Calculation of Length of A Fish Using Two-Dimensional Geometry

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ABSTRACT   *Length of the fish could also be determined with the help of two-dimensional geometry without handling the fish and also without the aid of a metre scale as in usual practice. In this method, X and Y axes are considered as the length and the maximum depth the water body respectively. Locating (X1, Y1) and (X2, Y2) as the coordinates of the two ends (tip of the snout and end of the caudal fin) of a fish, we could obtain the total length (TL) of the fish. Application of Pythagoras theorem and the modus operandi of these operations have been discussed in the present communication.*

Introduction

Mathematics is essential in determining various dimensions of physical and biological entities. And, geometry, as an integral component of mathematics, helps to ascertain multidimensional measurements of different entities. Various postulates in geometry provides tangible solutions to many physical and biological queries. Pythagoras theorem is a unique tool in determining various types of lengths using distance formula in association with coordinate geometry and trigonometry. Lengths of certain living beings, notably fishes, is difficult to measure in live condition, lest the fish may suffer injuries or may die due to long handling. In order to overcome this difficulty, length of a fish may be determined by two-dimensional geometry, in which, by plotting the X-distance (two ends of the fish body) and Y-distance (maximum depth of the water body). The present communication is a pioneering attempt in t this direction.

Materials and Methods

Let X axis be denoted by the length of the water body and the Y axis is denoted by the maximum depth of the water body. This is mutually perpendicular to the length of the water body. This 2 axis meet at a point which is taken as the origin of reference. The coordinates of this origin is (0, 0). The counting starts from the origin. Let us suppose that the particular species lie on any quadrant at a depth of Y1 towards Y axis, and X1 be the distance from the origin towards X axis. Which is equivalent to OM of the given figure below, and X2 be the distance measured from the origin towards X axis, equivalent to ON of the given figure. Then the length of the species may be found using the formula:

$$PQ = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2}$$

Where P is having the coordinate (X_1, Y_1) and Q is having the coordinate (X_2, Y_2).

- If $Y_1 < Y_2$, than the length of the species can also be found out by using the same formula.
- If $Y_1 > Y_2$, than also the length of species can also be found out using the same formula.
- The length of the fish remains unchanged if the position of the fish is kept inclined.
- The length of the fish could be obtained by maintaining the same depth.

The above mentioned distance formula is applicable in the following cases:

- $X_1 < X_2$ and $Y_1 = Y_2$
- $X_1 < X_2$ and $Y_1 < Y_2$
- $X_1 > X_2$ and $Y_1 > Y_2$

The essential feature of this methodology is ascertaining the length of the fish considering the X and Y values.

This method enables measurements of length of fish without disturbing the biodiversity and the habitat of the fish. It is a biodiversity friendly.

Hence the length of the fish is also be determined with the help of two-dimensional without touching the fish and also without using the meter scale as usual practice.

Sl. No.	Species	X1	X2	Y1	Y2	PQ
1	Labeo calbasu	4	4.6	5	5/5.01	10/60
2	Cyprinus carpio	10	10.5	5	5/5.01	50/50
3	Salomostoma bacaila	1	1.2	0.5	0.5/0.51	20/20
4	Guduisa chapra	0.5	0.6	0.5	0.5/0.51	10/10
5	Botia dario	6	6.1	2	2/2.1	10/10
6	Lepidocephalus guntea	6	6.05	2	2/2.01	5/5
7	Mystus tengara	6	6.05	1.5	1.5/1.51	5/5
8	Sprata sengala	3	3.5	3	3/3.4	50/65
9	Wallogo attu	4	5	2	2/2.5	100/119
10	Ompok bimaculatus	5	5.15	2	2/2.01	15/15
11	Eutropicthys vacha	5	5.15	1.5	1.5/1.7	15/25
12	Asparidio morar	5	5.10	1.5	1.5/1.51	10/10
13	Bagarius bagarius	10	11	5	5.5/5.51	100/119
14	Colisha fasciatus	6	6.05	1.5	1.5/1.51	5/5
15	Anabus testudineus	5	5.05	1	1.1/1.01	5/5
16	Clarius batrachus	7	7.20	1	1/1.2	20/28
17	Tetradonton cutcutia	3	3.03	0.5	0.5/0.52	3/3.6
18	Labeo rohita	3.5	4.3	5	5/5.01	80/90
19	Puntius ticto	5	5.002	2	2/2/01	2/3
20	Amblyphorongodon mola	4.5	4.54	2.5	2.5/2.6	4/5.5

