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REPRODUCTIVE POTENTIAL OF FISH AND IMPACT OF VARIOUS ECOLOGICAL CONDITIONS

SAAHIL MEHMOOD
RESEARCH SCHOLAR, SUNRISE UNIVERSITY, ALWAR RAJASTHAN
DR. YOGESH KUMAR YADAV
RESEARCH SUPERVISOR, SUNRISE UNIVERSITY, ALWAR RAJASTHAN

ABSTRACT

Testes and ovaries are reproductive organs found in fish. The gonads are paired, similar-sized organs that can completely or partially combine in the majority of species. Despite the significance of fish biology, certain countries' absence or paucity of fishery data results in overexploitation of the populations and, in some circumstances, management failure. Nearly all facets of human culture are impacted by freshwater ecosystems, which serve as organizational hubs within the landscape, offer a vast array of cultural and ecological services, and sustain a wide variety of biological species. the ecosystems that support fishing and other forms of commerce. An rise in temperature can disrupt the synthesis and/or activity of the aromatase, which can impact the sexual differentiation and reproductive cycles of all examined species as well as the sexual inversion process in sequential hermaphrodites.

KEYWORDFish Production, Fish Reproductive, Ecological, Fisheries and Freshwater

INTRODUCTION

Testes and ovaries are reproductive organs found in fish. The gonads are paired, similar-sized organs that can completely or partially combine in the majority of species. A variety of secondary organs may potentially improve reproductive fitness. The sex of a fish can frequently be detected by the shape of its papilla. The genital papilla is a tiny, fleshy tube behind the anus in some fishes, from which the sperm or eggs are expelled. Because they capture the end result of environmental disturbances, biological indicators are particularly significant among the large range of tools for evaluating environmental quality. Additionally, a comprehensive strategy based on the examination of reef creatures from many taxonomic families appears to hold a lot of promise. Despite this, fishes rank among the most significant elements of the coral reef ecosystem. Therefore, it is imperative to analyses the structure of coral reef fish populations in addition to evaluating the corals.

Fish reproductive biology is essential for managing fisheries, particularly in developing nations like Brazil where managers rely on size at first maturity and the start and length of the spawning season. Despite the significance of fish biology, some countries lack or have limited fishing data, which results in overexploitation of the populations and sometimes poor management. Subsidies also push the boundaries of sustainable exploitation. Most fish only have one or two spawning seasons per year, and spawning season has a temporal scale. The right time of year for spawning and the ideal conditions for larval survival must coincide for reproductive activities to be successful. Therefore, having fundamental biological information is essential for carrying out a trustworthy management system.

Nearly all facets of human culture are impacted by freshwater ecosystems, which serve as organizational hubs within the landscape, offer a vast array of cultural and ecological services, and sustain a wide variety of biological species. Freshwater animals are among the most endangered faunas in the world due in large part to the growing requirement to both meet the water demands of a growing human population and guarantee ecological integrity. Invasive non-native fish species are now widely acknowledged as posing a serious threat to extinction in freshwater ecosystems, working in concert with other factors such as habitat loss and fragmentation, hydrologic change, climate change, overfishing, and pollution (Dudgeon et al. 2006). Many introduced fishes have substantial ecological, evolutionary, and economic implications despite the fact that not all do, and the minority that do frequently have only minor influence on their new ecosystems. The severity of the ecological repercussions has been demonstrated, and they can range from native species changing their behaviour in the presence of invaders to the total restructuring of food webs and the extinction of entire faunas. Understanding the scope and variety of potential impacts of invasive species is crucial for researchers, managers, and policy makers concerned in protecting fish species diversity in the future.

