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INTERNATIONAL COLLECTIVE IN SUPPORT OF FISHWORKERS

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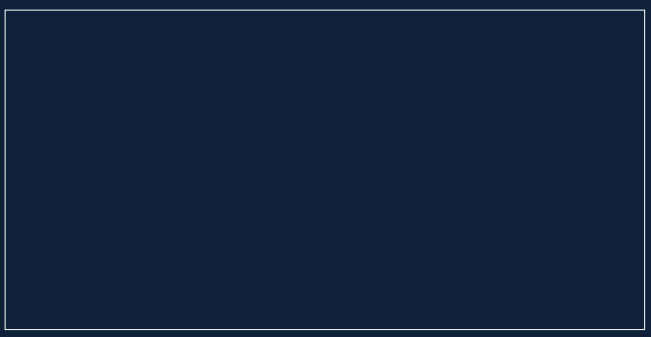

OCTOBER 1992

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CONSULTATION ON EPIZOOTIC ULCERATIVE SYNDROME VIS-À-VIS THE ENVIRONMENT AND THE PEOPLE

25-26 May 1992, Institute of Management in Government
Vikas Bhavan, Trivandrum 695 033, Kerala, India

Summary of Proceedings

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October 1992

INTERNATIONAL COLLECTIVE IN SUPPORT OF FISHWORKERS
27 College Road, Madras 600 006, India

Published by

Programme Co-ordination Centre
International Collective in Support of Fishworkers
27 College Road, Madras 600 006, INDIA

October 1992

Printing:
Nagaraj & Company, Madras 600 041, INDIA

Typesetting:
Satish Babu, SIFFS Computer Centre, Trivandrum 695 002, INDIA

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INTRODUCTION

In the last two decades a serious and severely damaging fish disease has been spreading through countries of the Asia-Pacific region with dangerous consequences to the fish resources and livelihood of inland fisherfolk. For a disease which is twenty years old, it is strange and baffling that the scientific community has not been able to pinpoint its causative agent.

Not only is this disease—now officially termed Epizootic Ulcerative Syndrome (EUS)—a scientific puzzle or, optimistically speaking, a scientific challenge, it is also a worrisome social problem. Hundreds of inland fishworkers, often the more marginalised amongst the fishworker communities in the affected countries, have been overnight deprived of their incomes as consumers began to totally reject the disfigured, disease-stricken fish.

With no signs of an immediate abatement of EUS and, worse, with all indications of a possible spread of the disease, the International Collective in Support of Fishworkers (ICSF) felt it was opportune and imperative to organize a forum where the best of expert opinion—both scientific and social—could be given free play to come up with some kind of consensus on the nature and prognosis of EUS, as well as to recommend prophylactic, therapeutic and control measures.

It was in this context that the ICSF, in co-operation with the Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, organised a two-day consultation on "EUS vis-à-vis the Environment and the People" in Trivandrum, India, during 25 and 26 May 1992.

This document is a report of the Consultation. While it does not purport to be a verbatim account of the two-day deliberations, it does record the important issues raised, the experiences exchanged and shared, and suggests how grand conclusions about as enigmatic a disease as EUS are ultimately elusive.

I CONSULTATION OVERVIEW

Since the two-day Consultation was essentially meant to be a common forum for administrators, scientists and activists, it was sought to be used as a kind of clearing house of ideas, conjectures and refutations. Given the fledgling state of research on EUS and the several doubts still prevalent about its aetiology and prognosis, the Consultation was by no means intended to be definitive. As such, despite a programme format, the proceedings were relatively unstructured and often followed the mood and tenor of the discussions.

The Consultation was organized into four Technical Sessions sandwiched between an Inaugural Session and a Concluding Session (see Appendix 1). Each Technical Session ended with a general discussion on that session, when the floor was open to

any participant to query, clarify or generally comment on any relevant issue raised in that session.

While the Inaugural Session sought to set the tone for the Consultation in terms of shifting the focus to the socio-economic aspects of EUS, the Concluding Session tried to arrive at some kind of broad consensus on the course of future action, though it deliberately shied away from a formal final declaration or conference statement.

In all, 43 persons took part in the Consultation, including three scientists from Thailand renowned for their work on EUS, as well as participants from Belgium, Germany, Senegal, and the United Kingdom. Most of the others were from seven Indian states, the majority coming from Kerala. The participants ranged from scientists and government officials to social activists and journalists (see Appendix 2).

II BACKGROUND

Though cutaneous ulcerative diseases are common amongst wild and cultured fish, for the last two decades, regions in Australia and Asia-Pacific have been witness to a group of epizootic syndromes, all involving a severe ulcerative mycosis.

As Kamonporn Tonguthai of the Aquatic Animal Health Research Institute, Kasetsart University, Bangkok, pointed out in her Keynote Address, which was an overview of EUS in the Asia-Pacific region, there have been several reports of ulcerative disease conditions amongst wild and cultured fish in this region. While EUS refers specifically to the Asian condition, there are great similarities with other fish conditions. However, Tonguthai cautioned, only further research can confirm whether these are indeed the same disease.

EUS was first reported in March 1972 from central Queensland, Australia, where several species of estuarine fish had developed large shallow circular or irregular skin lesions. Initially named "Bundaberg fish disease", it displayed a pronounced seasonality, and was soon associated with prolonged periods of rain which were thought to alter the quality of water and make it prone to infection by bacteria. As it spread to several species of freshwater fish in the river systems of Papua New Guinea and Western Australia, the disease soon came to be called "red spot".

In 1980 a similar haemorrhagic condition was seen among fish, including rice-field fish, in Java, Indonesia. But pathological and epidemiological differences seemed to set this apart from the Australian condition. However, subsequent outbreaks of EUS in brackishwater fish in the Philippines and typically ulcerated snakeheads and catfish in other states of Indonesia have confirmed the link with the Australian red spot.

In 1986 a Consultation of Experts on Ulcerative Fish Diseases organised by the Food and Agriculture Organisation (FAO), adopted the name "Epizootic Ulcerative

Syndrome" (EUS) to specifically refer to the Asian condition. The disease is characterised by large cutaneous ulcerative lesions which periodically cause the death of many species of wild and cultured freshwater fish.

