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Parasites of Channel Catfish in Illinois Hatcheries

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Abstract

Ninety channel catfish (Ictalurus punctatus) were trapped during September 1973 through April 1974 at three hatcheries located at Worden, Centralia, and Kinmundy, Illinois. All were examined for parasites and 87 were parasitized. The trematodes Azygia angusticauda and Neascus sp. were found in the gastrointestinal system and Cleidodiscus floridanus and Dactylogyrus sp. were attached to the gills. Five cestode genera, including Bothriocephalus sp., Corallobothrium giganteum, Eubothrium sp., Haplobothrium sp., and Proteocephalus ambloplitis were present. Rhabdochona sp. was the only nematode found. Protozoans; Costia sp., Myxobolus sp., Scyphidia macropodia and Trichodina discoidea and one kind of glochidium were observed. Three nonparasitic diseases were noted, Anemia, Dietary gill disease and Lipoid degeneration of the liver, all from fish collected at one location, and one form of bacterial infection, Chondrococcus columnaris, from fish at another site. The incidence of parasitism, developmental stage and organ parasitized are discussed. Effects of age, weight, sex and seasonal distribution on the extent of parasitism are also compared.

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INTRODUCTION

According to Belding, (1927) most fish destruction in nature is either a result of adverse environment or disease. The majority of common fish parasites have no serious effect although a number do cause extensive damage to their fresh-water and marine hosts. The annual loss, due to parasitic disease in economically important species, ranges into the millions of dollars (McCraren, 1973). While fish parasites are rarely dangerous to humans, they may render the fish host unfit for consumption. Reports on new types of fish diseases appear in the literature from time to time (Van Cleave 1919, Hoffman 1967, Davis 1953, Rock and Nelson 1965, Spall and Summerfelt 1969, Harper 1972, and McCraren 1973) but current knowledge of fish pathology is primitive and much study remains to be done.

Catfish farming is a big business in the United States (Lewis 1963, 1969, Crance 1967, Hickling 1968, Anonymous 1969a, 1970, and Jones 1970) and more people now than before depend upon these fish as a source of protein. The United States imports nearly 75 per cent of all commercial fish products used. Therefore, ways of growing fish more efficiently is a problem to be solved. Such a solution

depends in part on understanding those diseases that affect fish productivity. The present study was undertaken due to the paucity of research on the parasites of channel catfish, Ictalurus punctatus and the fact that it is the most widely farmed fish at Illinois fish farms.

LITERATURE REVIEW

Despite current interest, modern techniques and reports of new types of fish diseases appearing in the literature from time to time, our knowledge of fish pathology is equivalent to human pathology of the 17th century (Pauling, 1971). Two modern comprehensive treatises on parasites and diseases of fish exist. The work of Davis (1953), deals extensively with diseases and parasites of game fish and the problems of culturing and maintaining hatchery fish. Hoffman (1967) presents an extensive survey of the parasites of North American fish, with categorical itemization of all the parasites affecting a particular group. An excellent list of parasites of Ictalurus punctatus, the channel catfish, is noted.

Harms (1959, 1960) did impressive studies on parasites of three ictalurid species, including I. punctatus. This author deals with the developmental stage, host specificity, organ parasitized, intensity and incidence of infection and pays particular attention to the ecological habitat of the host and the season of the year. Studies on rearing channel catfish in cages were done by Lewis (1969). He found the possibility of greatly increased incidence of diseases and parasites, due to

the high densities of fish confined in the cages, and the dependence on artificial feed. He stated that food for caged fish must be more nutritionally complete than food provided for pond fish as they may also utilize natural food found in the habitat.

Techniques of investigation, diagnosis, prophylaxis, hygiene and therapy are a very important part of any disease research. Amlacher (1970) deals with such techniques as well as the biology of specific parasites. Diseases having particular affiliation with channel catfish were reported.

