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Research Article

Prevalence and pathology of neoplasia in the Spotted catfish, *Arius maculatus* (Thunberg, 1792) from the southeast coast of India

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This study investigated the spontaneous occurrence of neoplasms in spotted catfish, *Arius maculatus*, sourced from the Parangipettai landing stations, southeast coast of India. A total of 13,438 *Arius maculatus* (Spotted catfish) were examined for any signs of neoplasia, with 108 fish showing signs of neoplasia, resulting in an overall prevalence of 0.80 %. The gross and clinical symptoms revealed white, fleshy, and distended tumour masses located in the superficial fascia and subcutis. Necropsy examination showed evidence of local invasion; however, there was no evidence of metastasis to other visceral organs. The neoplasms were multinodular, with a regular, uniform distribution of stromal cells and giant cells. Atypical stromal cells contained round mononuclear cells arranged in a fascicular pattern. The appearance of the nuclei of the giant cells, which ranged from 6 to 47, was similar to that of the stromal cells; these resembled osteoclasts. Neoplastic lesions were histochemically positive for Masson's trichrome, periodic acid-Schiff and argyrophilic nuclear organizer region. Based on the clinical, histological and histochemical findings, this neoplasia was diagnosed as a giant cell tumour. The present study provides the first record of neoplasia prevalence in *Arius maculatus*, offering baseline data for future biomonitoring and suggesting neoplasia as a potential indicator of environmental health in Indian coastal waters.

[**Keywords**: Giant cell tumour, Histopathology, Neoplasm, Spotted catfish]

Introduction

Aquatic ecosystems are increasingly vulnerable to pollution due to their interconnectedness through atmospheric and marine transport routes[1-4]. While the effects of pollution on aquatic life, such as increased mortality and reduced reproductive success, are well documented, a more insidious and less understood consequence is the onset of cancerous growths or neoplasia. Once considered rare in wildlife, cancer is now recognised as an underappreciated threat to aquatic animals, particularly in polluted environments where organisms face chronic exposure to oncogenic substances[1,2,5–7].

Incidents of both sporadic and frequent tumours have been reported in cultured and natural fish populations[1,8–10]. Historically, there have been very few reports of fish tumours from India[11-15]. However, more recent studies have documented a higher incidence of tumours in both cultured and wild-caught fish within India[16–29]. There are various types of tumours identified in fish populations, characterised by abnormal growth of tissue and cells without preceding inflammation or a clearly identifiable infectious origin. The majority of these tumours are benign, while some are malignant. Tumours have been reported in virtually every organ system of wild fish, although their causes remain largely unclear[8,9,30]. It is estimated that more than 50 % of fish tumours involve the skin. Although neoplasms in lower vertebrates are often difficult to define precisely, fish tumours are typically diagnosed and classified using systems similar to those applied to higher vertebrates[30].

The spotted catfish, *Arius maculatus* (Thunberg, 1792), belonging to the family Ariidae, is widely distributed along both the east and west coasts of India, inhabiting marine and estuarine environments[31]. This species is of considerable commercial and ecological importance along the southeast coast of India, contributing substantially to artisanal fisheries and supporting local food security. Understanding neoplasms in this species is vital to safeguarding fishery resources and maintaining ecosystem health.

In humans, giant cell tumours most commonly affect the epiphyses of long bones, such as the distal femur, proximal tibia, distal radius, and proximal humerus[32]. However, giant cell tumours have not been previously reported in fish. Despite growing awareness of cancer in aquatic species, neoplastic disorders remain poorly documented in many commercially and ecologically significant fish, particularly within the Indian subcontinent.

The increasing number of reports describing neoplastic and proliferative lesions in fishes from Indian waters suggests that these conditions may represent an emerging concern for aquatic animal health and environmental monitoring. In recent years, a diverse spectrum of lesions has been documented in marine and estuarine fishes, including malignant melanoma in *Terapon jarbua*, fibroma in *Arius jella*, ovarian leiomyoma and myxoid neurothekeoma in *Sardinella longiceps*, and hypermelanosis or chromatophore hyperplasia in *Synaptura albomaculata* and *T. jarbua*[33-39]. In addition, a recent survey of commercially important marine finfishes revealed the occurrence and prevalence from Indian coastal waters[40].

The spotted catfish (*Arius maculatus*), a species widely distributed along the southeast coast of India, has received limited attention with respect to neoplastic conditions, with only a single previous report describing the occurrence of a neoplastic lesion in this species[38]. Building upon this initial observation, the present study provides the first assessment of neoplasia prevalence in *A. maculatus* and offers a comprehensive pathological characterisation of the lesions. Through gross examination, histopathological analysis, and histochemical characterisation, the study contributes to the broader understanding of neoplasia in aquatic organisms. Furthermore, it establishes valuable baseline data for future monitoring of tumour prevalence and highlights the potential use of neoplasia as a biomarker of environmental quality in Indian coastal waters.