The first reports of classic EUS came from peninsular South-East Asia, in 1979-80 from Malaysia's Bekok river system, and the next year from its northern rice-growing states, where freshwater rice-field species of fish succumbed to serious ulceration. In the course of the decade since then, the disease spread to almost all parts of South and South-East Asia, specifically Thailand, Laos, Myanmar, Vietnam, Cambodia, Bangladesh, India and Sri Lanka. In its westward spread from Australia, EUS' latest occurrences have been reported from Kerala, Gujarat and Rajasthan in India.

The spread of EUS shows a certain pattern. Outbreaks are typically cyclical, with the first occurrence being particularly severe and recurrences over the next two to three years less so. There is, however, no uniformity to this pattern. While the disease spread rapidly in some areas like Malaysia and Thailand, in other areas like Indonesia its progression was slow. Moreover, in Malaysia there was a one year gap between outbreaks.

The mechanism of spread is also not clear. The disease has spread rapidly northwards, where the rivers flow from east to west, and equally rapidly westwards in areas where the rivers are oriented from north to south. It would thus not be possible to attribute the transport of the pathogens to, say, monsoonal flood plains alone. Also mysterious is the spread of EUS to areas like Sri Lanka and some islands of the Philippines. (The unrestricted trade in live fish could be a mode of transmission).

Investigations into the potential causative factors have focused on viral, fungal and bacterial agents. Environmental parameters have also been studied. These abiotic factors are believed to cause sublethal stress to the fish, initiating disease outbreaks. Potential causes of stressful environmental conditions include temperature, eutrophication, sewage, metabolic products of fishes, industrial pollution and pesticides.

The quality of water also appears to be significant from an aetiological point of view. Parameters like salinity, alkalinity, temperature, hardness and chloride concentration (many of which are seasonally variable) are known to predispose fish to attacks of EUS. Infected fish showed signs of improvement when transferred to clean freshwater ponds.

Also, in much of Asia's paddy field systems, EUS occurred towards the end of the paddy cultivation period when the water level is low, decomposition of organic matter like grass and water weeds is common, and certain types of fertilisers accumulate.

Yet, as Tonguthai pointed out, ultimately no definite conclusions about the cause of the disease can be drawn since 'outbreaks are considered to be a complication of several factors.'

Correct diagnosis of EUS, focusing on symptoms of behaviour, external signs and histopathology, is the prelude to treatment (see Table 1 below). Both prophylactic and therapeutic treatment, usually involving the addition of quicklime, have reported satisfactory results. Yet, without large-scale comparative assessments across a variety of affected species, liming cannot be unequivocally advocated. In fact, lakes in Kerala with high levels of natural deposits of lime have also been the site for EUS outbreaks.

Prophylaxis revolves around good general husbandry practices including disinfection, opting for water from tube wells rather than irrigation canals or paddy fields, and ensuring disease-free stock and healthy fry. Apart from not overstocking ponds, other preventive measures include the use of antibiotics and chemicals (see Table 2 below).

III REGIONAL REPORTS

A. Thailand

According to Kamonporn Tonguthai, in 1981 a major epizootic spread from the south of Thailand to the north and north-east of the country. The most significant and best documented instances of EUS occurred in Thailand between September and March of each year from 1981 to 1984. Most severely affected were intensively cultured snakeheads.

Delineating the clinical and pathological features of EUS-affected fish, Supranee Chinabut of the National Inland Fisheries Institute, Bangkok, pointed out that the clinical signs of the affected fish were the same in the case of all species. In the earliest stages of the disease, lesions showed some damage to the epidermal layer of the skin, resulting in an area of epithelial necrosis with some inflammatory cell infiltration.

Severe cases showed large ulcerative lesions with degenerative changes in the muscle. Marked diffuse systemic necrotizing granulomatous mycosis was spread in the necrotic muscle bundles. The fungus was extremely invasive throughout the necrotic muscular lesions. In the latest stages, advanced lesions were observed, with fungal hyphae having infiltrated into some internal organs and produced tremendous numbers of mycotic granulomata in those organs.

According to Chinabut, many species of parasites were identified including species of *Palisentis, Triancloratus, Dactylogyrus, Gyrodactylus, Henneguya, Epistylis* and *Trichodina*. The predominant bacterial isolation from the late stages of the diseased fish was *Aeromonas hydrophila. Aeromonas sobria, Pseudomonas* spp, *Micrococcus* spp, *Flavobacterium* spp and *Vibrio* spp have all been occasionally isolated from affected

fish. Ulcerative disease rhabdovirus (UDRV) was found in the diseased fish. *Aphanomyces, Achlya* and *Sapralegnia* were identified from the surface of ulcerated fish.

While the causes of EUS are not clearly identified, Nontawith Areechon of the Faculty of Fisheries, Kasetsart University, Bangkok, pointed out that they may be related to stressful conditions of aquatic animals. Stress can be caused by, among other things, environmental changes and toxic substances. These can weaken the fish and make them more vulnerable to pathogens.

Treatment for therapeutic purposes include antibiotics and chemicals. Though these have brought some satisfactory results, they have many undesired side-effects too, as Areechon warned. These include residues, cost increases, development of bacterial resistance, and negative impact on the environment.

Based on the Thai experience, reported Areechon, the keys to a successful crop in the case of cultured fish are healthy fry, proper pond preparation and good management. However, these measures cannot be applied in the case of wild fish populations. Most important is the prevention of any condition stressful to aquatic animals. This would hinge around good water management, optimum stocking rates and proper ratio of fish species. In support of this advice, Tonguthai pointed out how EUS-affected fish improved in health when removed and put into a normal freshwater pond.

B. India

The first outbreak of EUS occurred in India in the North-Eastern state of Tripura during the monsoon month of September 1988, following floods from Bangladesh. Since then it has spread to almost all the other states, with the possible exception of Himachal Pradesh and Punjab.

