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# EFFECT OF POLLUTION ON THE THREADFIN BREAM *NEMIPTERUS JAPONICUS* IN THE HARBOUR WATER OF VISAKHAPATNAM

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**ABSTRACT**

In the present study, *Nemipterus japonicus* were collected from polluted harbour water of Visakhapatnam and found many zoonotic diseases which become major threat to human health. The diseases observed in this study are exophthalmia, skin discoloration with deep ulcers, frayed fins, damaged gills, distended abdomen with calcified gonads and a large polypoidal mass in the buccal cavity of *N. japonicus*. The results suggest that when such fish is consumed by humans, it may lead to many health problems

## INTRODUCTION

As the sea waters round the globe with its magnificent flora and fauna focus the miraculous creation, man with an urge to amplify the economic status with a selfish zeal, started polluting these natural gifts. The lack of proper management of domestic and industrial wastes which release hazardous chemicals is one among the environmental problems. There is no doubt this excessive levels of pollution are causing a lot of damage to human and animal health. The organic pollutants may cause declines, deformity and death of fish life, which in turn cause disease to humans.

The thread fin breams of the genus *Nemipterus* have an important commercial value as good protein source for mankind. There are many reports on the biological aspects of Nemipterids, but very few on the effect of pollution and parasite infections (Chao, 1985; Moravec and Harrison, 1989; Petersen *et al.,* 1993; Frantisek and Jean-Lou, 2005; Frantisek *et al.,* 2006; Seyed *et al.,* 2008; Miller *et al.,* 2009; Rajapandiyan *et al.,* 2009; Venmathi *et al.,* 2009; Diana and Ramulu, 2009, 2010; Rejomon *et al.,* 2010; Siavash *et al.,* 2010; Nurul *et al.,* 2011).

So far, there are no reports on the diseases such as exophthalmia, skin discoloration with deep ulcers, frayed fins, damaged gills, distended abdomen with calcified gonads, polyps in buccal cavity of *N. japonicus* from the harbour waters of Visakhapatnam. Since these studies are important for environmental assessment and for determining public health risk, investigations are taken up in this line.

## MATERIALS AND METHODS

The fish were collected regularly from the local market near Visakhapatnam harbour. The fish are examined for external diseased characters for identification of skin ulcers and differentiation is done at the rate of superficial or deep ulcerations. Skin scrapings and gill racker observations were done to identify the external etiology. The gill lamellae are mounted immediately with glycerine and observed under compound microscope. The abnormality of the stomach is observed by carefully opening the fish by giving an incision through the vent. Fins are observed for colour and deformity. To study the biological and physico-chemical characteristics in the harbour water, samples were collected from four different stations using Niskin water sampler. The first two stations S-I and S-II are from the inner harbour. Stations S-III and S-IV are from the outer harbour. The analysis of various water parameters were carried out by using standard procedures described in APHA (1995). Microbiological investigations were done using standard procedures described by Collee *et al.* (2006).

## RESULTS

Many diseases were encountered from the fish *Nemipterus japonicus* collected from polluted water of Visakhapatnam. The skin lost its original pink colour, the characteristic feature of *N. japonicus* and showed pale, milky colouration (Fig. 1). The infectious fish showed exophthalmic condition which is known as pop eye (Fig. 1a). The skin is exposed at focal areas due to loss of scales. It showed multiple superficial ulcers (Fig. 1b). The ulcers at an advanced stage developed into deep craters. These ulcers are surrounded by a ring of inflammatory necrotizing petechial hemorrhagic exudates which are often seen on the skin.