Materials and Methods

The specimens for this study were collected from the fish landing stations of Parangipettai, Tamil Nadu, on India's southeast coast over a one-year period, from January 2024 to December 2024. A total of 13,438 specimens of *Arius maculatus* (Fig. 1) were randomly examined to assess the presence of neoplasia. The fish were captured using standard local fishing methods, including hook-and-line, gill nets, and trawl nets. Upon capture, the fish was brought to the aquatic pathology laboratory at Annamalai University for further investigation. Fish was identified based on the FAO fish identification sheet[31]. Primary examination involved looking for both ecto and endo parasites. For bacterial and fungal analysis, blood samples and samples from various internal organs were collected. The tumour lesions were removed and were submerged in 10 % neutral buffered formalin for 48 hours. Subsequently, the biopsies were processed and embedded in paraffin wax. The thin section of 5 µm was incised with a rotary microtome (Yorco YSI-115). The sections were then stained as mentioned below. Haematoxylin and Eosin (H&E) staining was performed according to the method of Coolidge & Howard[41]. Collagen deposition was analysed by staining with Argyrophilic nuclear organiser region (AgNORs), Masson's trichrome and Periodic Acid–Schiff (PAS). The stained lesions were then examined under a phase-contrast microscope (Magnus MLX-DX).

Fig. 1 — Study animal *Arius maculatus* (Thunberg, 1792)

Results

In a study conducted over a year in 2024, a total of 13,438 specimens of *Arius maculatus* - Spotted catfish were examined for signs of neoplasia, with 108 (0.80 %) fish showing signs of this condition (Table 1). Monthly prevalence varied, with the highest recorded in December (2.12 %) and the lowest during the summer months of April, May, and June, when no affected fish were found. Other months showed moderate levels of prevalence, including 1.90 % in January, 1.40 % in February, and 1.70 % in November (Fig. 2).

Table 1 — Prevalence of neoplasia in *Arius maculatus*

Seasons	Month	No. of fish examined	No. of neoplasia affected fish	Prevalence (%)	
Post-monsoon	Jan	1101	21	1.90	1.11
	Feb	1210	17	1.40	
	March	1090	0	0.00	
Summer	Apr	1012	0	0.00	0.00
	May	1000	0	0.00	
	Jun	1015	0	0.00	
Pre-monsoon	Jul	1000	0	0.00	0.27
	Aug	1170	0	0.00	
	Sep	1154	9	0.77	
Monsoon	Oct	1192	13	1.09	1.65
	Nov	1174	20	1.70	
	Dec	1320	28	2.12	
Total		13438	108	0.80	

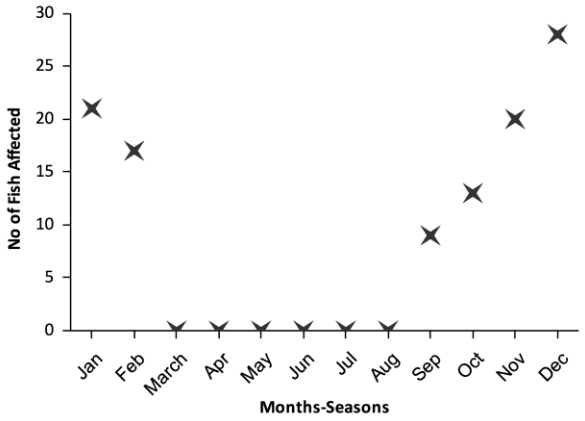

Fig. 2 — Prevalence of neoplasia in *Arius maculatus* from the Parangipettai coastal waters