With the factor of parasites and diseases continuing to be the major cause of financial loss in catfish farming, Thompson and Lewis (1970) expounded on the more troublesome parasites they encountered in the culture of I. punctatus in their Illinois hatcheries. Suggested control measures for the parasites Trichodina, Icthyophthirius, Myxosporidia, Scyphidia, Dactylogyrus, Columnaris and bacterial infection of the gut were cited. Clemmens and Sneed (1958) list chemical controls for parasites and diseases of I. punctatus. Bangham (1927) writing on diseases of fish in Ohio hatcheries reported disease problems similar to those found in Illinois hatcheries.

Few studies on specific parasites and diseases of channel catfish occur in the literature. Spall and Summerfelt's (1969) studies on an Oklahoma reservoir, concerned the host-parasite relations of certain endoparasitic helminths of the channel catfish. Davis (1922)

gave particular attention to a new myxosporidian protozoan of I. punctatus, which was described and named. Essex (1928, 1929) expounded on a new species of tapeworm, Crepidobothrium fragile. Sneed (1961) provided additional knowledge about Corallobothrium, a particularly troublesome cestode of channel catfish. Van Cleave (1919), doing a preliminary survey of Acanthocephala from fish of the Illinois River, cited one incidence of Echinorhynchus thecatus from I. punctatus. One study on Trematoda in channel catfish was located in the literature. Surber (1928) discussed Megalogonia ictalur, a new species of trematoda in I. punctatus.

Research on the straight gram negative rods of the bacterium, Aeromonas liguefacions, which locates on channel catfish, was carried out by Rock and Nelson (1965).

A few articles on miscellaneous diseases of particular importance to hatcheries were located. Phillips (1940), Phillips and Brockway (1947) and Tunison et al (1944) concerned themselves with the question of anemia in fish with discussions centering around exactly what constituted anemia and feasible control methods. To curb the imbalance of nutrients, the addition of fresh meat, particular vitamins and the other essentials needed in the synthetic diet were made. New light on the etiology of a similar problem, dietary gill disease, was shed by Tunison et al (1944), Wolf (1945) and Rucker et al (1952). They found this disease very similar to bacterial gill disease; yet fish with

the dietary form fully recovered with the addition of pantothenic acid.

A viral disease organism unique to I. punctatus has been recently discovered in hatcheries; this organism is channel catfish virus. Plum (1971), Wolf, Herman and Carlson (1972), Fijan, Wellborn and Naftel (1971) and McCraren (1973) have researched this new problem. In addition to being unique to channel catfish, channel catfish virus (CCV) is the only known virus disease of warm water fish in North America which causes serious losses. Fish farmers reported 100 per cent losses in affected lots (McCraren, 1973). The main concern centers around interstate shipments of fish which will spread the disease beyond its present distribution.

MATERIALS AND METHODS

Fish were obtained by utilizing net traps at Opel's Fish Farm at Worden, Illinois, Aydt's Fish Farm at Centralia, Illinois, and the Illinois Natural History Survey Hatchery Ponds at Kinmundy, Illinois. Ninety fish were trapped from September 1973 through April 1974. All fish collected were transported live to the laboratory and sacrificed by a sharp blow to the nape region. Immediately following death, specimens were weighed, measured to establish age (Anonymous, 1969b) and sexed after which they were examined for parasites. A dissection microscope was used to examine each fish for external parasites. Parasites observed were removed to microslides, fixed in five per cent formalin, and a coverslip mounted with CMC medium (Turtox Mfg. Co.).

Mucus scrapings were taken from the lateral portions of the body, tail, caudal fin and axillae of all other fins. Scrapings were placed on microslides in a drop of physiological saline and a coverslip applied. These preparations were examined for additional parasites using a compound microscope with a 10X objective.

The lower jaw was removed by cutting to the operculum; the

gill structures were removed, placed with warm physiological saline in a Syracuse watch glass and examined under a dissection microscope for adhering parasites. Protozoan parasites seen were placed in depression slides with a solution of methyl cellulose and physiological solution (1 to 3).

