International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

International Journal of Fauna And Biological Studies

ISSN 2347-2677
www.faunajournal.com
IJFBS 2017; 4(3): 139-142
Received: 28-03-2017
Accepted: 30-04-2017

Radha Rajanee
Department of Zoology
L.N.M.U Darbhanga, Bihar, India

Corresponding Author:
Radha Rajanee
Department of Zoology
L.N.M.U Darbhanga, Bihar, India

Role of water temperature and water quality on reproductive performance of fishes

Radha Rajanee

DOI: https://doi.org/10.22271/23940522.2020.v7.i6a.773

Abstract
Fish regulate body temperature because of the optimal temperature that they need to survive. Every species has an optimal temperature range at which they can be active, grow, reproduce, and metabolize. Water temperature and water quality plays a significant role in the reproductive processes of temperate fishes. Based on our present experiments, it was concluded that 20-32 degree centigrade was optimal breeding temperature for fishes and water temperature higher than this will reduce rate of reproduction. Seasonal change in temperature has a profound effect on reproduction in fish. All freshwater fishes are ectoderms that can not regulate their body temperature through physiological means and whose body temperature are identical to, or very close to the environmental temperature at their specific location. These fishes do thermo regulate behaviorally moving between thermally heterogeneous microhabitats to select most advantageous temperature for their current physiological state. However unlike physiological thermoregulation behaviour thermo regulation is constrained by the range are temperatures available in the environment. Because biochemical reaction rates are largely a function of body temperature, all aspects of an individual fish's physiology including growth, reproduction and activity are directly influenced by changes in temperature. Biochemical and physiological reactions that happen can be quantified by the Q10, a dimensionless number that measures the magnitude of the rate change over a 10 degree centigrade range. Global warming will affect individual fish by altering physiological functions such as thermal tolerance, growth, metabolism, food consumption, reproductive success, and the ability to maintained internal homeostasis in the face of a variable external environment. Like water temperature water quality is very important fish reproduction as poor quality water can effect the health, reproduction and growth of the fish. It is important that we have to pay attention to the water's chemical and physical factors.

Keywords: water temperature, fish reproduction, water quality, sex ratio

Introduction
Fresh water is an invaluable as well as a finite natural resources to mans varied activities like other water bodies, streams and rivers as we as ponds are specialized habitats of plants and animals, ecosystems are particularly sensitive to change induced basically by mans activities in water balance, in water chemistry and in habitats. Water temperature is one of the main variable in freshwater system because of its widespread effects on the life history, physiology, and behavior of most fresh water organisms including fishes. Freshwater fishes are poikilothermic or cold-blooded and realy on behavioral thermoregulation to modify their internal body temperature. Their ability to behaviorally thermoregulations is constrained by the thermal heterogecity of their immediate environment, because their body temperature will match the temperature of the water they currently occupy. Another main variable in fresh water system is hydrology. As with temperature, freshwater organisms have evolved to survive under a specific set of hydrology condition that help to define and shape their habitats. While temperature can have effects at all levels of organization from the individual to the ecosystem, hydrology tends to act the broader level. The health and subsequent growth and reproduction of fish are directly related to the quality of water in which fish are raised. Water temperature is one of the most important physical factors affecting fish reproduction. Fish are cold blooded animal which assume approximately the same temperature as their surrounding. Fish reproduction is to be affected by increasing water temperature arising from climate change. Normal Changes in environmental temperature have the capacity to affect endocrine function and either advance or retard gametogenesis and maturation, but above normal temperature