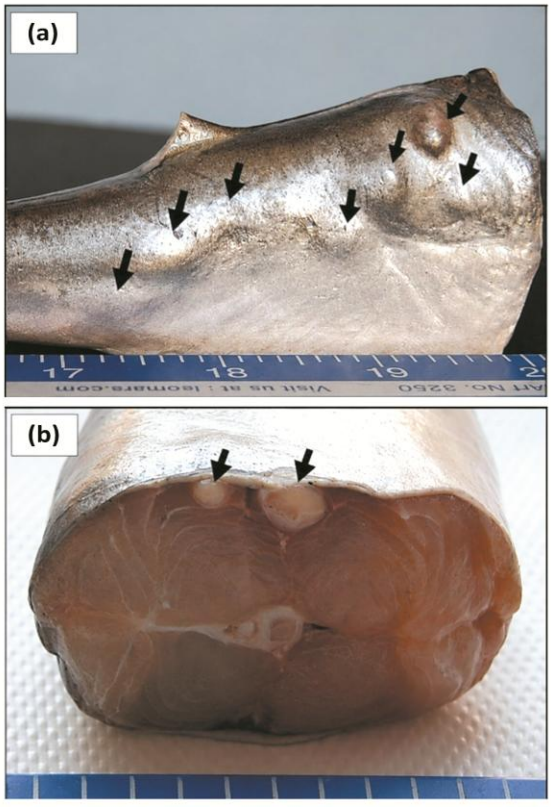

Fig. 3 — a) *Arius maculatus* affected with neoplasia (arrow); and b) Necrotised close-up view (arrow). Scale in cm

The pale, distended, solitary, fleshy tumour masses were located on both flanks. The masses protruded from the superficial fascia and subcutis (Fig. 3) in most cases. The size ranged between ±3 and ±11 mm in diameter. The monthly biometric characteristics of the examined *Arius maculatus* are presented in (Table 2).

The total length of the fish recorded during the study period ranged from 17.2 to 35.6 cm, with a pooled mean ± SD of 26.4±4.9 cm, while their body weight ranged from 105 to 420 g (mean ± SD: 265±78 g). Among the neoplasia-affected individuals, the total length ranged from 19.5 to 33.8 cm (mean ± SD: 27.8±3.7 cm), and the body weight ranged from 140 to 395 g, with a mean ± SD of 285±66 g. Month-wise analysis showed relatively consistent biometric measurements for the overall fish population, whereas affected fish observed in January, February, September, October, November, and December displayed slightly higher mean lengths and weights than the total population during these months (Table 2).

The excised lesions were non-vascularised, and necropsy examination revealed evidence of invasion; however, there was no evidence of metastasis into other visceral organs. No parasites were observed in wet smears of skin, gills and faces. Moreover, no bacteria and fungi could be isolated from the protruding masses.

Table 2 — Month-wise biometric measurements of *Arius maculatus* from Parangipettai coastal waters

Month	All fish length in cm (Mean±SD)	All fish weight in g (Mean±SD)	Affected fish length in cm (Mean±SD)	Affected fish weight in g (Mean±SD)
January	27.1±4.8	275±75	28.5±3.5	290±65
February	26.5±4.6	268±72	27.9±3.6	282±62
March	26.3±4.5	260±70	—	—
April	26.1±4.4	258±68	—	—
May	26.0±4.2	255±65	—	—
June	25.9±4.1	250±63	—	—
July	26.2±4.3	262±67	—	—
August	26.4±4.4	265±69	—	—
September	26.7±4.5	270±70	27.6±3.8	280±60
October	26.9±4.7	272±72	27.7±3.7	285±63
November	27.0±4.6	274±74	28.2±3.5	288±65
December	27.3±4.9	278±75	28.6±3.4	292±68

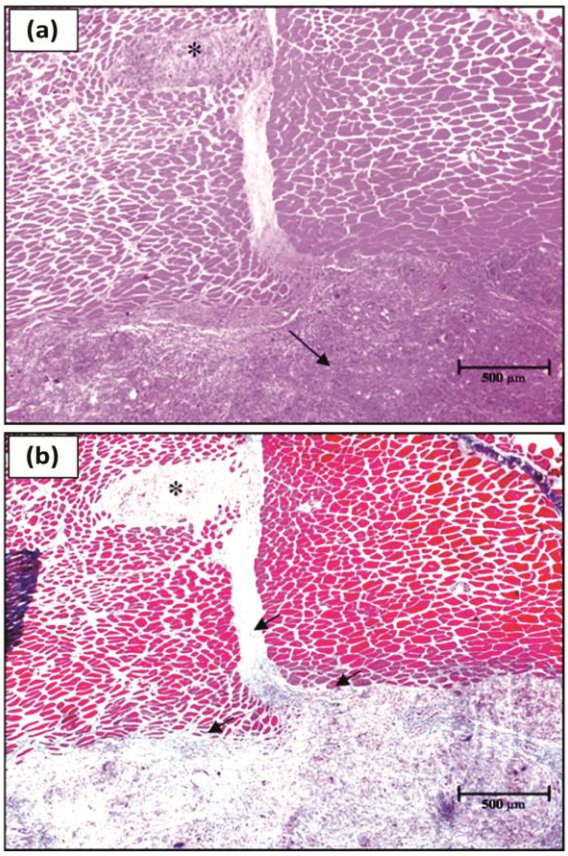

Fig. 4 — Neoplasia in *Arius maculatus*: a) Invasion of primary tumour (arrow), secondary tumour (*), staining in H&E; and b) Skeletal muscular degradation and invasion (arrow), secondary tumour (*), staining in MT