The outbreaks usually occurred between June and December, predominantly during the post-monsoon months. The incidence was more in confined waters (10-55%) than in rivers (4-15%). The fish species most susceptible to EUS are *Channa* (20-100%), *Puntius* (5-100%), *Clarias* (10-30%), *Heteropneustes, Mystus* (5-75%), *Nandus, Cyprinus, Glossogobius* (10-60%), *Anabas* (10-55%) and *Mastacembelus*.

Through environmental monitoring of the affected waters, it was determined that the intensity of incidence was higher (40-65%) in areas of low alkalinity (13-30 ppm) and hardness (6-45 ppm). Heavy metal analyses showed significant values for zinc and copper, but not perceptibly high enough to create stress for fish. Possibly more important stress factors are BHC, DDT and their metabolites, which have been detected in water, plankton and fish samples collected from the affected areas.

Aetiological investigations revealed spherical virus-like particles. A wide variety of bacterial forms have also been recorded from afflicted fishes, predominantly

Aeromonas spp., *Pseudomonas* spp., *Micrococcus* spp., *Vibrio* spp., *Klebsiella* spp., *Citrobacter* spp., *Staphylococcus* spp., *Arthobacter* spp. and *Corynebacterium* spp. The ulcers have been found to be invariably associated with the pathogenic fungus *Saprolegnia*.

Indian scientific investigations on remedial measures have recommended quicklime @ 200-600 kg/ha as providing encouraging results in containing the disease. More limited success has come from antibiotic therapy. CIFAX, a drug formulated by the Central Institute of Freshwater Aquaculture (CIFA), at a dose of 1/ha m water area, has proved helpful in containing EUS. So has bleaching powder @ 1 ppm.

1. West Bengal

According to Manas K. Das, senior scientist, Central Inland Capture Fisheries Research Institute (CICFRI), Barrackpore, West Bengal, the socio-economic impact of the disease was staggering. A sample survey of 500 affected fish farmers in an EUS-afflicted area of West Bengal revealed that maximum respondents (30-40%) suffered loss of fish. Before the outbreak of the disease, 44.4% consumed fish, but afterwards, consumption fell to 15%. Most respondents used lime as a remedy, with 68% success. The state government had distributed Rs 8 million worth of lime to the farmers, who used it prophylactically in the post-monsoon period. In West Bengal, the medium of radio was uppermost in disseminating information on EUS.

2. Manipur

Manipur is home to the biggest fresh water lake in the North-Eastern region of India—the Loktak Lake, which has an inundated area of about 28,000 ha. Fish is essential to the daily diet of Manipuris, 90% of whom eat fish in either dried or fresh form.

In June 1988 Manipur received its first information on the spread of EUS in the North-East. According to S. Debendra Singh, Director of Fisheries, Government of Manipur, the state government immediately banned the import of both dried and fresh fish as a precautionary measure. It also deputed an official (carrying some samples of suspected EUS-affected fish) to a seminar on EUS in Shillong in December 1988. Two officers were later sent for a 15-day course in Bhubaneswar, Orissa, to acquaint themselves with the identification and prevention of EUS.

The first true outbreak of EUS was reported from the capital, Imphal, on 12 May 1989. Subsequently, reports from other affected parts of the state began coming in. Technical officers of the state's Fisheries Department visited these sites for investigations. It was found that the species mainly infected were local indigenous ones like *Channa, Magur, Anabas, Barbus,* etc. However, EUS did not affect culturable fishes like Rohu, Catla, Mrigala, Common Carp and Chinese Carps. Further, unusually enough, EUS affected the wild waters, but not the ponds.

The state's Fisheries Department opened EUS Control Cells in all the district headquarters to combat the further spread of the disease. It also organised a day's training camp at the Inland Fisheries Training Centre, Lamphet, for officials as well as the public. The Department also publicised preventive measures through local dailies and radio broadcasts.

Among the measures recommended were:

- disinfection of nets by sun-drying, boiling in water, etc.
- treatment of ulcerated fish in 3% solution of common salt for 5-10 minutes or in 500-1000 ppm of potassium permanganate for one minute.
- disinfection of the affected ponds with unslaked lime (quicklime) @ 150-200 kg/ha, depending upon soil pH.

According to Debendra Singh, the control measures adopted by the department were found effective and there have been no further reports on the spread of EUS in the state. This, some participants of the Consultation felt, seemed exceptional since all other states reported a second outbreak.

3. Orissa

According to Utkal R. Das, Deputy Director, Department of Fisheries, Orissa, EUS in the state presented an unusual phenomenon. First reported in February 1989 from ponds in Balasore and Mayurbhanj (adjoining West Bengal), and then from Cuttack, the disease infected 80 blocks. But surprisingly, the river system and the reservoirs were not affected. As Kamonporn Tonguthai noted, this would question conventional wisdom which supposed that EUS spread from wild waters to ponds or at least occurred simultaneously in both areas. It was unclear how EUS in Orissa appeared confined to ponds.

The outbreak was severe, leading to panic. The state is estimated to have lost 186 tonnes of fish worth just over Rs 3 million. The state government targeted 5500 farmers in four districts for free supplies of lime. Between 1989 and 1991,11 of the 13 districts were covered. The government also tried to disseminate information on EUS at the panchayat level.

4. Tamil Nadu

While Tamil Nadu's Fisheries Department officials claim that only four of the state's 22 districts were affected by EUS, the participants from Tamil Nadu Agricultural University reported seven districts hit by the disease.

The disease was first reported from Chengai MGR District, Thanjavur District and South Arcot District during January, February and March 1991 respectively. The species mainly affected were indigenous varieties belonging to the families *Channidae, Mastacembelidae, Cyprinidae* and *Bagridae*. The intensity of infection was mild among major carps and exotic carps and also among the Tilapia species predominant in inland aquaculture.

