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Intra fish species association may be an asymptotic distribution

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Abstract

Species association is entertained in recent time using the logic of association rule-mining technique of data mining and found that the intra fish species association may follow an asymptotic distribution. As in fisheries, it has been found that intra species association remained very cohesive at the early stages of fish life cycle. Fishes have a huge number of offspring in the natural open water system. Each species has an initial association with lots of individuals, at this stage. Found most among the vertebrate and some even other non-vertebrate animals. Negative change in association in terms of individual fish with increasing fish age may prevail. The same association is highly dispersive when the species become aged. Association of such intra species distribution is a true asymptotic, $Y=aX^b$, specifically $Y=575.4 * X^{-0.8041}$, $R^2 = 0.8$, when we plot them in co ordinates X axis as Fish number and Y axis as fish age in days. This type of model association may form due to their biological reasons. Practical utility of this derivation, however, may remain in predicting fish catch in open water natural system per single effort. This present communication is made based on a derivation of intra species association model of species *Puntius*.

Keywords: Intra species association, open water natural ecosystem, Data-mining technique, Asymptotic distribution, Species association model.

1. Introduction

Intra species association is a study of fish behavior 'shoaling' at initial stages or 'intra species association' in life span, in natural fisheries is the matter of research since long to get more catch per single effort. In this research communication, a quantification of intra species association is attempted in *Puntius spp.* (3 species) namely, *P. conchonius*, *P. ticto*, *P. vittatus* and found an asymptotic equation like $Y=aX^b$, a natural rule, when Y denotes number of fish in of same species and X in fish age in days a,b are numeric constant. The similar trend could be found in other species as well. The study is performed based on fish biology and association rules into a model equation. Natural fisheries are an interesting subject for the mathematician and biologists and here is scope to find association rules within species. We are getting less fish behavioral information in culture based fisheries. As in cultured based system true intra species fish association may not be possible to study. There are still many species whose breeding is not yet practiced most *Puntius spp* is such a fish. Natural breeding of this species may take place in Reservoir, Oxbow lakes, Beel waters and Rivers. The communication derived in this article is based on observation and data capture in small reservoir. In limited situation, simulated assumption is made to derive data and to find the desired equation. Association pattern may remain similar or differs slightly in other water bodies as mentioned. The same authors (*Das et al.* 2006, *Das* and *Bandyopadhyay*, 2010) ^[1, 2] has communicated informatics on *Puntius* species and an updated *Puntius* database in Indian region. The present communication may be inductive to other species as well.

2. Materials and Method

Data is analyzed in MS Excel and asymptotic model equation (Fig. 1) is presented. Asymptotic equation, become a unique distribution for all the different fish species. For an example in case of any *Puntius spp* Such equation can be referred as $Y = 575.4X^{-0.8041}$, $R^2 = 0.8$.

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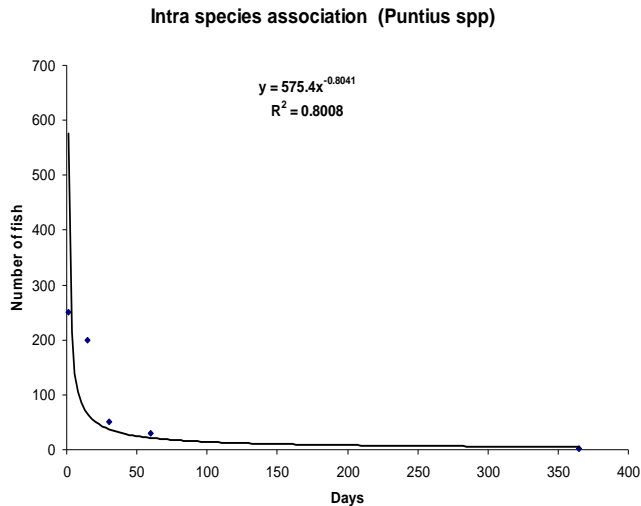


Fig 1: Asymptotic distribution as an intra species association model of *Puntius spp.*

In mathematical analysis, asymptotic analysis is a method of describing limiting behavior. The methodology has applications across science. This may be an application in computer science in analyzing algorithms, considering the performance of algorithms even in fisheries, applied to very large input data. The behavior of actual system when they are very large water body in accident analysis when identifying the causation of crash through count modeling with large visual and approximated data.

3. Results and Discussion

In fish biology, any group of fish that may stay together for social reasons are shoaling and if the group is swimming in the same direction in a coordinated manner, may termed as schooling. In common usage, the terms are commonly used. About one quarter of fishes shoal all their lives mostly at the initial stage of their life, and about one half of fishes shoal for part of their lives. Fish derive benefits from shoaling behavior, including defense against, enhanced foraging success, and higher success in finding a mate, may not be only for sex. It is also likely that fish benefit from shoal membership through increased hydrodynamic efficiency also. Fish use many traits to choose shoal mates. Generally they prefer larger shoals, shoal mates of their own species, shoal mates similar in size and appearance to themselves, healthy fish, and kin on meeting and recognized.

Fish can be obligate or facultative shoal. Sometimes immense gatherings fuel the ocean food web. Most forage fish are pelagic fish, which means they form their schools in open water, and not on or near the bottom water fish, demersal fish. Forage fish are short-lived, and go mostly unnoticed by humans, apart from an occasional support role in a documentary about a great predator. The predators are keenly focused on the shoals, acutely aware of their numbers and whereabouts, and make migrations themselves, often in schools of their own, they may span miles to connect with, or stay connected with them—Shoaling behavior is generally described as a trade-off between the anti-predator benefits of living in groups and the costs of increased foraging competition. The cumulative advantages of shoaling, as elaborated below, are strong selective inducements for fish to join shoals. Schooling of fish may be a classic example of emergence, where there are properties that are possessed by the school but not by the individual fish.

Asymptotic equation is a modeling approach based on data and intuition of fish study. All logics behind getting a relation is fish biology and some extent their water environments. Fecundity, conversion of egg to fry and mortality may little vary with the environments. However, equation trend may provide information and help in developing this type of model. However precision of model will be better when we may apply more samplings.

4. Conclusions

The study of intra species association, derived through a data-mining technique in open water natural system is due to the following fish biological reasons as well as human interests.

- Association behaviors
- Fish interactions in stochastic approach
- Reproductive advantages
- Hydrodynamic efficiency
- Predator avoidance
- Describing shoal structure
- Mapping the formation of schools
- Commercial fishing

Every other inland fish species might have a similar pattern of intra species association. This feature of association may be due to biological reasons and predatory fishes and trend may be cyclic over the time span. As stated, this has some applications like how many fish a fisherman can catch in a single effort. This may be obvious fish behaviour for all the species and may similar to this asymptotic distribution, always.

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