have deleterious effects on reproduction process. Water temperature plays a significant role in the reproductive processes of temperate fishes. Based on our present experiments, it was concluded that 20-32 degree centigrade was optimal breeding temperature for fishes and water temperature higher than this will reduce rate of reproduction. Seasonal change in temperature has a profound effect on reproduction in fish. Increasing temperatures cue reproductive development in spring-spawning species, and falling temperatures stimulate reproduction in autumn-spawners. Elevated temperatures truncate spring spawning, and delay autumn spawning. Increased temperature affects fat synthesis, metabolism, and the endocrine system of fish which results in the failure of the generative process. Effects of cooling water discharge on gametogenesis have been observed in some fishes for example cyprinid. Gametogenesis has been observed to be accelerated by cooling water discharges, especially in females. In our present study we analyse the main objective like the effect of temperature anomalies of fish reproduction. Further this study we found that water temperature has inverse effect on reproduction process of fishes. Water temperature above optimum range will reduce and slow down the reproduction process. For fishes breeding, there is an optimal temperature range. Warm temperature plays a primary role in stimulating the maturation of gonads in many fishes. Temperature has a direct effect on gonads, regulating their ability to respond to pituitary stimulation and effects on primary synthesis and release of gonadotropins. Temperature increases will affect reproduction, but the nature of these effects will depend on the period and amplitude of the increase and range from phase shifting of spawning to complete inhibition of reproduction. This latter effect will be most marked in species that are constrained in their capacity to shift geographic range. Studies from a range of taxa, habitats and temperature ranges all show inhibitory effects of elevated temperature albeit about different environmental set points. The effects are generated through the endocrine system, particularly through the inhibition of ovarian oestrogen production. Larval fishes are usually more sensitive than adults to environmental fluctuations, and might be especially vulnerable to climate change. In addition to direct effects on embryonic duration and egg survival, temperature also influences size at hatching, developmental rate, pelagic larval duration and survival. A companion effect of marine climate change is ocean acidification, which may pose a significant threat through its capacity to alter larval behaviour and impair sensory capabilities. This in turn impacts on population replenishment and connectivity patterns of marine fishes. Also Climate change will, or is already, affecting reproductive and early life history events of most fishes. This is occurring at a variety of levels and through a range of mechanisms which as our understanding develops are emerging as increasingly complex. These include the interplay of changes in physical variables with habitat, when in the reproductive cycle the thermal challenge occurs, the timing of spawning, whether events are extreme enough to initiate a physiological stress response, the energy status and reproductive age of the fish, and the thermal exposure history and adaptive capacity of the individual or the population. Fish regulate body temperature because of the optimal temperature that they need to survive. Every species has an optimal temperature range at which they can be active, grow, reproduce, and metabolize. Individuals often cannot support life and/or reproduce outside of this optimal temperature range. For some organisms, their optimal temperature range can be as narrow as a few degrees or as large as 20º C. A change in water temperature of only 2º C has been shown to stimulate the metabolism, appetite, and growth of some stream fish by 30-60%. When temperature changes are substantial, fish have been shown to move from areas of warmer water to colder water to avoid thermal stress. While lake fish may have cooler, deeper water to go to escape increased water temperature, fish in shallower lakes and streams often lack cooler refuge options. Air temperature is often used to discuss climate change, while water temperature represents a more sensitive indicator of climatic change. The primary determinate of river water temperature in temperate regions is seasonal variations in air temperature, though hydrological factors play a role as well. Several studies have found that water temperatures are increasing, such as the St. Lawrence River in Quebec, Canada, that was found to have increased by 1.3º C since 1960. Other surface waters have also warmed, such as Lake Superior (0.1º C/year, July-September, 1980-2005, Austin and Colman, 2008) and Lake Ontario (0.096º C/year, July-September, 1980-2006, Malkin *et al*., 2008). Climate-change models generally agree that air temperatures will likely continue to increase in the future. Water temperatures will increase as a result of this air temperature increase and potentially result in increased hydrological variability. In some cases, increasing temperature may be favorable for reproduction and recruitment of some species; as thermal constraints that may have limited them in the past are removed. Rising water temperatures have been shown to result in a sharp increase in the rate of egg development, hatching success, and survival of swim-up larvae for Northern pike. Water quality also can quickly decline in fish ponds as fish use the water to live, feed, reproduce, grow and excrete waste into. Fish farmers who wish to be successful should therefore understand the quality of their water, the needs of the fish and how to manage water quality factors. Water shoul have proper oxygen, Carbon Dioxide, Nitrogen, Ammonia and pH. The acceptable range for fish culture is normally between pH 6.5-9.0.

Materials and Method

Scholar has studied the effect of water temperature and aquatic variation on the fishes of study area Darbhanga and most of obersation and result are made in their natural habitat. However, for study of effect of temperature and aquatic variations in captivity some experiments were also performed on rainbow scop yellow perch at zoology lab of college L.N.M.U, Darbhanga. For study the effect of raised temperature and aquatic variation on fish reproduction in the various fish species of the study area, seasonal samplings were done from various study plots. Various sampling methods or fishing gears like cast net, scoop net, gill net and a circular net were used. Counts was done fortnightly from 24 different fixed stations covering an area of one meter square in the study plots and the fish population was estimated separately for both fragile ecosystem habitat (F) and natural habitats (NH) and expressed in average. A number of studies were carried out on the fish fauna of various protected areas in Darbhanga. Here we have done studied the species wise distribution of fishes. The scholar found 40 species from Darbhanga region. The most dominant family was Cyprinidae with 26 species. Scholar made a review of fresh water fishes from Bihar. A total of 146 species belonging to 10 orders, 27