Since the state's Fisheries Department lacked investigating facilities, the Animal Sciences Department of the University of Madras carried out microbial investigation to identify the causative agent. The Tamilnadu Veterinary and Animal Sciences University constituted a 'Disease Investigating Team', comprising officials of the Madras Veterinary College, the Fisheries College, Tuticorin and the state's Fisheries Department. During March 1991 this team toured the most affected district, Thanjavur, collecting samples as well as the kidneys and livers of diseased fish. Research is currently on to identify the primary causative agent.

During the same time, scientists from CIFA, Bhubaneshwar, also visited the affected sites to collect samples. In April 1991 a scientist from the CICFRI, Barrackpore, made a similar visit. This institute, in collaboration with the School of Tropical Medicine, Calcutta, has identified the causative agent as *Citrobacter intermedius* and *Klebsiella aerogens,* from samples collected during February and April 1991.

Based on the drug sensitivity pattern of the isolate during investigation, the affected fishes were treated with the poultry drug BIFURAN (Nitrodurozone 100 mg; Furazolidone 14.5 mg/100 mg) at the concentration of 25 ppm in water. Ulcerative wounds healed in five to seven days of therapy. However, cost considerations prevented this from being tried out in larger areas.

In the year 1992, EUS erupted extensively in many districts of the state. It was observed that the outbreaks coincided with the low temperatures prevailing during the post-monsoon rains. Analytical reports of water quality indicate low alkalinity and softness as predisposing factors.

A collaborative effort is now on with the Department of Animal Disease Investigation and Control, Madras Veterinary College, to identify the primary aetiological agent and secondary invaders. A proposal has also been submitted to the state government to establish a microbiological laboratory at Madras. Further, a 'Disease Monitoring Cell', controlled by the Assistant Director of Fisheries (Hydrology), has been formed to monitor the disease and liaise with the nodal agency and the central government at Delhi.

The following preventive and control measures have been suggested to the farmers, with encouraging results:

Prevention

- Better water quality management, as in aquaculture practices.
- Application of unslaked lime in unaffected ponds @ 200 kg/ha once a month for three consecutive months, depending on the pH of the water and soil.
- Restriction on transferring the use of nets and other potentially transmitting agents from infected to unaffected water columns.

Control

The following measures were recommended to reduce the incidence of EUS and the mortality of fish in affected ponds:

- Application of 25 kg turmeric powder and 100 kg unslaked lime, thoroughly mixed and sprinkled over the pond surface, in 1 metre depth of water for every hectare. This should be done once a week for three weeks.
- The use of 200 kg unslaked lime per hectare, three times in 14 days (i.e. on Day 1, Day 7 and Day 14), provided the water pH does not exceed 8.5.

5. Andhra Pradesh

EUS was reported first during October 1990 from the Kolleru Lake of West Godavari and Krishna Districts. Outbreaks occurred in all water areas like irrigation canals, drains, swamps, ponds and lakes. It affected the following species: 1) *Ophicephalus* 2) *Clarias* 3) *Anabas* 4) *Saccobrancheous* 5) *Catfish* 6) *Puntius* 7) Indian major carps like Catla, Rohu and Mrigala. First to succumb to the disease were black fish and major carps in the wild waters. The disease then spread to fish in cultured ponds.

Symptoms were typical—skin discolouration, red spots, haemorrhagic lesions, deep ulcers, and slow and unbalanced movement of fish swimming with heads out of the water. High mortality was found in the wild waters, especially among air breathers, cat fish and *Barbus*. However, EUS was not as prevalent among the major carps in the culture ponds due to preventive measures and the prophylactic use of antibiotics by the farmers of the area.

According to P. Prabhakara Rao, Assistant Director of Fisheries, Andhra Pradesh, the following preventive measures were adopted:

- application of lime @ 50 kg/acre.

- application of salt @ 10 kg/acre through gunny bags hanging from feed poles in the fish tank, and 2 kg of salt/100 kg feed.
- dip treatment with potassium permanganate @ 0.5 to 2% ppm.
- application of antibiotics like oxytetracycline, doxycycline, and terramycin @ 5 gm/100 kg of fish for ten days.
- preventing the entry of diseased fish into the tanks by the use of a mesh.
- adding mineral and vitamin mixtures to the feed.
- avoiding the exchange of water when neighbouring tanks and canals have been affected.
- periodic monitoring of the health of fish.

The following treatment was advised:

1. Application of:

- lime @ 100 kg/acre
- potassium permanganate
- malachite green
- antibiotics like oxytetracycline, doxycycline and terramycin @ 10-20 gm/100 kg of fish for ten days or erythromycin @ 60-100 mg/1 kg of fish feed.

2. Adding to the feed, mineral mixture @ 2% and 100 gm of vitamin mixture per tonne of feed.

3. Stopping the use of manure in the tank during the disease period.

The state's Commissioner of Fisheries has directed the field staff to publish and distribute pamphlets on EUS among the fish farmers in the areas affected by the disease.

6. Kerala

Among the more recent of Indian states to have been affected by EUS, Kerala has rich fishery resources, and fisheries is an important sector of the state's economy. According to D. Sanjeevaghosh of the state's Department of Fisheries, the sector absorbs about 3% of the state's population and contributes to around 2.5% of its Net Domestic Product.

The state's total annual inland fish production is estimated to be 36,000 tonnes from 355,000 hectares of inland waters. Around 200,000 people belonging to 33,000 fishermen families depend entirely on the inland fishery resources for their livelihood. They are essentially subsistence fisherfolk, not much better off than agricultural workers.

EUS was first reported from Pookote Lake in the Banasurasagar reservoir area in the northern district of Wynad in June 1991. The disease took the Department of Fisheries by surprise since it affected even fingerlings cultured in the lake by the Department. In three weeks, it had spread to wells and ponds in Wynad.

By the end of August 1991, EUS had spread to the fresh and the brackish waters of Kuttanad, Vembanad Lake and the rivulets in Kottayam, Alappuzha and Pathanamthitta in the south. The Central Marine Fisheries Research Institute (CMFRI), Kochi, estimates that EUS afflicted 25% of fish in the Vembanad Lake, while cultured fish in only a few ponds were affected.

