FISH HEALTH SECTION AFS NEWS LETTER

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MONOCLONAL ANTIBODIES RECOGNIZE STRAINS OF IHNV

C. K. Arakawa, C. N. Lannan and J. R. Winton
Hatfield Marine Science Center
Newport, OR 97365

Neutralizing monoclonal antibodies (Mabs) were produced against the Sacramento River (SRCV) and Round Butte (RB) isolates of infectious hematopoietic necrosis virus (IHNV). Six isolates of IHNV (Table 1) were tested for serological differences using these Mabs. The RB, AUKE, and 193-110 isolates were neutralized by the RB Mab but not the SRCV Mab (Table 2). The SRCV isolate was neutralized by both the RB and SRCV Mabs while the OSV isolate was neutralized by neither. There was less neutralization of the Elk River isolate by both Mabs (Table 2). Thus, at least three, and possibly four, serological strains of IHNV have been identified among the isolates tested using these 2 reagents. Recognition of serotypes will be important in epidemiological studies and in the development of certain vaccines against IHN. Although additional testing must be done, these Mabs can be used as an improved diagnostic reagent in neutralization assays with most isolates of IHNV. Small aliquots of these reagents are available to qualified researchers from the authors.

Table 1. IHNV isolates used in this study.

ISOLATE	SOURCE
Round Butte (RB)	Steelhead Round Butte H., Oregon
Sacramento River Chinook Virus (SRCV)	Chinook Nimbus H., California
193-110	Rainbow Hagerman Valley, Idaho
Auke	Sockeye Auke Creek H., Alaska
Elk River	Chinook Elk River H., Oregon
Oregon Sockeye Virus (OSV)	Sockeye Willamette R. H., Oregon

FISH HEALTH SECTION ELECTION

Ballots have been mailed to the membership for the election of new officers. The nominating committee has developed a very good slate of candidates which include Ronald P. Hedrick and Rodney W. Horner for the position of President-Elect; Emmett Shotts and Charlie Smith are candidates for a two-year term on the Nominating Committee and Craig Banner and Frank Hetrick are seeking a three year term for that committee. The Board of Certification will be complete with two of the following: John G. Hnath, Howard M. Jackson, Andrew J. Mitchell, Thomas E. Schwedler, or Joseph R. Sullivan. Please return your ballots to Randy MacMillan, chairman of the Membership and Balloting Committee. It is hoped that each member of the Section will participate. In our most recent election (the approval of new by-laws), only 10% of you participated. Let's reverse the numbers !

Is Anybody out there?

Pink Floyd

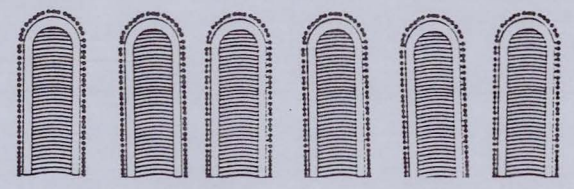

Table 2. Cross neutralization of IHNV isolates by plaque reduction assay.

IHNV ISOLATE	Neutralization Index Using Monoclonal Antibody	
	RB/B5	SRCV/A3
RB	3.2	0
AUKE	3.1	0
193-110	2.4	0
SRCV	1.9	3.3
Elk River	1.7	1.5
OSV	0	0

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PASSAGES

Dr. Steven Newman has become Technical Director, Argent Chemical Laboratories, 8702 NE 152nd Ave., Richmond, WA 98052. His phone number is 206-885-3777.

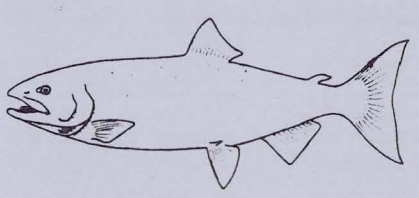
Dr. Thomas Goodrich is now Director of Microbiology and Aquaculture, Biomed Research Laboratories, 1115 E. Pike St., Seattle, WA 98112. The phone number is 206-324-0380.

Bruce Stewart has moved from Oregon Aqua Foods to become Fish Health Specialist, Bureau of Fish Management, Wisconsin Dept. of Natural Resources, Box 7921, Madison, WI 53707.

"TANKERING" OF ATLANTIC SALMON

Keith A. Johnson
Operations Manager, Southern Southeast Regional Aquaculture Association, Ketchikan, AK 99901

An article appeared in the April 14, 1986 issue of **Seafood Trend** (vol. II, no. 20) regarding the live transportation of Atlantic salmon from Norway to the U.S. East Coast. The net effect from the marketing standpoint will be fresh fish to the market at a decreased transportation cost. However, the fish health implications of the procedure must be seriously considered. Since the U.S. Fish and Wildlife Service is charged under title 50 with the responsibility of monitoring the importation of live salmonids, I am requesting a response from the USFWS regarding their views on the likelihood of an importation of a disease agent and to outline their program for sampling these imports. The discharge of water used in the transportation is another issue which should be addressed.