Two drops of blood were taken from the heart using a 1 cc syringe and a 23 gauge needle. Blood smears were made, stained with Giemsa and examined for hemoparasites.

The gastrointestinal tract of each fish was removed following ventral, lateral and opercular incisions. The tract was placed in a petri dish containing physiological saline at room temperature and contents removed. The entire muscosal lining was examined using a dissecting microscope and any parasites observed were transferred to watch glasses with warm saline.

Air bladder, gall bladder, and urinary bladder contents were placed on microslides and examined microscopically as were teased portions of kidney and liver. Parasites thus observed were treated as those from gut contents.

All parasites were ultimately fixed in five per cent formalin and mounted with CMC medium.

Protozoan parasites were identified using Jahn (1949), Kudo (1934, 1966), Wellborn and Rogers (1966), Hoffman (1967), and Thompson and Lewi s (1970). Helminths were identified using Harms (1969),

Sneed (1961), Hoffman (1967), and Hoffman and Meyer (1974). Pathological conditions other than those caused by parasites were diagnosed according to the descriptions in Phillips (1940), Phillips and Brockway (1947), Davis (1953), Amlacher (1970), and Harper (1972).

RESULTS

The average length of ten fish collected from Opel's Pond was 5.3 inches with a range of 3.8 inches to 6.2 inches. These data indicate all fish collected at this station were six months to one year of age. Seventy fish collected from Aydt's Pond had an average length of 5.1 inches and a range of 4.0 inches to 9.0 inches. This placed them in the one to two year old group. An average of 4.2 inches and a range of 3.0 inches to 5.3 inches was observed for the ten fish collected at the Natural History Survey Pond. These were placed in the six month to one year age group.

The average weight was 1.3 ounces (range .5 to 2.5 ounces) for Opels Group, .8 ounces (range .3 to 3.0 ounces) for the Aydt's group and 1.0 ounces (.3 to 1.5 ounces) for the Natural History Survey Group.

Opel's Pond had a 1:2 male to female ratio, Aydt's Pond a 1:1.3 and the Natural History Survey Pond a 1:1.5.

Eighty-seven of the ninety fish examined were parasitized. Three categories of helminth parasites were found and four kinds of protozoan parasites, in addition to molluscan glochidial forms. The

glochidia were apparently of one kind and tentatively identified as Quadrula pustulosa. Also three non-parasitic diseases and one kind of bacterial infection were noted.

No Protozoa, Nematoda or dietary related diseases were observed in the Opel Pond Collection (Table 1). Two genera of trematodes, two of cestodes, one of Mollusca and a bacterial infection were observed. The highest incidence of parasitism was in the cestode category (Corallobothrium 100%).

The Aydt Pond Collection accounted for three genera of Protozoa, four of Trematoda, five of Cestoda, one of Nematoda, one of Mollusca and two other diseases (Table 2). Highest incidences of parasitism were in the trematode category (Dactylogyrus 72.9%) and the cestode category (Corallobothrium, 60.9%).

The fish collection of the Natural History Survey had two genera of parasites located in each of the Protozoa, Trematoda and Cestoda categories with the highest incidences of parasitism also in the categories Trematoda (Dactylogyrus, 70%) and the Cestoda (Corallobothrium, 70%), (Table 3).

Fish of the Opel Pond Collection were all six months to one year of age, 90% were parasitized and all parasites were located internally.

The Aydt Pond fish in the six month to one year class were 96.9% parasitized with 55 fish having only internal parasites and seven having both external and internal. The one to two years class was 100%

Table 1. A checklist of parasites of 10 Ictalurus punctatus (4 males and 6 females) collected at Opel's Pond, Worden, Illinois; September - November 1973.