Contrary to claims by the state government and experts, the disease did not subside with the monsoon. By October it had moved to Thrissur and was reported from ponds and canals inside 'kole' fields. In November 1991 EUS hit Kuttanad again, appearing in Kumarakom, affecting 30% of the fish there. By January 1992 it had spread to the southern-most district, Trivandrum, where 15-30% of the catch in Veli Lake was affected. Two months later, it was reported from the Achenkoil river.

In all, 11 of the state's 13 districts have been visited by EUS, affecting five districts particularly severely. The species affected are murrels, *Clarias, Etroplus, Barbus, Wallago* and *Channa*.

Estimates of the financial losses suffered by Kerala's inland fishworkers vary from the official figure of Rs 20 million to newspaper reports of between Rs 120 and 200 million. (The value of the annual catch from the Vembanad Lake alone is estimated at Rs 100 million).

Sanjeevaghosh of the state Fisheries Department, and Vincent Benedict of the Inland Fisheries Project Cell; Mavelikkara, studied five districts of Kerala (with particular focus on Kuttanad) during September 1991 - April 1992 to assess the socioeconomic impact of EUS on the inland fisherfolk. They found that the spread of EUS had completely paralysed the inland fish market.

Despite official announcements that unaffected fish could safely be eaten, panicky consumers did not bother to make such distinctions, even shunning safe mussels and ducks. In Alappuzha, water for domestic use had to be supplied in tankers since people were afraid to use supposedly contaminated lake water even for washing. (According to Kamonporn Tonguthai, a similar loss of confidence in freshwater fish occurred in Thailand too, in 1982-83, during the initial outbreak of EUS and led to financial losses of over $8.7 million).

In Kerala, the immediate effect of the collapse of the market was to throw inland fishworkers out of work. Particularly hit were women fish vendors, who had to seek alternative employment—often with little success—as agricultural labourers, head-load and quarry workers, rubble breakers, brick makers and construction workers. In many places, illicit brewing became the main source of livelihood. The economic consequences were severe. With earnings almost totally wiped out, fishermen often had to resort to loans with interest rates as high as 180%.

The state government responded to the first reports of EUS by inviting a group of experts from CICFRI to study the disease, while simultaneously setting up a monitoring cell in the Fisheries Directorate. Importantly, it also announced a week's free ration. This was in contrast to other states which did not bother to give any relief in kind to the affected fisherfolk.

Subsequently, agitations by the Kuttanad fisherfolk brought some more relief, when the government agreed to buy EUS-infected fish at Rs 2 per kg. (This was, of course, destroyed). Three fishworkers' unions took up the cause of relief. These were the Kerala Matsya Thozhilali Aikya Vedi, the Matsya Thozhilali Union and the Kerala Swatantra Matsya Thozhilali Federation.

Each union had its own particular emphasis. The Vedi attributed the outbreak of EUS to the unscientific development efforts in the agricultural and fisheries sectors of Kuttanad. The Union demanded free rations for at least one month, supply of drinking water, financial aid and development work at the panchayat level to generate employment.

The Federation demanded financial compensation for the affected fisherfolk. Its agitation received powerful impetus from the fast by its leader Jose Kaleeckal, which forced the government to take action including "fixing a floor price for inland fish catches, adequate compensation and steps to contain the disease".

By November 1991 the government released Rs 3.75 million to the Fishermen's Welfare Board for the payment of compensation at Rs 150 per head. Nonetheless, at the time this report was presented, the distribution of money had not yet begun. In May 1992 the state government, on its own volition, proposed to sanction funds for liming. But whether it actually did so is moot.

Clearly, the implementation of relief measures was not without shortcomings. For one thing, the government was slow to react, reassured by expert opinion that EUS would pass off naturally with changed weather conditions. For another, free rations reached just a few thousand fisherfolk, only those registered with fishermen's societies. As late as October, despite the state's Chief Minister admitting that he had been proved wrong on the recurrence of EUS, neither had the fisherfolk begun to receive cash relief nor were there enough government outlets to purchase the diseased fish.

According to the Kerala participants at the Consultation, but for the campaign by the unions, even this minor relief would not have materialised. Interestingly enough, none of the unions demanded prophylactic measures to combat EUS, despite its evident recurrence. Once the relief measures had been accepted, the demands for control of the epidemic subsided.

One useful by-product of the socio-economic impact of the disease has been the government's fresh attention to research on EUS in Kerala. Since the state experiences two monsoons and has semi-enclosed waters, its condition is specifically different.

The effects on Kuttanad of pesticides and agro-chemicals was debated. According to a very significant Indo-Dutch study on water conditions in Kuttanad, large doses of fertilisers (20,000 tonnes) and toxic pesticides (500 tonnes) had been sprayed over 66,000 hectares of paddy fields. These must have entered the water body each time the fields were drained prior to planting. Also deleterious to the Kuttanad ecosystem has been the Grow More Paddy programme and the construction of the Thaneermukkom salt water barrier which put an end to the erstwhile flushing out of the backwaters during the monsoons.

But a scientist from the Central Institute of Fisheries Technology (CIFT) questioned the conclusion on pesticides. He claimed that residues of pesticides, mercury and cadmium were within accepted levels of toxicity. If high levels of pesticides and heavy metals were the cause of EUS, he argued, then the first outbreak should have occurred in Kuttanad, not Wynad.

The scientists from Thailand supported this line of thinking. Kamonporn Tonguthai pleaded for more experimentation before a specific pesticide could be pinpointed as a triggering factor. She pointed to the case of Laos where, despite the absence of pesticide pollution, EUS was reported. Supranee Chinabut quoted from a study by FAO which questioned pesticides as a causative factor. The study noted the occurrence of EUS in mountain ponds untouched by environmental pollution. Though pesticides could affect water quality, low alkalinity seemed to be the common factor all over South-East Asia, Chinabut added.

This appeared to fit in with the hypothesis of Kerala's experts, that monsoon rains lowered the alkalinity of water, leading to EUS. However, it was pointed out that the

pattern of the monsoons has been the same even prior to 1991. Further, added Sanjeevaghosh, Wynad received less monsoon than Kuttanad, yet was the first site of the disease.