EFFECTS OF THREE CHEMICAL AGENTS ON SERUM CORTISOL AND BLOOD CHEMISTRY IN THE CHANNEL CATFISH

Lydia A. Brown, J. A. Ainsworth, M. H. Beleau, J. Bentinck-Smith, Ruth Francis-Floyd, J. D. Freund, and P. R. Waterstrat

In an attempt to evaluate the effect of capture stress on normal hematological parameters, 40 previously acclimated channel catfish were divided into four groups. Each group was given one of the following treatments: MS222 (60 mg l^{-1}) ; metomidate (5 mg l^{-1}), Flunixin meglumide (5 mg l^{-1}) and placebo treated controls.

Each group was given one initial stresser (taken as the act of administering the agent). Blood samples were then taken sequentially from the start of the experiment for a 23-day period. Serum cortisol was assayed as an indicator of stress. Other parameters investigated were sodium, potassium, magnesium, chloride, calcium, inorganic phosphorus, creatinine, glucose, amylase, aspartate amino transferase, lactic dehydrogenase and alkaline phosphatase.

MS222 was administered in a dose calculated to produce tranquilization. Metomidate is a tranquilizing agent with no analgesic properties while Flunixin meglumide, although not previously used in fish, has analgesic activity with no tranquilization in mammals.

When sampling fish, both MS222 and metomidate treated groups showed a high degree of tranquilization. A high mortality was recorded in the metomidate group which may have been a function of the dose of metomidate given. The Flunixin treated fish did not respond to the insertion of the needle for caudal venipuncture.

There were no significant trends in any of the hematological parameters tested except for cortisol. MS222 and metomidate treated fish had significantly lower levels of cortisol over the first 24 hours compared to Flunixin meglumide and the control treated fish. Thereafter, there were no differences between any of the groups. It is thought that metomidate may have actively suppressed cortisol production and this finding is discussed in the paper to be presented for publication.

ERRATA

In the last issue of the Newsletter, two errors appeared in the article by Richard Heckman on plerocercoids of cutthroat trout. Due to space limitations, two photographs could not be used but were cited in the text and the correct spelling for the nematocide is Ivermectin. The editors regret these mistakes.

SENSITIVITY OF *FLEXIBACTER COLUMNARIS* TO ROMET-30®

Thomas L. Wellborn, Jr. Leader
Extension Wildlife & Fisheries
Mississippi Cooperative Extension Service,
P.O. Box 5446, Mississippi State, MS 39762

Robert M. Durborow, M. David Crosby, Tim Santucci
Mississippi Cooperative Extension Service
P.O. Box 142, Stoneville, MS 38776

The sensitivity of *Flexibacter columnaris* to Romet-30 (sulfadimethoxine + ormetoprim) was tested. *F. columnaris* isolates from 24 cases of channel catfish kills were found to be resistant to Romet-30. Thus, when concurrent epizootics of systemic columnaris, *Edwardsiella,* and *Aeromonas* sp. occur, Terramycin should be the drug of choice.

ANTIBIOTIC TREATMENT TO PREVENT PRESPAWNING LOSSES OF COHO IN HATCHERIES

Dorothee Kieser
Diagnostic Service, Department of Fisheries and Oceans,
Fisheries Research Branch, Pacific Biological Station
Nanaimo, British Columbia, Canada V9R 5K6

Salmon that return to a hatchery in early summer but do not spawn until late fall are at risk due to infectious diseases. Prespawning mortalities in an early-return coho stock at the Capilano Hatchery, Vancouver, B.C. have traditionally been very high. Losses are mainly a result of *Renibacterium salmoninarum* and other bacterial diseases.

To reduce prespawning mortalities in the Capilano Hatchery, a test group of 500 fish were injected with a combination of erythromycin and oxytetracycline immediately upon return to the hatchery. Fish received 20 mg/kg body weight of each drug. A second injection of the same dosage was given approximately 3 weeks prior to ripening. A control group of 500 fish was handled in the same manner but not injected.

During the 5 month holding period fish in the injected group were virtually free of fungus and external lesions. In the control group, fish showed large areas of fungus on the body.

In the treated group, 63 fish died before spawning, while in the control group 337 were lost over the same time period. The injected group yielded approximately 89,000 eggs compared to only 6,300 from the control group.