Parasite Categories	Parasite	No. Hosts Parasitized M	F	Incidence of Parasitism	Developmental Stage	Organ Parasitized
Protozoa		-	-	-	-	-
Trematoda	Azygia angusticauda	2	2	40%	Adult	Intestine
	Dactylogyrus sp.		3	30%	Adult	Gill filaments
Cestoda	Bothriocephalus sp.	1	3	40%	Immature and Adult	Stomach and intestine
	Corallobothrium giganteum	4	6	100%	Plerocercoid and Adult	Intestine
Nematoda		-	-	-	-	-
Mollusca	Glochidia of Quadrula pustulosa	2		20%	Glochidium	Gill filaments
Other Diseases		-	-	-	-	-
Bacteria	Chondrococcus columnaris		1	10%	Advanced	Gill filaments

Table 2. A checklist of parasites of 70 Ictalurus punctatus (26 males and 44 females) collected at Aydt's Pond, Centralia, Illinois; September 1973 - March 1974.

Parasite Categories	Parasite	No. Hosts Parasitized M	No. Hosts Parasitized F	Incidence of Parasitism	Developmental Stage	Organ Parasitized
Protozoa	Costia sp.	1	1	2.1%	Adult	Skin
	Scyphidia macropodia	2	1	4.0%	Adult	Skin
	Trichodina discoidea	3	7	14.2%	Adult	Skin
Trematoda	Cleidodiscus floridanus	1	4	7.1%	Adult	Gill filaments
	Dactylogyrus sp.	26	25	72.9%	Adult	Gill filaments
	Neascus sp.	1		1.4%	Adult	Liver
Cestoda	Bothriocephalus sp.	2	6	11.4%	Adult	Stomach and intestine
	Corallobothrium giganteum	20	28	60.9%	Plerocercoid and Adult	Intestine
	Eubothrium sp.		1	1.4%	Adult	Intestine
	Haplobothrium sp.		1	1.4%	Adult	Intestine
	Proteocephalus ambloplitis		1	1.4%	Adult	Liver
Nematoda	Rhabdochona sp.		1	1.4%	Adult	Gall Bladder
Mollusca	Glochidia of Quadrula pustulosa	1	4	7.1%	Glochidium	Gill filaments
Other Diseases	Anemia	1	5	8.1%	Advanced	Gill filaments and blood
	Dietary gill disease	2	5	10.0%	Advanced	Gill filaments
	Lipoid degeneration of the liver	3	8	15.7%	Advanced	Gills, stomach, intestines and body cavity

Table 3. A checklist of parasites of 10 Ictalurus punctatus (4 males and 6 females) collected at Natural History Survey Pond, Kinmundy, Illinois; March - April 1974.

Parasite Categories	Parasite	No. Hosts Parasitized M	No. Hosts Parasitized F	Incidence of Parasitism	Developmental Stage	Organ Parasitized
Protozoa	Myxobolus sp.	1	1	20%	Cyst	Gill gilaments
	Trichodina discoidea		1	10%	Adult	Skin
Trematoda	Cleidodiscus floridanus		1	10%	Adult	Gill filaments
	Dactylogyrus sp.	4	3	70%	Adult	Gill filaments
Cestoda	Bothriocephalus sp.	1	2	30%	Adult	Stomach
	Corallobothrium giganteum	4	3	70%	Plerocercoid and Adult	Intestine
Nematoda		-	-	-	-	-
Mollusca		-	-	-	-	-
Other Diseases		-	-	-	-	-

parasitized with two fish having only internal parasites and four having both external and internal parasites.

The Natural History Survey Collection had the youngest fish (five months) and all were 100% parasitized with only one account of internal parasites. The six month to one year class was also 100% parasitized and eight fish had only internal parasites and one had only external.

Of the 87 fish parasitized 86.3% had only internal parasites, 1.2% only external and 12.5% both external and internal. The five month age class of the 90 fish collected was 100% parasitized, the six month to one year class 93.5% and the one to two year class 100%.

The Opel Pond Collection weight class .26-1.75 ounces was 85.7% parasitized and all six fish had only internal parasites. In the 1.76-3.00 ounce class 100% were parasitized and all three fish had only internal parasites.