Nearly every area of human society is impacted by freshwater ecosystems, which serve as organizational hubs within the landscape, offer a wide range of cultural and ecological functions, and support a diverse range of biological species. The growing demand Freshwater species are among the most endangered wildlife worldwide due to the need to simultaneously supply the water demands of an expanding human population and maintain ecological integrity (Leidy and Moyle 1998; Ricciardi and Rasmussen 1999; Jenkins 2003). Invasive non-native fish species are now widely acknowledged as posing a serious threat to extinction in freshwater ecosystems, working synergistically with other factors such as habitat loss and fragmentation, hydrologic change, climate change, overfishing, and pollution (Dudgeon et al. 2006). Many introduced fish have significant ecological, evolutionary, and economic impacts despite the fact that not all introduced fish become established and the minority of those that do frequently have little appreciable effects on their new ecosystems. Environmental consequences have

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A number of changes that are significantly relevant to their functioning, resilience, and the commodities and services they can offer are made to the ecosystems that support fisheries and other economic activities. Due to our incomplete understanding of ecosystem structure and function, as well as the inherent difficulty of differentiating between changes that are caused by humans and those that are natural,

LITERATURE REVIEW

YONATHAN ZOHAR (2021) The study of fish reproductive biology has expanded quickly over the past 50 years, driven by the wide variety of species and physiologies as well as bottlenecks in aquaculture linked to reproduction. This assessment offers my viewpoint on the area throughout this time, incorporating both basic and applied developments and significant anniversaries. We were able to conclude the fish life cycle and develop a dependable, year-round egg production by overcoming the inability of farmed fish to ovulate and spawn in captivity thanks to our fundamental knowledge of the brain-pituitary-gonadal axis. Technologies for creating more effective mono-sex and reproductively sterile fish were driven by an understanding of the molecular and hormonal systems involved in sex determination and differentiation. Many discoveries have been made as a result of the growing number of enthusiastic fish biologists, as well as the availability of cutting-edge tools like transgenesis and gene editing, as well as new models like the zebrafish and medaka. These discoveries have also provided new insights into the reproductive biology of higher vertebrates like humans. As a result, fish are now frequently used as examples of vertebrate reproduction. The International Symposia on Reproductive Physiology of Fish (ISRPF), where our scientific family has gathered every four years since the late Ronald Billard hosted the first meeting in 1977 in Paimpont, France, may be the best example of the advancements in our subject. We were able to take advantage of the molecular and biotechnological revolutions in the life sciences, which allowed us to provide a higher resolution of fish reproductive and endocrine processes, provide answers to more questions, and delve into deeper comprehension. As the one person who has had the good fortune to attend all of these meetings since they began, I have seen first-hand the astounding evolution of our field. Undoubtedly, the following (five) decades will be equally intriguing as we continue to merge small fish models with aquacultured species, basic and translational research, and physiology with genomes.

Rosario Domínguez-Petit et.al (2022) Aquatic animals' reproductive success is influenced by a complicated web of interactions between their habitat, their reproductive individuals' characteristics, and human-induced selection. All of them come into being directly or indirectly as a result of parental influences, which can also make up for certain adverse external consequences. Parental influences, which can potentially have a transgenerational impact, are the impacts that an individual's phenotype and the environment in which they develop have on the phenotype of their descendants. In order to examine the reasons of diversity in parental effects and their impacts on reproductive resilience and population dynamics, this study outlines the many forms of parental effects and evaluates the current evidence.

Abner A. Bucolet.al (2021) There is limited empirical evidence that coral reef fish's reproductive capacity (egg output per unit area) rises in NTMRs. Here, we hypothesized how two species of protogynous reef fish, Cephalopholisargus (Epinephelidae) and Chlorurusbleekeri (Labridae: Scarinae), developed their reproductive potential both inside and outside the Philippine NTMRs. We used a space-for-time substitution approach to estimate the critical reproductive parameters and then applied them to species-specific density and length data from 17 NTMRs (durations of protection 0–11 years) and paired fished sites (controls). We also used density and length data for C. argus from an Apo Island NTMR and a nearby control, which were gathered nearly annually over a 29-year period. The findings imply that after 11 years of protection, C. bleekeri can generate 6.0 times higher reproductive potential in NTMRs than controls, which translates to roughly 582,000 more eggs being produced per 500 m2 inside NTMRs. After 11 years in the space-for-time substitution, there was no obvious improvement in C. argus' reproductive potential. At Apo Island NTMR, C. argus' reproductive potential rose by around six times over a period of 29 years, while the ratio of the NTMR to the control population's reproductive potential fell with time (from 3.2 to 2.4), most likely as a result of C. argus spillover from the NTMR to the control. At the 29th year of protection, C. argus was predicted to lay about 113,000 additional eggs on a 500 m2 area inside Apo Island NTMR. In C. bleekeri and C. argus, ratios of reproductive potential between NTMR and controls were frequently higher than comparable ratios of density or biomass. The study emphasizes the significance of species-specific reproductive life history features that affect how differently larval fish subsidies derived from NTMRs develop.