Histopathologically, the intramuscular stromal lesion locally invaded through degradation of skeletal musculature (Fig. 4). The neoplastic lesions were multinodular, with a regular, uniform distribution of stromal cells and giant cells. Nuclei of stromal cells were round and arranged in a fascicular pattern, but occasionally had a focal storiform arrangement. Stromal cell pleomorphism and necrosis were rare (Fig. 5a). Giant cells were large and multi-nucleated (varied from 6 to 47); the nuclei were similar to those in stromal cells, and resembled osteoclasts (Fig. 5b). Masson's trichrome was positive for stromal and giant cells, and demonstrated that stromal lesions contained moderate cellularity with low numbers of collagen fibres (Fig. 5c & d). PAS stained moderately positive for stromal cells and strongly positive for giant cells (Fig. 5e). AgNORs stained positive for AgNORs dots/nuclei; the stromal and giant cells indicate strong expression of AgNORs dots/nuclei (Fig. 5f). These results suggest that environmental factors associated with seasonal changes, such as water temperature, quality, and other ecological conditions, may influence the occurrence of neoplasia in *Arius maculatus* in this region.

Discussion

The present study is the first to document the prevalence of neoplasia in *Arius maculatus* from the southeast coast of India. This finding is significant because neoplasia in wild fish populations can serve as a sensitive bioindicator of aquatic ecosystem health and reflect the presence of environmental stressors, including pollutants and other anthropogenic activities[1,42-45].

The giant cell tumour is a rare neoplasia in higher vertebrates and has not been previously reported in fish. The mesodermal tumour lesions observed in *Arius maculatus* and their pathological manifestations are similar to those reported in humans[46]. Wieneke *et al.*[46] demonstrated that regular and uniform distribution of stromal cells and giant cells is present in the neoplasms. Stromal cells contain round to oval,