The .25 ounce class of the Aydt Pond Collection was 100% parasitized and all six fish had only external parasites. The .26-1.75 ounce class was 96.5% parasitized and the 55 fish had only internal parasites. The 1.76-3.00 ounce class was 100% parasitized with one fish having only internal parasites and six fish having both external and internal.

The Natural History Survey .25 ounce class was 100% parasitized and two fish had only internal parasites and one had only exter-

nal. The 1.76-3.00 ounce class was also 100% parasitized with seven fish having only external parasites.

The .25 ounce class of the 90 fish collected was 100% parasitized, the .26-1.75 ounce class 94.5% and the 1.76-3.00 ounce class 100%. Over 88.9% of the total number of channel catfish examined were 6 months - 1 year of age and 66% weighed .26-1.75 ounces.

Azygia angusticauda, Neascus sp. and Chondrococcus columnaris were observed only in fish collected in September, October and November, 1973. Only in the second collection group (February, March and April, 1974) was Myxobolus sp., Cleidodiscus floridanus, Eubothrium sp., Haplobothrium sp., Proteocephalus ambloplitis, Rhabdochona sp., anemia, dietary gill disease and lipoid degeneration of the liver discovered. Parasites found in both collection groups were Costia sp., Scyphidia macropodia, Trichodina discoidea, Dactylogyrus sp., Bothriocephalus sp., Corallobothrium giganteum, and an unknown glochidia. The incidence of parasitism was higher in the fall collection than in the late winter-early spring collection.

The catfish collected at the Opel's Fish Farm were the only ones chemically treated for parasites, using Aquaflavin, Copper sulphate, Malachite green and Terramycin. The chemicals were administered in long duration baths (3-10 days) in the holding tanks and breeding ponds. The concentrations used were 1 gm./100 liters of water for Aquaflavin, 10-20 gm./1 Terramycin, 2 lb./acre-ft. Copper sulphate and .25 lb./acre-ft. Malachite green.

DISCUSSION

In 1973 and 1974, 90 channel catfish (Ictalurus punctatus) were collected from Opel's, Aydt's and Natural History Survey Hatchery Ponds in Illinois. These catfish represented collections of months September - November 1973 and February - April 1974. Eighty-seven of the ninety fish examined were parasitized by at least one species. Three categories of helminth parasites and four kinds of protozoan parasites were found, in addition to a molluscan glochidial form. Also three non-parasitic diseases were noted and one kind of bacterial infection. Seventy-five of the eighty-seven fish parasitized had only internal parasites, one had only external and eleven had both internal and external parasites. Table 4 lists parasites found at each pond.

The age and weights appeared to have little overall relationship to the extent of parasitism; with all fish being 85-100 per cent parasitized. The degree of parasitism may have been affected by the ecological habitat of the host and season of the year more than by the size of the host fish. Tables 1, 2, and 3 illustrate minor differences between the sexes and the extent of parasitism. Parasitism was generally higher in the fall than in winter or early spring, allowing for a few isolated, possibly accidental, new genera discovered in early spring.

Table 4. A checklist of parasites found at the Worden, Centralia and Kinmundy, Illinois fish hatcheries; September 1973 - April 1974.

Parasite Categories	Parasite	Opel Pond	Aydt Pond	Natural History Survey Pond
Protozoa	Costia sp.	-	+	-
	Myxobolus sp.	-	-	+
	Scyphidia macropodia	-	+	-
	Trichodina discoidea	-	+	+
Trematoda	Azygia angusticauda	+	-	-
	Cleidodiscus floridanus	-	+	+
	Dactylogyrus sp.	+	-	+
	Neascus sp.	-	+	-
Cestoda	Bothriocephalus sp.	+	+	+
	Corallobothrium giganteum	+	+	+
	Eubothrium sp.	-	+	-
	Haplobothrium sp.	-	+	-
	Proteocephalus ambloplitis	-	+	-
Nematoda	Rhabdochona sp.	-	+	-
Mollusca	Glochidia of Quadrula pustulosa	+	+	-
Other Diseases	Anemia	-	+	-
	Dietary gill disease	-	+	-
	Chondrococcus columnaris	+	-	-
	Lipoid degeneration of the liver	-	+	-

This indicates parasitism is highest during the months when food consumption is also higher, when more ova and larval stages of the parasites are ingested.