**Table: Study of morphmetric parameters of a fish using two-dimensional geometry.**

Results and Discussion

The present study provides information regarding the length of different fishes based on geometrical concepts. The data have been extrapolated from coordinates of the two ends of a fish. The data have been fed into Excel Programme of MS Office 2010 and the calculation had been done based on distance formula. The distance (length) have been calculated by substituting the values of $X_1 Y_1$ and $X_2 Y_2$ The study indicated that in the case of *Cyprinus carpio,* by changing the values of Y_2 and keeping the other

values same, the distance, thus obtained, remained unchanged. Similar results were also obtained in the case of other fishes, notably, *Botia dario, Gudusia chapra, Lepidocephalichthys guntea, Mystus vittatus, Ompok bimaculatus, Ailia coila, Trichogaster fasciata, Anabas testudineus,* etc. In this study, the maximum length obtained was 119 cm while the minimum length obtained was 3 cm. However, in most of the cases, the length was found to be multiples of 5. The length of the following fishes were found to be different by changing the values of Y_2 , such as, *Labeo rohita, Labeo calbasu, Wallago attu, Bagarius bagarious, Clarias batrachus, Sperata seenghala.* Thus, there is flexibility of easy handling of large number of data in this method.
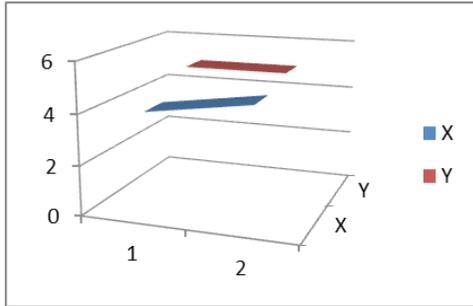
Labeo calbasu
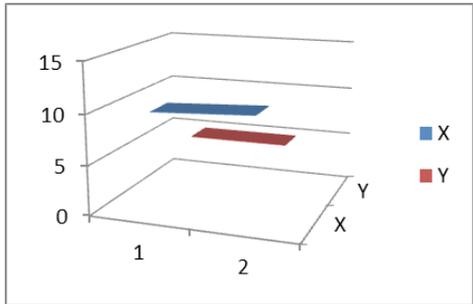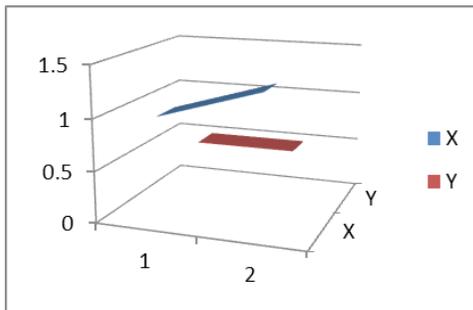
Botia Dario