Some of the more far-fetched aetiological conjectures pointed to infected fishlings brought into Kerala by private agencies as well as to droppings of birds which had eaten diseased fish. As for the subjective perceptions of the fisherfolk themselves, Sanjeevaghosh reported that they regarded EUS as a curse of nature and a warning against destructive human intervention into the natural aquatic environment.

Sanjeevaghosh's study brought another dimension to the hypotheses on the origin of EUS. He highlighted the strongly interlinked riverine network of Kerala's water body system. Starting from Wynad in the north, a continuity of water bodies could be established between the Kaveri and the Kaverretty rivers, which flowed through Tamil Nadu and Karnataka, and the three Kerala rivers, viz. Pamba, Achenkoil and Meenachil. Given that EUS had been reported in Tamil Nadu in early 1991 and in Karnataka in 1990, it is likely that the disease spread from those neighbouring states via the riverine network, possibly aided by floods.

IV DIAGNOSIS

In order to distinguish it from other ulcerative conditions, correct diagnosis of EUS is vital. The following table summarises NACA's general findings on the progressive diagnostic symptoms of EUS:

Table 1

Progressive Diagnostic Symptoms of EUS

BEHAVIOUR 1. Reduced appetite. 2. Swim with head out of the water. 3. Floating lethargically. 4. Death.
EXTERNAL SIGNS 1. Small red or grey erosions appear. 2. Lesions expand into large ulcers, loss of scales, haemorrhaging, oedema. 3. Snakeheads may show severe erosion of the head or body cavity.
HISTOPATHOLOGY 1. In early stages, small haemorrhagic lesions on skin surface (epidermis, dermis and hypodermis), not affecting underlying muscle. 2. Early lesions continue to. show mild epithelial necrosis, surrounding oedema, haemorrhage of underlying dermis, and inflammatory cell infiltration, but accompanied with severe necrotizing myopathy, although only a few fungal hyphae enclosed in epithelioid capsules are apparent. No disruption of internal organs. 3. Advanced lesions show large bacterial ulcerations, massive necrotizing granulomatous mycosis of underlying muscle fibres, involving a distinctive branching aseptate oomycete coated with epithelioid cells. Hyphae may invade abdominal viscera and penetrate renal tubules and glomeruli, causing death. Ususally, only mild generalised histopathological changes in other organs.

V TREATMENT AND PROPHYLAXIS

As the above accounts show, successful prophylactic and therapeutic treatments have generally involved the addition of quicklime, a relatively simple and inexpensive way of enhancing water quality. This fact only reinforces the need to overcome the environmentally degrading conditions which may predispose fish to disease.

Salt, potassium permanganate, bleaching powder and malachite green can also be recommended as alternative, or additional, prophylactic measures. Others include formalin, iodine and the peroxide disinfectant VIRKON S. Claims of success have also come from 'traditional' home-spun remedies like the application of crushed tamarind or banana leaves or turmeric powder to the infected ponds. These methods, however, have not been scientifically tested. Antibiotics have been found useful in controlling secondary bacterial infections.

Overleaf is a summary of treatments advised by NACA:

Table 2
Summary of Advised Treatments

POND TREATMENTS — PROPHYLACTIC		
Lime Ca(OH)2	40-100 kg/ha monthly	Depending on pH of water
Bleaching powder	50 ppm 7-10 days before stocking	Disinfects pond
POND TREATMENTS — THERAPEUTIC		
Lime $Ca(OH)_2$	150-600 kg/ha fortnightly depending on pH of water	Sterilizes water and increases alkalinity
Salt	1%	Lowers toxicity of NH3, NO2
Potassium permanganate	3-5 ppm/ha	Inhibits secondary infections
Bleaching powder	1 ppm or 5-10 kg/ha	Disinfectant
FISH TREATMENTS — THERAPEUTIC		
Salt	3-4 % dip	Controls parasites, inhibits bacteria and fungi
Potassium permanganate	5 ppm bath (clean water)	Inhibits secondary infections
Malachite green	1 ppm dip	Fungicide and parasiticide
Antibiotics	Oral, parenteral or bath treatment, as recommended	Controls bacterial infections. Care needed to avoid resistance and residue problems

VI AGENDA FOR FUTURE RESEARCH

A. Aetiology

As reiterated by the Consultation reports, the aetiology of EUS is still shrouded in mystery. Clearly, more studies are needed with particular emphasis, as NACA advises, on investigating the role of Oomycete fungi and viruses in the pathogenesis of the disease. Also required are more detailed descriptions of the histopathological characteristics of EUS and similar ulcerative conditions.

In the case of India, according to I.S. Bright Singh of the Cochin University of Science and Technology and S. Radhakrishnan of the Kerala University's Department of Aquatic Biology and Fisheries, the unavailability of fish cell lines has greatly hampered the progress of research on the viral aetiology of EUS.

Further, some scientists at the Consultation felt that since the primary aetiology of the disease has yet to be identified, it would be unwise to declare unequivocally that the disease can never be transmitted to higher vertebrates.

B. Control

The episodes of EUS narrated at the Consultation point to the need for an integrated approach to fish health, particularly general husbandry and management techniques. This, however, calls for more detailed studies quantifying preventive and curative treatments. Only such studies will produce workable techniques to control EUS in cultured fish populations, and perhaps in wild fish populations in enclosed and semi-enclosed waters.

C. Conservation

In the aftermath of an EUS outbreak, the species left unaffected will be either genetically resistant strains or those which have acquired immunity. The worst affected species might become extinct. Already, in several parts of India, the Channa spp. has almost been wiped out of the water bodies. In addition to conserving them in their natural habitats, suggest Singh and Radhakrishnan, they could also be bred under captivity for ranching operations. These could then be used to repopulate the riverine systems with Indian Major Carps.