In the present study Corallobothrium giganteum and Dactylogyrus sp. were the most common parasites. Thompson and Lewis (1970) also found Dactylogyrus sp. to be common in the fall. In contrast Davis (1953) and Thompson and Lewis (1970) cited Trichodina discoidea and Ichthyopthirius multifiliis as the most common parasite of young channel catfish. Few cases of infection by the protozoans Costia sp., Myxobolus sp., Scyphidia macropodia and Trichodina discoidea were observed. Thompson and Lewis (1970) found the greatest infestation by Scyphidia in two to three week old fingerlings. This helps explain the low incidence in these collections, as the fish ranged from 5 months to 2 years of age. Studies by Kudo (1934), who first discovered myxosporidians in channel catfish in Illinois, and Davis (1953) are supported by this study's findings that the gill filaments were the commonest location of Myxobolus sp. in the host fish.

The low incidence of external parasities may be associated with the fact that the stock fish are raised in hatcheries, placed in ponds when very young and small, and thus not exposed to "natural" levels of parasitic infective stages for any great period of time. The ponds' independence of rivers and streams and the fact that intermediate hosts of parasites may not be easily transported to hatchery ponds from

rivers and streams may explain why many naturally occurring parasites have failed to be introduced in any large proportions. Harms (1959, 1960) found external parasites less common in catfish from ponds than from any other source. Hoffman (1967) studied channel catfish from rivers and streams finding high incidences of external parasites compared to internal ones.

Harms (1959) found few Acanthocephala infestations in his study and Van Cleave (1919) had only one citing from unimpounded channel catfish of the Illinois River. No Acanthocephala were found attached to the host fish in this study. Only one nematode was discovered, Rhabdochona sp., in the Aydt pond collection. Similar were Bangham's (1927) findings, and he considered nematodes of minor importance in hatcheries. Glochidia tentatively identified as Quadrula pustulosa were present in small concentrations. This low incidence of infestation was probably due to the collection periods and the lack of adult clams in the ponds. Howard (1913) found the highest parasitism by Quadrula pustulosa glochidia in the summer and the lowest in the spring. Quadrula pustulosa glochidia are found to have a predilection for I. punctatus as reported by Wilson (1916). The lack of apparent gill damage to those fish found to be infected with glochidia supports the contention of Lefevre and Curtis (1910) that a single channel catfish may be induced to carry several thousand more mussels than it would under ordinary natural circumstances in nature and not suffer adversely.

One case of Chondrococcus columnaris was found. According to Davis (1953), channel catfish are a less susceptible fish to this myxobacterial disease than are buffalofish and crappies.

Differences existed between the kinds and incidence of parasites at each of the three collection sites. The incidence of Protozoa and Trematoda found in Aydt's and Natural History Survey Ponds were significantly similar. No protozoan parasites were located in the Opel Pond collection and only a limited number of trematodes. This was attributed to chemical prophylaxis. Aquaflavin, Copper sulphate, Malachite green and Terramycin were administered in these ponds. Hoffman and Meyer (1974) cite Aquaflavin as a controlling agent for Scyphidia, Trichodina and Cleidodiscus. Hoblou (1958), Bogdanova (1962) and Hoffman and Meyer (1974) also contend Malachite green is an effective preventative of Trichodina. The best control for all protozoans was reported as Malachite green by Leteux and Meyer (1972). Cestode infestations in all three collections were similar. Unsuitable conditions appeared to be the cause of the absence of glochidia in the Natural History Survey Pond collections. Glochidia in the Aydt and Opel's ponds were of minor incidence at 7.0% and 20.0% respectively. The lack of copepod parasites (Ergasilus versicolor, Achtheres pimelodi on the gills and Argulus appendiculosus on the body and fins) normally associated with the glochidia Quadrula pustulosa, (Wilson, 1916) may explain the low parasitism. The diseases, anemia, dietary gill disease and lipoid degeneration of the liver, present in the host fish of

