

NOTES ON A *SAPROLEGNIA* EPIDEMIC AMONGST QUEENSLAND FISH.

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(*Read before the Royal Society of Queensland, 26th November, 1917.*)

Early in July, 1917, Mr. F. Mills wrote on behalf of the local authorities at Longreach, in Central Queensland, to the Health Department, Brisbane, stating that large numbers of fish were dying in the Thomson River from some unknown cause, and as the river was not running, it was feared that the drinking of such polluted water supply by the local residents might be injurious. He went on to say that it was commonly reported that the same state of affairs existed in all the western rivers from Longreach to Mackinlay, the disease affecting nearly all species of local fish. Owing to the extent of the waterholes (*i.e.*, the chain of ponds which represent the western rivers during the dry period of the year), and the great destruction of fish which was taking place, it was found impracticable to keep the water clear of dead fish; consequently the water supply was in danger of contamination. The letter was eventually forwarded to the Director of the Queensland Museum.

In August a note was received at the Museum through the Inspector of Fisheries, Brisbane, from Mr. A. Sugden of the Quilpie pumping station, in connection with the extension of western railway line in Southern Queensland. He stated that various fish, particularly the "black bream" *and "jew fish," and, to a less extent, the "yellow

*Mr. J. D. Ogilby informs me that the fish mentioned are black bream = *Therapon* sp.; jew fish = *Tandanus tandanus* or else *Neosilurus hyrtlui*, probably both; and the "yellow belly" = *Plectroplites ambiguus*.

bellies," or "golden perch," were affected in the Bulloo River by a disease which appeared to cause death by suffocation, and that quantities of dead fish were to be seen floating on the surface of the waterholes, giving rise to anxiety on the part of those persons who were compelled to use such water supply. He further mentioned that it was reported that the fish in Cooper's Creek were similarly affected, and that wild pigs were fattening on them. The disease was not observed at Cheepie, in the Beechel Creek, a tributary of the Paroo River. A fresh-water catfish or jew fish (identified by Mr. Ogilby was *Neosilurus hyrtlui* Steind.) was sent down by Mr. Sugden to the Museum and was referred to me. On examination, it was found to be heavily parasitised by the fungus *Saprolegnia*.

A conversation with Mr. Mills, who saw the specimen, convinced me of the identity of the cause of the outbreak in the two localities. Dr. J. S. C. Elkington, Federal Quarantine Officer for this State, informed me that he had observed numbers of dead perch and catfish* floating down the Brisbane River in the vicinity of the city during August and part of September of this year (1917).

From the above it will be noted that the epidemic had a very wide distribution during the late winter, extending over practically the whole of western Queensland and occurring in the south eastern corner of the State also. It involved rivers belonging to the inland drainage system, at least one flowing into the Gulf of Carpentaria and one into the Pacific. The affected area must have comprised many thousands of square miles.

On receiving my identification of the malady, the late Director, Dr. R. Hamlyn-Harris, wrote to the Southern States for information. In reply, Mr. E. Harkness, of the Fisheries Department, New South Wales, forwarded a copy of an article by Brotherston† as well as notes on one by Day‡, and mentioned that one of his officers who had spent many years in Queensland, stated that over twenty-five years ago "yellow-bellied perch" were dying in large

*Mr. Ogilby states that this perch is *Sciaena australis* Gunther, and the cat fish are *Tandanus tandanus* and *Neosilurus hyrtlui*.

† A. Brotherston. "Salmon disease" in Herbert's "Fish and Fisheries."

‡ Day. Salmonidæ of Britain.

numbers at Lammermoor Station, on a tributary of the Barcoo. This fish he believed to be identical with the golden perch of the Murray River, *Plectroplites ambiguus*. A thunderstorm brought down a freshet heavily charged with silt and the fish mortality apparently ceased. The cause was believed to be *Saprolegnia*, or some related fungus.

Mr. C. E. Lord, Hobart, wrote stating that *Saprolegnia* was well known in Tasmania, where it attacked fish, particularly in dry seasons, and although the fungus could be controlled in the hatcheries by immersing diseased fish in a salt water bath, no method of treating the affected lakes and rivers of the island had been discovered.

As far as I have been able to ascertain, *Saprolegnia* has not been as yet recorded as occurring in Queensland. Bailey* does not mention it in his census of our plants, nor do either McAlpine† or Cooke‡ make any reference to its presence in any of the Australian States. In 1888, however, Mr. J. D. Ogilby** reported that black bream *Chrysophrys australis* (= *Sparus australis*) and eels, *Anguilla australis* were taken in the freshwater portion of the Port Hacking River, N.S.W., dying from disease caused by *Saprolegnia* sp. A concise description of the appearance of affected fish was given. He believed that the prevalence of the parasite was due to the long continued drought and to the almost complete stagnation of the fresh water. Dr. J. C. Cox in commenting on Mr. Ogilby's remarks, pointed out that the epidemic was due to the unhealthy and unnatural conditions under which the drought had compelled these particular fish to live. In 1902 Dr. Greig Smith§ exhibited before the Linnean Society of N.S.W., a salmon affected with *Saprolegnia ferax*, which was forwarded to him from Tasmania.