D. Environment

As NACA has stressed, environmental factors like temperature, alkalinity, hardness and pH, are important in initiating EUS. But only further, more rigorous, experimental work can determine which ones are really critical.The absence of adequate data on the relationship between a fish and its environment is an obstacle to unravelling the complex relationship between EUS and the environment. In this

context, the continuous and region-wide monitoring programme of selected environmental parameters, established under NACA, ought to help in elucidating these variables.

E. Immunization

If, in the years ahead, EUS starts affecting culture fisheries too, newer and more efficient measures will have to be devised to protect exotic species. Singh and Radhakrishnan suggest immunization against the primary aetiology as the most acceptable proposition to meet such an eventuality. Since there have been isolated instances of carps getting infected with EUS, they also recommend immediate studies on the immune systems of carps, with special reference to the environmental impact on the production of antibodies.

CONCLUSION

As a devastatingly chronic syndrome, EUS has few parallels in the history of fish diseases in inland water bodies in the Asia-Pacific region. Its seemingly relentless spread has only fuelled panic and despair amongst inland fisherfolk and aquaculturists, as became clear from the presentations made at the Consultation.

While scientists are yet to come to firm grips with the aetiology of EUS, experiences from the affected regions suggest simple and invariably effective measures for treatment and prophylaxis.

Evidently, however, much more scientific research remains to be done on the aetiology and histopathology of EUS. Equally important would be further socio-economic analyses of its impact on the livelihood and working conditions of affected fishworkers.

Significantly, the reports presented at the Consultation revealed certain institutional and organizational lacunae. Few governments had any ready-made, adequately responsive institutional arrangements in the fisheries sector to tackle as major a crisis situation as that created by EUS. Not strangely therefore, action was often contradictory—at times slow and at other times, hasty and misdirected.

In this connection, the experience of Kerala, India, demonstrated the power of mass-based campaigns and agitation programmes by fishworkers' organizations. Such grass-roots action forcibly elicited responses from the state. These may not have been as effective as many fishworkers would have desired. However, they certainly represented some form of redressal.

In this perhaps lies a pointer to the future of collective action. As the tides of confusion and ignorance continue to retard scientific progress in unravelling the mystery of EUS, only such campaigns can hope to bring succour to the affected fishworkers.

APPENDICES

1. Consultation Agenda
2. List of Participants
3. Reporting Form
4. Sampling Procedure
5. Useful Addresses
6. On ICSF

APPENDIX 1

AGENDA

CONSULTATION ON EPIZOOTIC ULCERATIVE SYNDROME (EUS)

VIS- A-VIS THE ENVIRONMENT AND THE PEOPLE

25-26 May 1992, Institute of Management in Government
Vikas Bhavan, Trivandrum 695 033, Kerala, India

MONDAY, 25 MAY 1992

0900 - 0930	**Registration**
0930 -1015	**Inaugural Session**
Chairperson:	Ms Valsalakumari Director of Fisheries, Government of Kerala
Welcome & Introduction:	John Kurien Associate Fellow, Centre for Development Studies Trivandrum (ICSF Member)
Chairperson's Address	
Inaugural Address:	Prof. C.G. Ramachandran Nair Chairman, Committee on Science & Technology Govt. of Kerala
Vote of Thanks:	Sebastian Mathew Executive Secretary, ICSF
1015 -1030	**Tea**

1030 -1300 **Technical Session I**

Chairperson: Prof. P.C. George
Senior Fishery Adviser (Retd.), FAO

Paper I -
Keynote Address: Overview of EUS in the Asia-Pacific Region

Dr. Kamonporn Tonguthai
Aquatic Animal Health Research Institute
Kasetsart University, Bangkok

Paper II - Status of Research on EUS in Thailand

Dr. Supranee Chinabut
Aquatic Animal Health Research Institute
Kasetsart University, Bangkok

Paper III - Water Quality and the Outbreak of EUS: The Thai Experience

Dr. Nontawith Areechon
Department of Aquaculture, Faculty of Fisheries
Kasetsart University, Bangkok

1300 - 1400 **Lunch**

1400 - 1500 **General Discussion on Technical Session I**

1500 - 1515 **Tea**

1515 - 1615 **Technical Session II**

Chairperson: Prof. P. Natarajan
Head, Dept. of Aquatic Biology & Fisheries
University of Kerala

Paper IV - Status of EUS in India

Dr. Manas Kumar Das
CICFRI, Barrackpore

1615 - 1715 **General Discussion on Technical Session II**

TUESDAY, 26 MAY 1992

0900 - 1030 **Technical Session III**

Chairperson: V. Vivekanandan
Chief Executive, SIFFS
Trivandrum(ICSF Member)

EUS: Experiences of Individual States of India:
Reports from Various State Govt Representatives

- Andhra Pradesh
- Karnataka
- Kerala
- Manipur
- Orissa
- Tamil Nadu
- West Bengal

1030 - 1045 **Tea**

1045 - 1145 **General discussion on Technical Session III**

1145 - 1300 **Technical Session IV**

Chairperson: Dr. Wolf-Dieter Hartmann
Team Leader, COFAD-GOPA
Freshwater Fisheries Biological Research Station, Palghat

Paper V - Socio-economic Impact of EUS on the Inland Fishworkers of Kerala

D. Sanjeevaghosh
Department of Fisheries, Government of Kerala

1300 - 1400 **Lunch**

1400 - 1530 **General Discussion on Technical Session IV**

1530 - 1545 **Tea**

1545 - 1700 **Concluding Session**

APPENDIX 2

CONSULTATION ON EPIZOOTIC ULCERATIVE SYNDROME 25-26 MAY, IMG, TRIVANDRUM, KERALA

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APPENDIX 3

STANDARDIZED FORM FOR MONITORING AND REPORTING OUTBREAKS OF EUS
(Source : NACA)

Date :_____

Collected by :_____ Agency:_____

Signature:_____ Address :_____

Site Description

1. Country :_____

2 Location

Province :_____ Village :_____

District :_____ Block # :_____

City :_____ Ward # :_____

Town :_____ Other :_____

3. Type of Water Body :

Lake ☐ Rice-field ☐ Canal ☐

Reservoir ☐ River ☐ Pond ☐

Swamp ☐ Other :_____

4. Fish species found :_____

Size of pond (ha) :_____

Stocking rate (fish/m2) :_____

Aquaculture practices, if any :_____

Fish Population Data

Collect a random sample of as many fish as possible from affected site and record the following:

Fish species	No. of fish	No. infected	% infection	Severity of infection

Separate infected fish samples and take the following data:

Fish species	Length range (cm)	Weight range (gm)	Other remarks/ observations

Water Quality Data

(To be conducted on site at least once during the outbreak period)

Time: _____ Date: _____
(Preferably in the morning)

Water temperature

Turbidity

Depth

Acidity

Alkalinity

Ammonia (T)

Ammonia (Un-ionized)

Dissolved oxygen

Hardness

Chloride

Carbon dioxide

Nitrite

pH

Other Laboratory Examination:

(To be undertaken where facilities/capabilities exist)
(See guidelines for proper collection of fish samples)

	Samples collected	Results enclosed	Results awaited
Histopathology	☐	☐	☐
Parasitology	☐	☐	☐
Bacteriology	☐	☐	☐
Virology	☐	☐	☐
Mycology	☐	☐	☐
Heavy metals	☐	☐	☐
Pesticides	☐	☐	☐

Other remarks : (Please state if sent to other institutions for further examination)

Name of Institution:_____
Address:_____
Contact Person:_____
Date sent:_____
Status:_____

Economic Data

(To be taken from fish-pond owner and fish market vendor)

1. Quantity of fish dead in kg (per species, if possible): _____
_____

2. Value (US$) of fish lost :_____
_____

3. Fish market price:_____

	Fish species	Price before outbreak	Price after outbreak
a.			
b.			
c.			
d.			

4. Other information regarding impact on fish farmers, consumers, etc.:

Collection of Diseased Specimens

(Collect at least one sample/species of all infected species and preserve in 10% formalin for future reference)

APPENDIX 4

PROCEDURE FOR SAMPLING FISH FOR HISTOPATHOLOGICAL EXAMINATION

(Source: NACA)

1. Sample only live specimens of diseased fish. If clinical symptoms are readily apparent, several samples of each species should be collected, preferably at different stages of infection.

2. Dissect large fish and take samples of skin/muscle, spleen, kidney and liver. The muscle section should include the lesion and the surrounding tissue. Small fish can be slit along the abdomen and preserved whole.

3. Fix the tissues immediately in cold 10% formalin. The amount of formalin in the jar should be 15-20 times the volume of the tissue to be fixed.

4. Gently agitate the fixative 2-3 times over the first hour after adding the tissue.

5. The selected site should be sampled repeatedly over the affected period and specimens sent to a centralised facility.

APPENDIX 5

USEFUL ADDRESSES

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APPENDIX 6

ON ICSF

The International Collective in Support of Fishworkers (ICSF), formed in Trivandrum, India, in 1986, is a global, multi-faceted network of community organisers, teachers, technicians, researchers and scientists, linked by a close association with fishworkers' organisations in their respective areas of work.

ICSF's ultimate commitment is to the thousands of fishworkers, especially in developing countries, who have been inexorably pushed to the periphery of society by a process of development which is at once lop-sided and inequitable. ICSF hopes to contribute towards a reversal of this state of affairs.

ICSF's activities can broadly be divided into four areas, although they are often complementary and integrated. These are Monitoring and Research; Exchange and Training; Campaigns and Action Programmes; and Communications.

Monitoring and Research deals with the impact of technology, legislation and aid on small-scale fishworkers. Also studied are their work and living conditions, the role of women, the socio-economic impact of modern aquaculture practices, and the degradation of the working environment. In this area, ICSF strives for the participatory involvement of the fishworkers themselves.

The **Exchange and Training** programme seeks to facilitate a South-South dialogue aimed at lessening technological and organisational dependence on the developed countries. At the same time, there is no bias against any South-North dialogue, which is also encouraged to increase solidarity among fishworkers and their supporters.

The **Campaigns and Action** programmes highlight and seek to alter processes that have adversely impacted on fishworkers' access to resources, working conditions and livelihood. With this in mind, ICSF participated in the recent Earth Summit at Rio. It also intends to make widely known the implications of bilateral and multilateral fishery agreements.

The **Communications** component disseminates information on ICSF's activities through several publications under the generic title SAMUDRA, which means 'ocean' in many Asian languages. There are two regular publications-the SAMUDRA NEWSLETTER, circulated among ICSF members, and the SAMUDRA REPORT, for a wider, more general audience. Detailed research studies, usually commissioned, are published in the SAMUDRA series of MONOGRAPHS/DOSSIERS.

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E.N.I.G.M.A O.F E.U.S

In the last two decades a serious and severely damaging fish disease has been spreading through countries of the Asia-Pacific region with dangerous consequences. Not only is this disease — now officially termed Epizootic Ulcerative Syndrome (EUS) — a scientific puzzle, it is also a worrisome social problem. Hundreds of inland fishermen, often the more marginalised amongst the fishworker communities in the affected countries, have been overnight deprived of their incomes, as consumers began to totally reject the disfigured, disease-stricken fish.

It was in this context that the International Collective in Support of Fishworkers (ICSF), in co-operation with the Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, organised a two-day cosultation on "EUS vis-à-vis the Environment and the People" in Trivandrum, India, during 25 and 26 May 1992. *Enigma of EUS* is a report of the consultation. While it does not purport to be a verbatim account of the two-day deliberations, it does record the important issues raised, the experiences exchanged and shared, and suggests how grand conclusions about as enigmatic a disease as EUS are ultimately elusive.

The ICSF, formed in Trivandrum, India, in 1986, is a global, multi-faceted network of community organisers, teachers, technicians, researchers and scientists, linked by a close association with fishworkers' organisations in their respective areas of work. ICSF's ultimate commitment is to the thousands of fishworkers, especially in developing countries, who have been inexorably pushed to the periphery of society by a process of development which is at once lop-sided and inequitable. ICSF hopes to contribute to reversing this state of affairs.