Aydt's Pond; the other two sources were unaffected. A proper diet appeared to be the preventative found at the other two collection sites. Absence of these diseases in the Opel Pond was also attributed to the use of Terramycin and Copper sulphate. Axelrod (1962) reports Terramycin and Davis (1953) cites Copper sulphate as controls for dietary gill disease and anemia. All of these interrelated diseases of the Aydt Pond collection were in advanced stages. Infected fingerlings tended to ride high in the water, oriented themselves into the flow and appeared lethargic and pale. Diseased fish mortality increased rapidly with 50 per cent or more dead in a period of one to two days if left untreated. These diseases may explain unexpected mass die-offs of seemingly healthy fish at many hatcheries. The gills of fish infected with dietary gill disease were almost identical to early stages of a bacterial gill disease infection, except little fusion of gill filaments was seen and epithelial cell proliferation was not so marked. Tunison et al.(1944), Wolf (1945), and Rucker et al.(1952) studied trout and found a deficiency of panthothenic acid, riboflavin, pyridoxine and folic acid as the prime ingredients absent in the diets of fish infected with anemia and other dietary diseases.

Lipoid degeneration of the liver has been quite common in Europe, causing heavy losses and has only recently become a serious threat in American hatcheries. The gills of the infected fish were a much lighter color than normal and a few advanced stages showed a

light pink to white gill filament color. This coloration is due to a marked anemia, also common in hatcheries. Goldstein (1971) cites overdosage of vitamins and poisons as a cause for lipoid degeneration of the liver.

In addition to the imbalance in the contents of dry foods fed and the lack of fresh meat, hatchery practices constitute a major cause of all three of the above diseases. Spoilage and destruction of numerous anti-anemic properties of the diet through oxidation is caused by hatcheries mixing and grinding, at one time, enough food for several days or even a month. Also, when food is thawed and ground, even for short periods, most nutritive value is lost. Problems also arise when bulk feed has been sitting at distributors for a long period of time before purchase by the fish farmer.according to Phillips and Brockway (1947).

The infection in the Aydt Pond collection with the cestodes Eubothrium sp. and Haplobothrium sp. is unusual, these worms are normally parasites of trout and no record of their presence in channel catfish could be found in the literature. It is possible that the observed cases were accidental infection. Proteocephalus ambloplitis was found attached to the fibrous coat of the liver in one host. Normal location is is the stomach and intestine of largemouth and smallmouth bass, Hoffman and Meyer (1974). Also a nematode, Rhabdochona sp. had invaded the gall bladder of its host. Normally this nematode is in the intestine and stomach according to Hoffman (1967). It may have migrated to the

gall bladder via the common bile and cystic ducts from the duodenum. Chondrococcus columnaris was found on the gills of the impounded I. punctatus. Normal infection sites are the head, back and fins, Davis (1953) and Axelrod (1962), although Thompson and Lewis (1970) also found this gram negative myxobacterium on the gills of their channel catfish hosts.

The high parasitism in hatcheries is due to increased virulence of the causative organism, lack of resistance on the part of the fish owing to an unfavorable environment, conditions suitable for growth and an easy means of transmission. It appeared most parasites made their entry through the food chain. While most I. punctatus bear parasites, even in the wild, domestication renders them more susceptible to epidemics. Anemia and other vitality lowering dietary deficiency diseases, over crowding, lack of exercise, as in cage reared channel catfish, and artificial food favored the spread of epidemics in the channel catfish hatcheries.

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