Carl Tamario et.al (2019) Fish migration patterns provide an abundant, environmentally significant, and socioeconomically beneficial example of biological diversity. Individuals, groups, and species exhibit variation and flexibility in migration, serving as a helpful model system for studying how ecological and evolutionary processes shape biodiversity and how biological systems react to environmental heterogeneity and change. Commercial and recreational fishing both target migratory fish, which has an effect on how aquatic ecosystems work. Unfortunately, exploitation, pollution, habitat destruction, dispersal obstacles, overfishing, and continuous climate change, which brings changed, innovative, more variable, and harsh circumstances and selection regimes, are putting many species of migrating fish under growing jeopardy. Protection, sustainable use, and adaptive management are all required. However, measures taken to lessen the catastrophic effects of such threats complicate the situation for migrating fishes further. Gene flow and selection may be impacted by changes in river connection brought on by the removal of dispersal obstacles like dams and the creation of fishways, along with compensatory breeding and additional stocking. It is still entirely unknown how this may impact the dynamics, genetic structure, genetic diversity, evolutionary potential, and viability of spawning migrating fish populations. We explain and explore fundamental topics related to evolution and the preservation of biological variety, as well as trends, causes, and effects of variation and flexibility in fish migration, in this narrative review.

Minrui Huang et.al (2021) Fishes are being seriously and increasingly threatened by global climate change, which leaves the future of both global fisheries and the diversity of wild fish in question. For signaling and forecasting the effects of climate change on fish populations, communities, and even aquatic ecosystems, it is crucial to understand how fish growth adapts to changing surroundings. However, research on this topic is still lacking, and some findings are conflicting. By examining data on the environment, species, and response patterns from 1187 documents published between 1976 and 2018, this study aimed to review the state of current research. This analysis helped to identify important questions that are currently being ignored as well as potential causes for these divergences. According to the findings, 75% of investigations (mainly in temperate and subtropical regions) were carried out in the field, while the remaining studies were all controlled experiments. Comparatively less research has been done on freshwater fish than on marine fish. Only 309 fish species, representing 30 orders, or less than 1% of all known fish species, have been examined to see how climate change has affected their growth. Fish from the order Actinopterygii were all researched. By number of species, the top three orders were Perciformes, Cypriniforms, and Falconiformes; nevertheless, Falconiformes was the order that was most frequently examined. Pelagic environments were most prevalent among the fish under study, followed by demersal and habitats near coral reefs. Small fish were generally underrated in both freshwater and marine ecosystems.

REGULATION OF FISH REPRODUCTION

The hypothalamic-pituitary-gonadal axis (HPG), which controls reproductive function in fish, is modulated by seasonal variations in proximal environmental variables. The follicle-stimulating hormone (FSH) and luteinizing hormone (LH) are secreted by the pituitary in response to the gonadotropin-releasing hormone (GnRH) produced by the hypothalamus. These two hormones in turn stimulate the production of steroid sex hormones such as estradiol-17 (E2), 17,20-dihydroxy-4-pregnen-3-one (17,20P), and testosterone (T) and One noteworthy component of teleost reproduction is the crucial part that specific enzyme complexes, such aromatase (P450aro) in females and 11-hydroxylase (11H) in males, play in steroidogenesis. While 11H facilitates the conversion of T to 11KT in the testicles, aromatase induces the transformation of T (made as a precursor) into E2 in the ovaries. The gonads' sexual hormones promote gametogenesis in both sexes, oocyte maturation and vitellogenesis in females, and permeation in males. Additionally, these hormones regulate the physiological processes of gonad differentiation and sex change in sequential hermaphroditic species [9,10], as well as the development of secondary sexual traits and reproductive behavior.