The operculum and jaws are hyperemic (Fig. 2). The fins are


**Figure 1: Diseased skin with pale coloration a. Exopthalmia (Pop-eye); b.Skin Ulcer**

**Figure 2: The operculum and jaws are hyperemic**

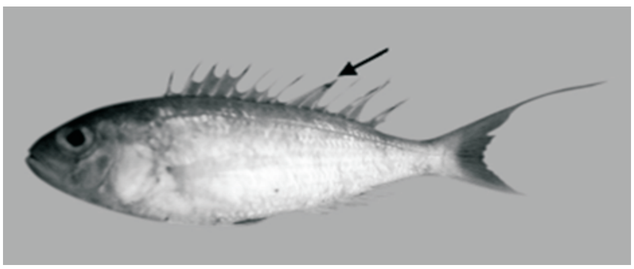

**Figure 3: The fins are frayed showing delicate, opaque, pale edges**

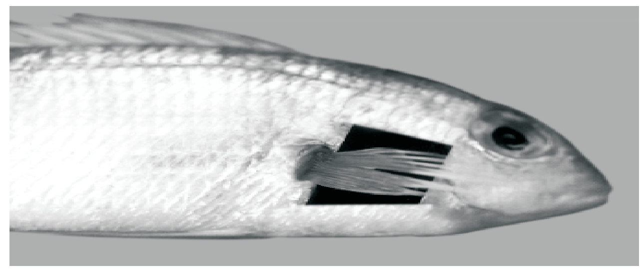

**Figure 4: Hemorrhages at the base of pectoral, pelvic, dorsal and anal fins are observed with**

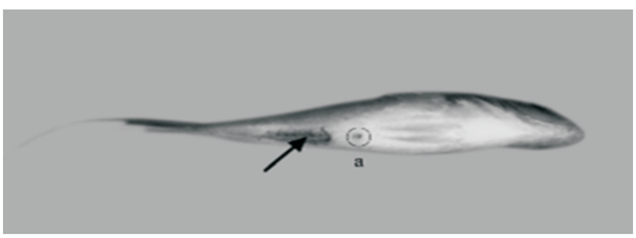


**Figure 5: The anus is inflamed with exudates of mucus secretions**

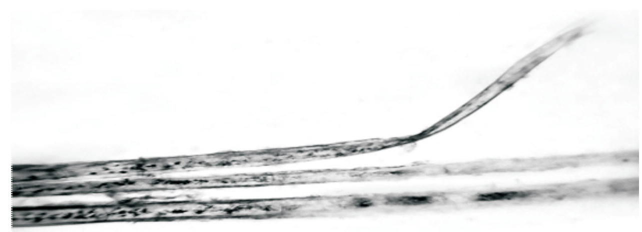

Figure 6: The gills are pale with patechial hemorrhages and gill lamellae are frayed and fragmented

**Figure 7: The stomach is bulged with distended oedamatous abodmen**

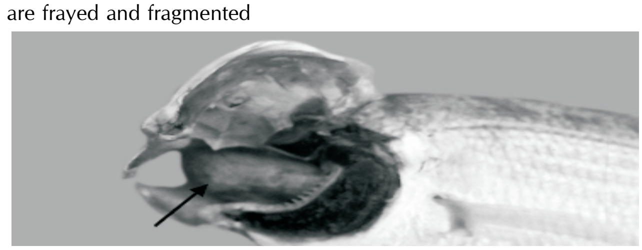

**Figure 8: Polypoidal mass in the buccal cavity**

frayed showing delicate, opaque, pale edges (Fig. 3). Hemorrhages at the base of pectoral, pelvic, dorsal and anal fins are observed with inflammation (Fig. 4). The anus is inflamed with exudates of mucus secretions (Fig. 5). The gills are pale with patechial hemorrhages and gill lamellae are frayed and fragmented (Fig. 7). The entire branchial apparatus is swollen with intense mucous secretions. The stomach is bulged with distended oedamatous abdomen (Fig: 7). The diseased fish showed a large polypoidal mass in the buccal cavity which interfere with the respiratory movements, due to which fish died of anorxea (Fig. 8).