Cyprinus carpio

Lepidocephalus guntea

Salomostoma bacaila
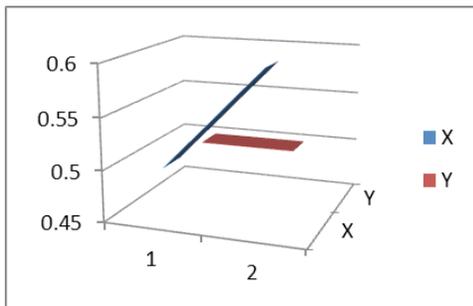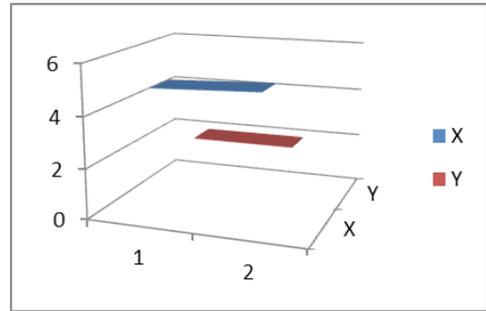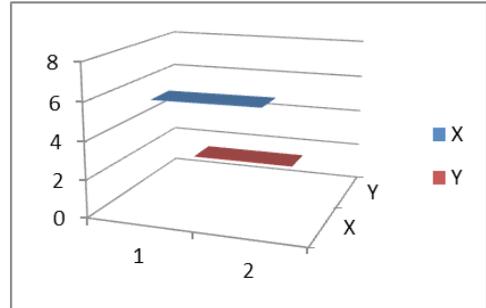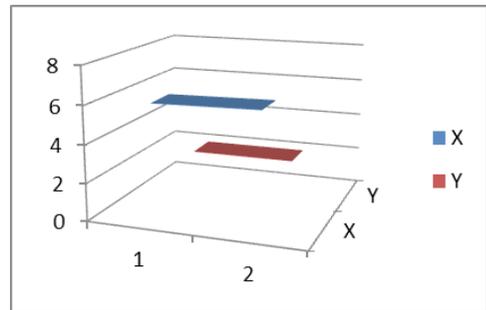
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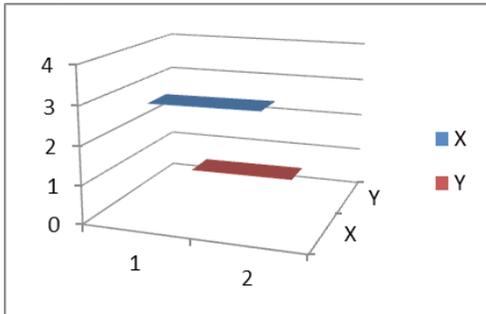

Guduisa chapra
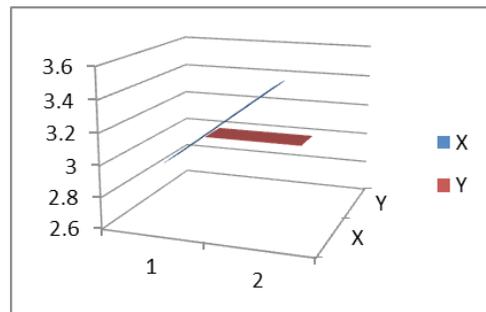
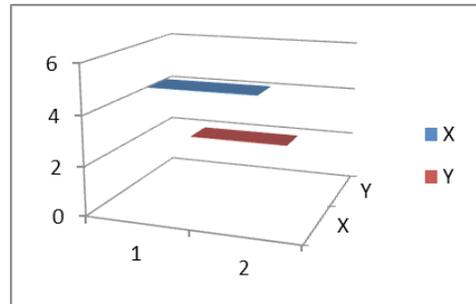**Seprata sengala**
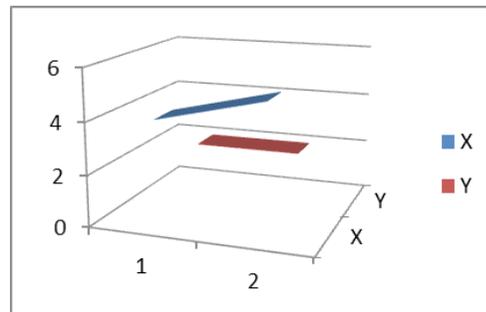
Wallogo attu
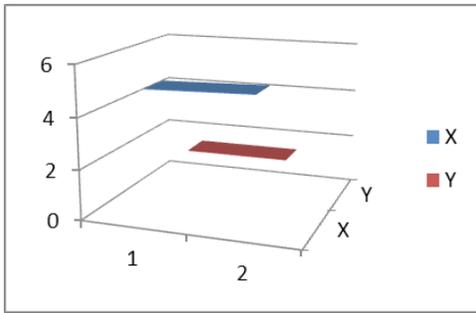
Ompok bimaculatus
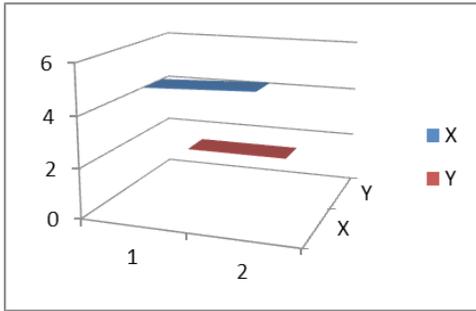
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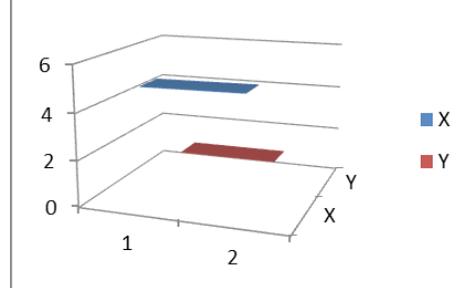
Eutropicthys vacha