The specimen submitted to me presented the typical appearance of a *Saprolegnia* infested fish. There were

* F. M. Bailey. Comprehensive Catalogue of Queensland Plants, 1912, Govt. Printer, Brisbane.

† D. McAlpine. Systematic Arrangement of Australian Fungi, 1895.

‡ N. C. Cooke. Handbook of Australian Fungi, 1892.

** J. D. Ogilby. Note on the cause of death in fishes from the National Park, N.S.W. P.L.S., N.S.W., 3 (n.s.), 1888, pp. 890-1.

§ Greig Smith. Notes and Exhibits P.L.S. N.S.W., 27, 1902, p. 495.

greyish-white flocculent fungoid patches covering the skin of the greater part of the head, body and fins—detached and flaky in places. Entangled amongst the fungus were particles of reddish or orange grit probably added by the fish in its attempts to rub off the parasite against the river bank or gravel. On examination the fungus was seen to possess the characters of the genus *Saprolegnia*, falling into the subgenus *Eusaprolegnia* (*S. ferax* group) as defined by Schroeter* and by Hofer†. Though abundant sporangia were present, no mature sexual organs were detected and consequently a specific determination could not be satisfactorily made, though the parasite is most probably *S. ferax* Nees (or *S. thureti* de Bary, which apparently is a synonym‡). Huxley gave an account of *S. monoica*** a very closely related form which also affects fish§.

The gills were invaded, and on examination were seen to be partly denuded of their epithelium and even of some of their more deeply-lying tissues, so that parts of the branchial arches came to project freely. The whole gill apparatus was clogged by the presence of large blood clots and mucus penetrated by the mycelium from which sporangia were developed. Sections of an infected gill and of the skin were made. Lying above the skin was a covering or feltwork of hyphæ which readily became detached during the manipulation, but the rooting hyphæ or haustoria could be seen at intervals penetrating into the

* J. Schroeter. *Saprolegniinæ* in Engler and Prantl's *Natürlichen pflanzenfamilien* Teil 1, Abt. 1, 1897, pp. 97-8, and fig. 77 B. and C.

† B. Hofer. *Handb. d. Fischkrankheiten*. Stuttgart, 1906, pp. 106-7.

‡ F. Gueguen. *Les Champignons parasites de l'homme et des animaux*, Paris, 1904; p. 82, pl. 6.

** T. Huxley. *Saprolegnia* in relation to the salmon disease. *Q.J. M.S.* 22, 1882; *Nature* 25, 1882, p. 437.

Gueguen. *l. c.*, p. 81.

Schroeter *l. c.*, p. 98.

§ The chief literature regarding *Saprolegnia* is listed by Schroeter (*l. c.*, p. 93); Gueguen (*l. c.*, pp. 90-2); and De Bary, *Vergl. Morphol. n. Biol. d. Pilze*. 1884, p. 157. Cytological work on one species of the genus has been published recently by P. Dangeard (*Bull. Soc. Mycol. France*, 32, 1916, pp. 87-96), an abstract appearing in the *J. R. Micr. Soc.*, 1917, (3), p. 323. Various methods of cultivating *Saprolegnia* have been published, the information being summarised by Gueguen (*l. e.*, p. 79-80).

skin between the epidermal cells, which were more or less destroyed. The underlying narrow layer of dermal muscular fibres did not seem to be much affected, though the connective tissue of the dermis was apparently injured or destroyed, especially between these dermal fibres and the adjacent body musculature. The latter readily broke up into bundles or even into fibres, this no doubt being due to the destruction or loosening of the surrounding connective tissue.

Hofer* mentions that according to the duration of the disease, there may be produced only epithelial injuries or a complete destruction of the subcutaneous layers, or there may be relatively deep crater-like erosions into the musculature even in living fish. He goes on to say that it has not been definitely determined whether the destruction of the cells surrounded by the hyphæ which nourish themselves by diffusion of the cells' contents, is caused by a toxin produced by the fungus, or whether it is the result of a loosening of the cells from their surrounding structures and a deprivation of their oxygen supply.