INFLUENCE OF TEMPERATURE IN FISH REPRODUCTION

The physiological impact of temperature on the regulation of fish reproductive activity, particularly in tropical species, is poorly understood. At the level of some critical connections in the HPG axis functioning, temperature fluctuations most likely cause differences in the expression of genes directing the production of reproductive hormones and their associated enzymes [12]. The synthesis, structure, and activity of the neurohormones, hormones, and enzyme complexes involved in steroidogenesis are all directly influenced by temperature at the cellular level since these molecules are thermosensitive and thermolabile [9]. By (1) inhibiting the expression of the genes that control the synthesis of reproductive hormones and associated enzymes, (2) changing the activity levels of hormones in the bloodstream and enzymes in the gonads, and (3) altering the specific affinity of reproductive hormone receptor cells, temperatures above an organism's thermal physiological tolerance range can have a detrimental effect on its reproductive processes [15,24]. Therefore, a higher than ideal temperature may have an impact on female reproductive physiology, egg quality, and oocyte growth and maturation, as well as the timing of ovulation and spawning.

EFFECTS OF RISING TEMPERATURE IN FISH REPRODUCTION

Effect on Reproductive Cycle

Particularly in tropical fish, even relatively small temperature rises can cause endocrine alterations in the fish's HPG axis [12]. Temperatures beyond 30 C can start to interfere with the endocrine processes involved in reproduction in some species [15,26]. In general, an increase in temperature causes fish reproductive cycles to be off schedule. This effect appears to be more pronounced in females than in males, according to experimental research on various animals [24]. The decrease or inhibition of aromatase and E2 synthesis and activity when environmental temperature rises above a species' physiological thermal tolerance limit causes this timing error in a female's reproductive cycle. The season in which the temperature rises in relation to the season in which a species reproduces will determine how off the timing is. The effects of temperature will be substantially influenced by both the annual pattern of thermal change and the temperature itself. Therefore, in temperate areas, high temperatures can shorten or extend the reproductive season for species that reproduce in the spring or summer and delay the season for species that reproduce in the fall [15,24]. Fish species frequently spawn year-round or for a significant portion of the year in tropical climates. The start of the breeding season in species that begin reproducing after exceeding a thermal threshold can be delayed by temperature increases in certain areas. As long as the upper limit of the reproduction-compatible temperature range is not surpassed, the reproductive season may prolong. Ovulation and spawning may eventually be momentarily halted if the highest temperature falls outside of a tropical species' physiological tolerance zone during the reproduction season [3,24]. In fact, the genes that code for steroidogenic enzymes in the gonads of both sexes are inhibited by severe temperatures, which changes gonad development and prevents gamete emissions [12,15,24]. Due to a mismatch between the date of hatching and favorable environmental conditions for larval survival, timing errors in fish reproductive cycles can easily result in detrimental changes in gamete quality and on larvae growth.

CONCLUSION

Because they capture the end result of environmental disturbances, biological indicators are particularly significant among the large range of tools for assessing environmental quality. The right time of year for spawning and the ideal conditions for larval survival must coincide for reproductive activities to be successful. Freshwater organisms are among the most endangered fauna worldwide due to our incomplete understanding of ecosystem structure and functioning as well as the inherent difficulty of differentiating between natural and human-induced changes. This is largely due to the increasing need to simultaneously meet the water demands of a growing human population and ensure ecological integrity. These adjustments may have a major impact on a population's sex ratio and the size distribution of males and females, as well as the temporal dynamics of maturation and gamete release. Fish that are gonochoristic or protogynous hermaphrodites may undergo declines in the proportion of females, which could reduce population fecundity across all of the examined species.

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