Clarius batrachus

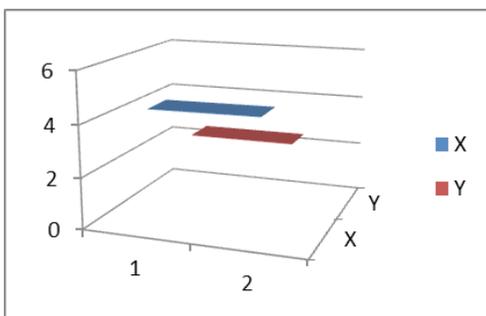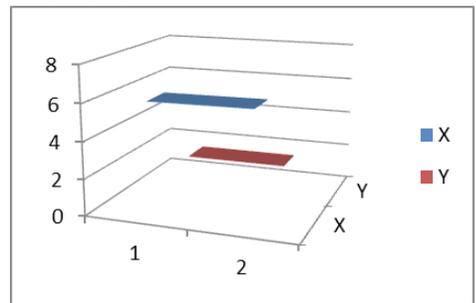**Asparidio morar**
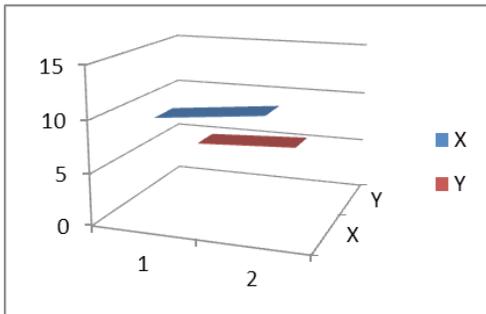
Tetradonton cutcutia
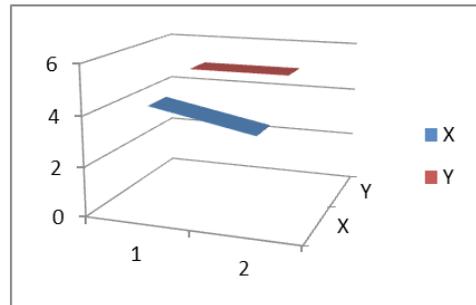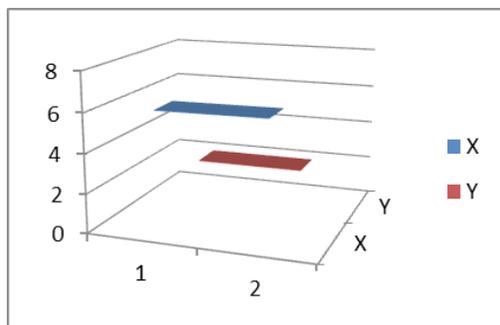

Bagarius bagarius

Labeo rohita

Colisha fasciatus

Puntius ticto

Amblyphorongodon mola

Figure: The Graphical Representation of X and Y value of different Fish Species with respective to their location

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