In sections of the branchiæ one could readily see that a large amount of gill substance had been destroyed by the fungus. The spaces between adjacent gills and between the two hemibranchs of the same gill were choked up with blood and mucus, the blood cells in places forming relatively large masses or clots continuous with the eroded ends of ruptured branchial blood-vessels. The epithelium of the gills was destroyed, as also were the branches of the branchial veins on the outer side of each hemibranch, though the capillaries extending between the arteries and veins were intact, probably being protected by their deeper situation in the gill substance. Sometimes the branches of the branchial arteries were eroded. Commonly it was impossible to determine the outer limits of the gill owing to the destruction of the epithelium and the superficially situated blood vessels, whether afferent or efferent branchials, whose contents merged into the surrounding clots. The latter were penetrated by hyphæ as also was the gill tissue itself. The mere presence of the fungus would act mechanically as a hindrance to the free circulation of water through the

* Hofer. *l. c.*, p. 101, pl. 10.

gills and thus impede aeration. When we consider the effect of the parasite destroying the tissues, we can readily understand why death soon follows. The presence of hæmorrhage clogging the gills would accelerate the result.

Much has been written regarding the parasitism of *Saprolegnia*, but it is generally admitted that the fungus is a saprophyte and a facultative parasite, *i.e.*, it can become parasitic when circumstances are favourable. Such would occur if the fish be weakened in any way, either by sickness, by lack of food, by unsuitable surroundings (*e.g.* stagnation of the water, excessive fungoid or bacterial life depleting the oxygen supply), or by injury to the skin, whether caused mechanically or resulting from invasion by animal parasites. The rapidity with which the fungus extends over the affected fish depends especially on the resistance of the host's skin and to a less degree on the temperature. Healthy fish in suitable surroundings are apparently not affected.

In freshwater hatcheries and aquaria *Saprolegnia* may become a very serious pest, consequently all conditions which interfere with healthy fish life—such as those mentioned above—should be guarded against, diseased and dead fish and insects should be removed, since the fungus is able to fructify on these.

As remedies for infected fish, Hofer mentions a number of solutions—10 per cent. saline, .01 per cent. sublimate, .01 per cent. magnesium sulphate, zinc or copper sulphate, weak boracic or salicylic acid, 1 per cent. potassium permanganate. These should be applied by means of a sponge to remove and destroy superficial hyphæ and sporangia but the more deeply situated mycelium is still capable of reproduction. Sometimes fish are placed for half an hour in a bath containing one grain of potassium permanganate in 100 litres of water, aeration being resorted to during the bathing operation. This quantity of solution is said to be sufficient for ten pounds of fish. In the case of diseased salmon, their removal to the sea is known to destroy the fungus.

When small ponds are infected it has been recommended that they be drained and then disinfected by using lime

water. The use of permanganate under such circumstances is condemned.

The above information may be of some use in the case of aquaria and fish hatcheries but is not applicable to the Queensland conditions where large expanses of water in widely distributed areas are concerned. Where the town water supplies are affected, little can be done beyond removing any dead and dying fish that can be reached—also any surplus vegetation. This may perhaps be done by netting. The boiling of such water before use is of course advisable.

The state of affairs existing in the late winter was due no doubt to the long period of dry weather restricting the flow of the rivers and converting them into a chain of water-holes. Thus stagnant conditions prevailed, leading to unhealthy environment for the fish, causing weakness and thereby giving *Saprolegnia* an opportunity to exchange a saprophytic existence for a parasitic mode of life. The death of numbers of fish would increase the amount of organic pollution and deplete the oxygen supply owing to the presence of abundant saprophytic bacteria and fungi, thus still further aggravating the position. The arrival of the rainy season should soon remedy the trouble as the rivers will be set in motion, aeration will be improved, and the surroundings become again suitable for healthy fish life.

Since the above was written, Mr. C. Booker, M.L.A., has informed me that during the recent very dry weather (August and September) thousands of dead fish were to be seen in the Wide Bay district, in Wide Bay Creek and the Mary River, whose waters had become stagnant and contained abundant vegetation. Amongst the affected fish seen by him were jew fish (*Tandanus* and *Neosilurus hyrtlui*); Murray cod (*Oligorus macquariæ*); ceratodus (*C. forsteri*); mullet (*Mugil dobula*); bony bream (*Dorosoma come*); and perch (probably *Plectroplites ambiguus*, though perhaps it may be *Sciæna australis*)*. The epidemic disappeared after the rains set in.

*All names kindly supplied by Mr. J. D. Ogilby, of the Queensland Museum.



Johnston, Thomas Harvey. 1917. "Notes on a Saprolegnia Epidemic amongst Queensland Fish." *The Proceedings of the Royal Society of Queensland* 29, 125–131. <https://doi.org/10.5962/p.351435>.

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