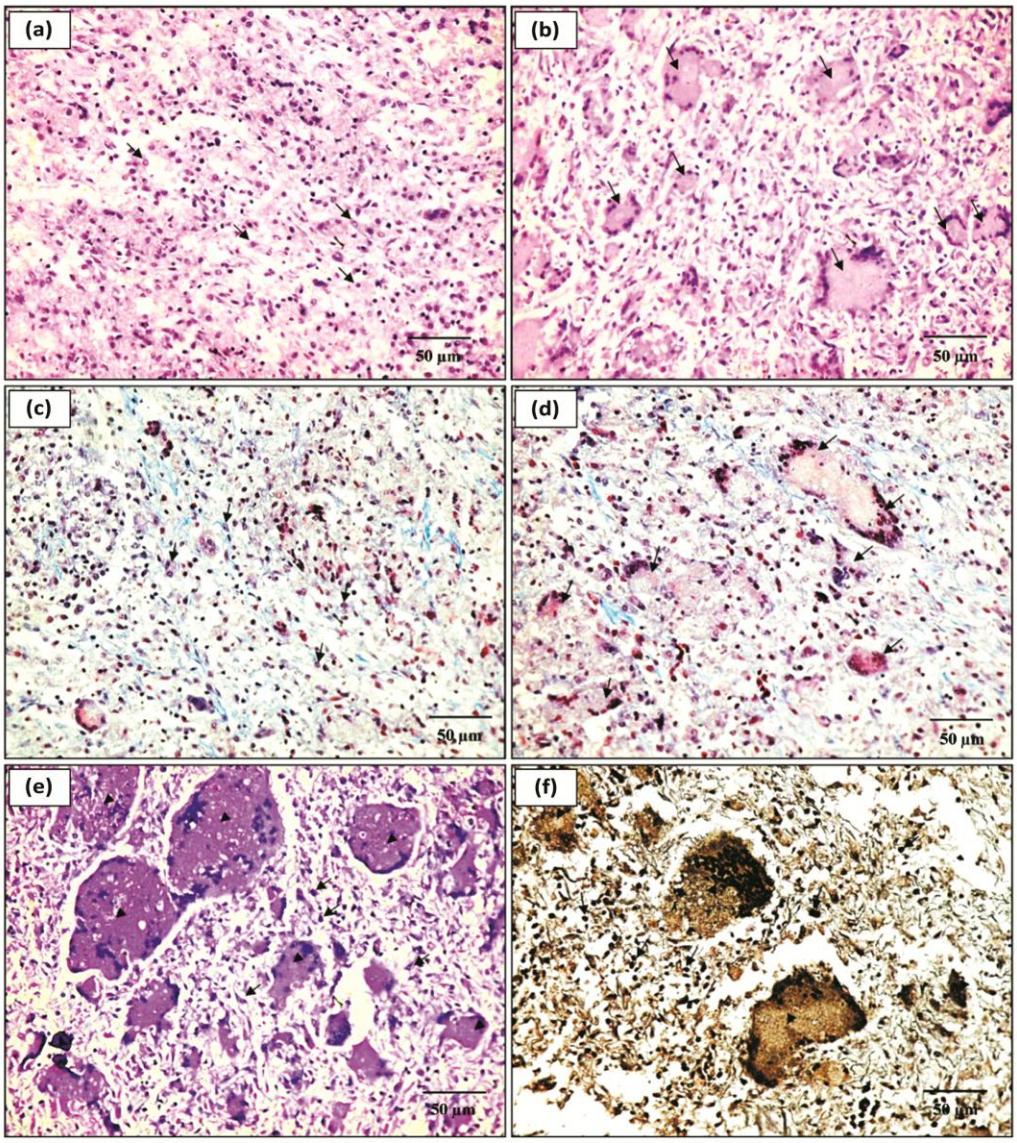

Fig. 5 — Neoplasia in *Arius maculatus*: a) Round mononuclear stromal cells (thin arrows); b) Multinucleated and hypertrophic giant cells (thin arrows); c) Mononuclear stromal cells with myxoid matrix (thin arrows); d) Multinucleated giant cells with myxoid matrix (thin arrows); e) PAS moderate to highly stain with stromal (thin arrows) and giant cells (arrowheads); and f) AgNORs dots/nuclei moderate to highly stain with stromal (thin arrows) and giant cells (arrowheads)

polygonal, or elongated mononuclear cells, mixed with numerous large osteoclast-like giant cells with 50 to 100 nuclei, multi-nucleated[47]. Stromal cells contain a fascicular pattern with focal storiform arrangement. They displayed round 'fried-egg' with centrally located nuclei and wide, thin peripheral rimming of acidophilic cytoplasm[48]. The pathological examinations of the mesodermal tumours revealed local invasion with endophytic growth, suggesting the malignant character of this neoplasm. Masson's trichrome indicates collagen deposition, fibrosis, myofibroma, and soft tissue tumours[49]. The present study revealed the type of fibroblast and the range of fibrils. The PAS reaction is a non-specific indicator of glycogen, which is present in basement membranes, including blood vessels, neoplastic tumour cells, and distinct metastasis[50].

In the present report, the differentially stained glycoproteins and glycolipids indicate a mesenchymal lesion and malignant characteristics. Nucleolar organiser regions (NORs), which bind to silver ions through a set of acidic, non-histone proteins, are chromosomal loops of DNA involved in the ribosomal synthesis[51]. Argyrophilic nucleolar organising regions

(AgNORs) are the sites of ribosomal RNA. Malignant tumour cells exhibit more AgNOR protein patterns, indicating increased cell proliferation[51,52]. In the present study, neoplastic cells were strongly stained with AgNOR dots/nuclei, which clearly indicate aggressive premalignant characteristics. Based on gross and histopathological findings, the neoplasia was diagnosed as a giant cell tumour. This neoplasia was observed only in the external parts of the body. No evidence of metastases was observed in this case. The data presented here provide a valuable baseline for such monitoring.

This study highlights the need for further investigations into the causes, progression, and ecological impacts of neoplasia in Indian marine fishes. Future research should integrate chemical pollutant analysis, contagious cancers in aquatic environment, molecular biomarkers of carcinogenesis, and broader histopathological surveys across multiple species to build a clearer picture of aquatic cancer epidemiology.

Conclusion

This study provides the documented evidence of neoplasia in the spotted catfish (*Arius maculatus*) from the southeast coast of India, with a recorded prevalence of 0.80%. The neoplastic lesions, characterised by multinodular growths of stromal and giant cells with no observed metastasis, highlight the susceptibility of this species to tumour development. These findings are significant because neoplasms in wild fish populations can serve as sensitive bioindicators of aquatic ecosystem health, reflecting the influence of environmental stressors and pollutants. The baseline data generated through this study can support future research on fish health monitoring, cancer epidemiology in aquatic organisms, transmissible cancer, and the assessment of environmental quality along the Indian coastline.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Ethics Statement

This article does not contain any studies involving human participants or live animals performed by any of the authors.

Author Contributions

AG: Supervision and specimen collection; and VK: Conceptualization, specimen collection, formal analysis, and manuscript writing.

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