families and 61 genera were recorded so far from it same regions of Darbhanga. This includes 24 species of fishes of which 19 were reported from Southern and 05 from Northern of study field. Different species of fishes, which were studied, including carps, catfishes, murrels, and other species. Ripening or ripe ovaries were then taken from the main breeding months of fishes and cut into small portions and fixed in Bouin's fluid. On hardening, they were opened in glass dishes and the oocytes carefully separated from the adhering tissues. All the oocytes which was obtained were measured under a micro meter eye-piece. In which species where the ovary was very large, only a portion was taken for the oocyte measurements. Generaly three to four average sized individuals of each species were selected for the oocyte study and from these fishes a typical condition was laid down on the basis of its predominance to illustrate the distribution of oocytes in that species. In each individual roughly 50 to 100 eggs were measured but when temperature of water increased or decreased then number of egg will reduce. The degree of maturity of gonads in various species was determined according to the arbitrary scheme used for B. pholis and C. gunnel/us. In all, five maturity stages were defined as follows:-

1. Immature virgins – Ovaries thin and like, eggs microscopic.
2. Mature virgins and recovery spent – Ovaries swollen and containing eggs just visible to the naked eye.
3. Ripening - Ovaries enlarged and containing con-specious opaque eggs.
4. Ripe – Ovaries distended and containing large translucent eggs.
5. Spent – Ovaries collapsed with no eggs seen by the naked eye. In some cases a few residual eggs present.

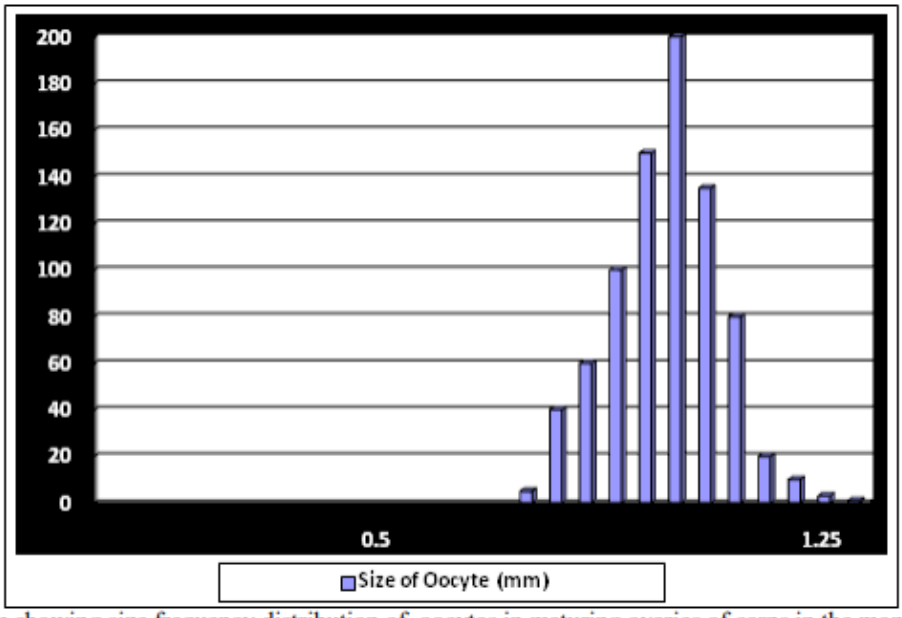

Figure: Histogram showing size frequency distribution of oocytes in maturing ovaries of carps in the month of July-August

stage of oocyte of fishes namely *Labeo rohita*, *Labeo calbasu* and *Cirrhina mrigaia* collected from its natural habitat of kosi region. The oocyte of collected specimen were observed and are counted based on the stage of maturity. The observation was presented in table below:

Table

Month 2011	Average Temperature Range°C	Type of oocyte found (%)				
		Immature	Maturing	Ripening	Ripe	Spent
Jan	5-20	48	35	02	0	15
Feb	10-28	38	37	05	0	20
Mar	15-36	30	40	19	0	11
Apr	18-40	27	42	24	02	05
May	22-42	20	48	26	06	0
Jun	24-46	11	34	43	12	0
Jul	25-35	02	08	29	58	03
Aug	22-34	01	01	05	83	10
Sep	20-36	02	02	08	15	73
Oct	18-35	01	01	03	06	89
Nov	15-33	32	02	01	03	62
Dec	10-30	53	08	01	01	37

