final weights obtained after the learning are generally called as permanent weights or memory. These are further used for prediction or classification of unknown data sets.

Fig. 1. Shows the 3-D plot for the experimental data set obtained for various algae present in the lake water. It can be observed that, the data set was non-linearly separable with each other and regression analysis to be carried out for obtaining the desired correlation is quite difficult. The ability of ANN can be observed.

Table 1 shows the comparison of measured and predicted values of physiochemical parameters and Bacillariophyceae for the Isapur water. The accuracy of predicted results can be improved by reducing the mean square error. It can be observed that actual and predicted values are in close resemblance with each other. The first six parameters in table are treated as inputs to neutral network after training. Weight calculations of each layer of neural network were calculated using Levenberg-Marquardt back propagation algorithm.
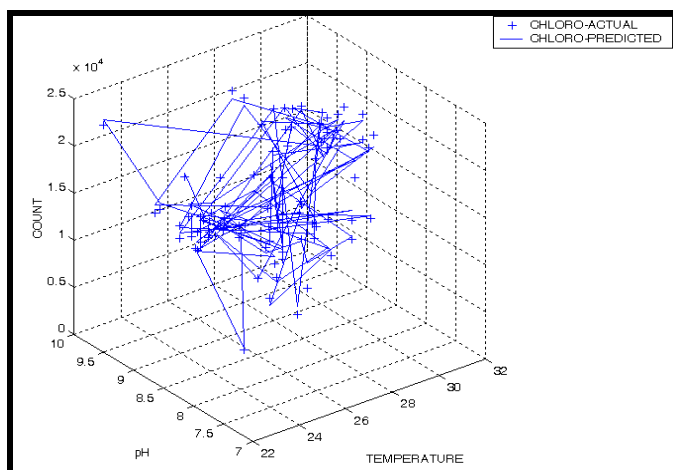
Fig 1: Actual measured experimental data sets and predicted count of Bacillariophyceae using ANN in 3-D space

Table 1: Comparative table for Measured and Predicted values physiochemical parameters and phytoplankton

Parameters	Actual	Predicted by ANN	% Error
WT	24.46	-	-
Ph	7.4	-	-
Cond	93.2	-	-
DO	5.2	-	-
Free Co2	1.28	-	-
P.Alk	26.5	-	-
TDS	384.4	395.58	-2.90
T.Alk	184.8	188.7	-2.14
T.Hard	193.6	217.81	-12.50
CaCO3	148.4	148.58	-0.79
Ca++	59.64	59.99	-0.58
Mg++	32.54	35.65	-9.53
Cl++	15.39	13.75	10.65
Sulphate	0.141	0.16	-1.02
Phosphate	0.127	0.164	-29.76
Nitrate	0.39	0.48	-23.28
BOD	10.25	12.09	-18.03
Chloro	16740	23312	-39.25

5. Conclusions

Artificial Neural network has the ability to carry out the regression analysis quite accurately. In this paper design of feed forward neural network is provided, which predicts the water parameters and Bacillariophyceae present in the water samples from the previous historical data sets. To predict the parameters only six easily measurable parameters are used.

6. References

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