The hydrobiological parameters of harbour water samples collected from four sampling stations are given in tabulated form (Table 1). The first two stations S-I and S-II are from the inner harbour which is highly polluted, due to industrial discharge and untreated domestic sewage. Stations III and IV are from the outer harbours. The results revealed appreciable hydrographic and biotic changes. There is gradual decrease in temperature from first to fourth station. pH is high at third station and DO at second station. BOD is high at second station and salinity at fourth station. Permanganate oxidability, Phosphate, $NO_2$ and $NO_3$, Ammonia, Copper, Zinc, Lead, Cadmium, Mercury and total bacterial count was high at stations I and II of the inner harbour.

## DISCUSSION

Visakhapatnam has got beautiful natural harbour, but now it has been altered and polluted by human activity. The inner harbour is discharged with industrial wastes and untreated domestic sewage, and outer harbour accommodates iron ore carriers, oil tankers and cargo vessels. The untreated pollutants from these become stagnant and aggravate heavy loads of bacteria, resulting in chronic infectious diseases and mass mortality of fish. In the present study, the hydrobiological results revealed appreciable variations. The first two stations S-I and S-II from the inner harbour has got high pollutants with heavy

**Table 1: Water quality parameters in surface waters off Visakhapatnam harbour with average values**

| Characteristics | Stations I | II | III | IV |
|---|---|---|---|---|
| 1. Temperature°C | 30.26 | 30.2 | 30.0 | 30.11 |
| 2. pH | 7.78 | 7.85 | 8.04 | 7.83 |
| 3. Salinity (ppt) | 31.2 | 30.34 | 31.6 | 32.9 |
| 4. DO (mg/L) | 6.8 | 7.2 | 6.27 | 6.5 |
| 5. BOD (mg/L) | 4.9 | 5.2 | 1.2 | 1.4 |
| 6. Permanganate oxidability (mg/L) | 16 | 20 | 1.5 | 2.1 |
| 7. Phosphate (mg/L) | 3.7 | 4.1 | 0.24 | 0.21 |
| 8. $NO_2+NO_3$(mg/L) | 4.6 | 4.8 | 0.75 | 0.64 |
| 9. Ammonia (mg/L) | 0.9 | 1.3 | 0.06 | 0.76 |
| 10. Copper (**μg**/L) | 4.05 | 4.43 | 2.32 | 2.12 |
| 11. Zinc (**μg**/L) | 30.24 | 29.32 | 5.43 | 6.32 |
| 12. Lead (**μg**/L) | 4.4 | 3.92 | 1.65 | 1.32 |
| 13. Cadmium(**μg**/L) | 1.86 | 1.63 | 0.65 | 0.54 |
| 14. Mercury (**μg**/**L**) | 0.023 | 0.02 | 0.01 | 0.01 |
| 15. Total bacterial count cfu/100mL) | 18532 | 16552 | 340 | 291 |

All the data is based on average of five determinations

bacterial load. The samples from outer harbour S-III and S-IV has got less bacterial load compared with the former. These results correlate with other authors. Raman (1995) reported heavy load of organic matter causing major changes in water quality and organisms in Visakhapatnam harbour as a result of pollution. Ratna Bharathi *et al.,* (2001) noticed high pollution gradients in these harbour waters. Vijaykumaran (2005) observed elevated productivity parameters at the outer harbour off Visakhapatnam.

In the present study, *Nemipterus japonicus* collected from Visakhapatnam harbour waters are highly diseased. As Nemipterids are bottom dwellers, these fish are mostly affected by the polluted environment in which they live. These demersal species are particularly susceptible to physical abnormalities and diseases, which appear to be associated with contaminated sediments (Stehr *et al.,* 1997).

The diseased fish showed skin discolouration along with epidermal damage. These changes may be due to quick response to stressors (Whitear *et al.,* 1986; Iger *et al.,* 1995), because skin is a common target for many pathogens. The changes in the body colouration due to skin damage may also increase a fish susceptibility to predation (Abbott and Dill, 1985). Toxins that interfere with oxygen uptake process may cause epidermal damage. This damaged skin might increase the penetration of toxins across the skin.

The fish collected from pollutant harbour waters often showed a high prevalence of ulcers. The close relationship between skin damage and microbial colonization makes difficult to identify the initiating cause of a skin ulcer (Noga, 2000). Epidermal ulcer is considered to be one of the best biomarkers of polluted and stressful environments (Sindermann, 1990).