Result & Discussion

Normally, fish are classified broadly as cold, cool, or warm water, depending on their tolerance for particular temperature ranges. Within each temperature classification, fish survival is bounded by an upper and lower water temperature, between which an optimum temperature range for reproduction exists. When temperatures vary outside the optimum range, reproduction decreased and in some cases, mortalities may result, depending on the magnitude of the deviation from the optimum temperature. Not only the organism survival, but growth and reproduction of each organism have critical temperature ranges. Each organism must be favored by the proper temperature if the individual or its population is going to survive. For instance, temperature influences enzymatic reactions through hormonal and nervous control to digestion, from respiration and osmoregulation to all aspects of an organism's performance and behavior. High and low temperatures that are lethal to individual organism of a species determines the distribution and abundance it's populations. The health, growth and reproduction of fish are directly related to the quality of water and temperature in which the fish are raised. Water quality and temperature is most important physical factors affecting fish reproduction and growth. The proportion of fish breeding within each temperature treatment declined with increasing temperatures and increasing PH of water. Increased water temperatures can stimulate the decomposition of sludge, formation of sludge gas, multiplication of saprophytic bacteria and fungi and in the consumption of oxygen by decomposition processes thus affecting the aesthetic value of a water resource. On the other hand, increasing temperatures may be beneficial to recreation by lengthening the swimming season. Also fish reproduce and grow well when water pH is in between 6.5-9.0.

Conclusion

Temperature is a fundamental physical regulatory factor in the lives of fishes and this effect is expressed particularly strongly in the control of all reproductive processes development and its survival. That water temperature has inverse effect on reprouctiom processes of fishes. The Water temperature above optimum range will slow the reproduction process. There is an optimal temperature range for breeding of fishes. Critical water temperature limits exist, above and below which fish will not reproduce. All fishes breed very well under optimum temperature ranging between 20℃ to 32℃ and water pH is in between 6.5-9.0. From January Month onward the atmospheric temperature shows a regular rise reaching its maximum in mid-Month of June. In these months we can see a greater range of variation in the maximum and minimum temperatures. Fishes of Darbhanga region for example the species Labeo rohita, Catla catla, and Cirrhina mrigala, are known to breed only once a year during the monsoon season.

References

1. Billard R, Breton B, Fostier A, Jalabert B, Weli C. Endocrine control of the teleost reproductive cycle and its relation to external factors: salmonid and cyprinid models. In: Comparative Endocrinology, 1978, 37-48
2. Burrough RJ, Kennedy CR. The occurrence and natural alleviation of stunting in a population of roach, Rutilsrutilus (L.) J Fish Biol 1979;15:93-109
3. Wootton RJ. Energy costs of egg-production and environment determinants of fecundity in teleost fishes. Symp. Zool. Soc. Lond 1979;44:133-159
4. Johnston CE, Gray RW, McLennan A, Paterson A. Effects of photoperiod, temperature and diet on the reconditioning response, blood chemistry and gonad maturation of Atlantic salmon kelts (*Salmosalar*) held in freshwater. Canadian Journal of Fisheries and Aquatic Sciences 1987;44:702-711
5. Medford BA, Mackay WC. Protein and lipid content of gonads, liver and muscle of Northern pike (*Esox Lucius)* in relation to gonad growth. J Fish. Res. Bd Can 1978;35:213-219.
6. Bhashkar H, Gurdarshan Singh. An Introduction to Fishes.
7. Punkhurst NW, Philip Munday L. Effect of climate change on fish reproduction. Marine and Fresh Water Research, 2011.
8. Dalia Luks Iene, Henrik Svedang. A review on fish reproduction with special reference to temperature anomalies, 1997.
9. Yang Gao, Sun Gyu kim, Lee JY. Effect of pH on Fertilization and hatching rates of fishes, 2011.
10. Prasad B, Pila. The Indian Zoological Memories, 1932, 4.
11. Roy SP. Secondary productivity of fresh water ecosystem in: Advances in fish research 2003;3:99-108. (eds) J.S. Datta munshi, J Ojha, T.K. Ghosh, Narendra Publishing House Delhi