Although, frayed fins are reported by many investigators as fin erosion, it is defined as epidermal loss occurring on the fins due to possible sub lethal effects (Moore *et al.,* 1996). Exophthalmia or pop eye is often caused due to sudden environmental deterioration, poor water qualities *i.e.,* drop in pH or it can be a bacterial infestation (Leong *et al.,* 2006).

The present study revealed acute gill erosion with frayed gill lamellae and pale colouration, as these respiratory organs are directly exposed to metal contaminants in the polluted waters. Plankton enrichment of the marine ecosystem plays a direct role in gill disease and mortalities in some fish species (Liber *et al.,* 2005). The chronic exposure of fish to sub lethal levels of toxicants damage gill lamellae (Rodger, 2007).

There is a significant distended oedamatous abdomen with calcified gonads in the diseased fish. The biological diversity of fish from contaminated water bodies as a result of the radioactive pollutants does not show considerable changes immediately, may decrease species population during the next 10-20 years because of disturbances in their reproductive system (Ryabov, 1992).

The diseased fish subjected to autopsy showed prominent lesions in the buccal cavity with heavy infestations of bacterial loads. In the previous studies, it is found that biochemical fluctuations in total carbohydrates and total proteins are seen in liver, intestine, skin and muscle of fish infected with bacteria (Diana and Ramulu, 2009 and 2010; Diana and Manjulatha, 2012). In a similar study Peter *et al.* (2009) described morphological deformities, such as split fins, scale disorientation, hyperplasia of the surface of the mouth, muscle atrophy, opercular deformity, gill deformity, eye deformity, skeleton deformity, outward protrusion of the lower lip, tumors and other swellings, jaw deformity, head or lower jaw bent to one side, protruding mouth or nose part depression, fin deformity, including body shape deformity and protrusion of the mandibular cartilage as biomarkers in *Tilapia* species from contaminated waters in Taiwan.

Metal distribution between the different tissues within an organism depends on the mode of exposure and can serve as pollution indicator (Maheswari *et al.,* 2006). Few scientists have reported metal accumulation in *Nemipterus* species. Rejoman *et al.* ,(2010) reported on the concentration of Fe, Co, Ni, Cu, Zn and Pb in the muscle tissue of *N. japonicus* from Kochi and Mangalore on South West Coast of India. Siavash *et al.,* (2010) determined the concentration of arsenic and mercury in edible muscle of *N. japonicus* from Persian Gulf. Nurul *et al.,* (2011) reported the amount and type of organic pollutants of dioxins and furans accumulated in the lipid compartment of *N. japonicus* from Malaysia.

Some parasitologists reported infections in *Nemipterus* species. Chao (1985) surveyed on *anisakis* larvae in *N. virgatus* from Taiwan. Moravec and Harrison (1989) reported a nematode parasite, *Paraphilometroides nemipteri* in *N. peronii* from Malaysia. Petersen *et al.,* (1993) reported an unidentified microspora infection in *Nemipterus* species from central Philippine water. Frantisek and Jean-Lou (2005) found two anisakid nematodes from *N. furcosus*. Frantisek *et al.,* (2006) identified nematode *Camallanus carangis* from *N. furcosus* off New Caledonia. Seyed *et al.,* (2008) evaluated acanthocephala infection in *N.japonicus* from Bushehr waters of Persian Gulf. Rajapandiyan *et al.,* (2009) reported on the prevalence and distribution of *Vibrio vulnificus* in *N. japonicus* caught off Chennai, Indian Ocean. Venmathi *et al.,* (2009) reported copepod infection in *N japonicus* from Malaysia. Miller *et al.,* (2009) reported a digenean parasite in *N. furcosus* off New Calidonia.

From all these studies, it is well established that most of the investigations are taken up on the helminth and other infections in *Nemipterus* species. Therefore the present study helps as a tool for environmental assessment for determining public health risk.

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