VACCINATION OF CATFISH AGAINST ENTERIC SEPTICEMIA OF CATFISH

John A. Plumb
Dept. of Fisheries and Allied Aquacultures
Auburn University, Auburn, AL 36849

There is increasing evidence that *Edwardsiella ictaluri,* the causative agent of enteric septicemia of catfish (ESC), is becoming the most important disease problem in the catfish industry. With limitations on the ability of antibiotics to control ESC, interest is turning to vaccination as a preventive measure. In 1985 we reported on the feasibility of vaccinating catfish during the winter. Fish held in cold water for 3 months following exposure showed protection. In November, 1985 we vaccinated catfish by immersion in a sonicated *E. ictaluri* preparation, and held them in ponds until April of 1986. Agglutination antibodies were detected 30 days following vaccination and at 30 day intervals throughout the winter. Upon challenge in April and May, a slight increase in survival occurred in the vaccinated fish; however, the difference from control fish was not significant. Survival was over 90% in both groups. Although there was no significant difference in mortality of vaccinated versus control catfish, it was shown that fish vaccinated in the fall will retain agglutinating antibodies until at least the following April. Whether or not these antibodies are protective is presently unresolved.

ROMET-30® APPROVED FOR CATFISH

M. H. Beleau
College of Veterinary Medicine and
Delta Branch Experiment Station
Mississippi State University

On Friday, May 23, 1986, the Federal Register (Vol. 51, No. 100) contained the final rule on the supplemental new animal drug application filed by Hoffmann-LaRouche, Inc. for the use of Romet-30 in catfish. The approval is for 50 mg of active ingredients per kg of live body weight of fish per day for a five (5) day treatment period. The withdrawal period is three (3) days in catfish versus 42 days in salmonids. The drug label states it is for control of enteric septicemia of catfish caused by *Edwardsiella ictaluri* strains susceptible to the sulfadimethoxine and ormetoprim combination. The FDA approval process involved use of a significant amount of field data and demonstrated a model approach for future drug approvals in aquaculture.

HERPESVIRUS SALMONIS (HPV): FIRST OCCURRENCE IN ANADROMOUS SALMONIDS

R.P. Hedrick,[1] T. McDowell,[1], and W. Wingfield[2]

[1]Aquaculture and Fisheries Program, Department of Medicine
School of Veterinary Medicine, University of California
Davis, CA 95616 USA

[2]State of California, Department of Fish and Game
Fish Disease Laboratory, 2111 Nimbus Road
Rancho Cordova, CA 95670 USA

Adult steelhead trout (*Salmo gairdneri*) returning to Warm Springs Hatchery on the Russian River in Northern California were found to harbor a herpesvirus. Although there were no external signs of infection, virus was isolated from all pools of ovarian fluids on one sample date. The cytopathic effects of the virus in CHSE-214 and RTG-2 cells were characteristic of herpesviruses. The morphology and size of the virions confirmed its designation as a herpesvirus. The capsid is hexagonal with an average diameter of 93 nm and is enclosed in an envelope 231 nm in diameter.

Specific rabbit antiserum made to the steelhead herpesvirus (SHV) reacts strongly with herpesvirus salmonis virus (HPV). Cross-neutralization studies confirmed the similarity of the two viruses. Additionally, both viruses share a requirement for temperature of growth. Neither virus replicated at 15C or higher and of the temperatures tested, 10C was optimal. This was in marked contrast to the three other known herpesviruses from salmonid fish which replicate at temperatures up to 20C. These three additional herpesviruses have been isolated from salmonids in Japan. Sano was the first to describe a herpesvirus (NeVTA) recovered from kokanee salmon (*Oncorhynchus nerka*) fry undergoing an epizootic. Later both Kimura et al. and Sano et al. reported isolations of viruses from masou salmon (*Oncorhynchus masou*) and these were designated OMV and YTV, respectively.

Cross-neutralization studies with all five herpesviruses from salmonids, indicate homology between the three Japanese isolates but indicate they are clearly different than HPV and SHV (which are closely related). These studies suggest that the viruses from Japan and the U.S. are indeed geographically distinct and their distribution is seemingly not a result of recent importations of eggs or fish.

The reasons for the unexpected recurrence of HPV (SHV) in a hatchery in California are unknown. In contrast to OMV, which has spread quickly through many salmon stocks in Hokaiddo (Japan), HPV has not been known since 1975 when the rainbow trout (*Salmo gairdneri*) broodstock at the Winthrop National Fish Hatchery in Washington State (the only previous location the virus has been found) was destroyed. This was in spite of numerous plantings from progeny of the infected stocks.

Current studies in the laboratory are examining the virulence of SHV and the possible latent nature of the virus in progeny of infected adults.

DETECTION OF A SYSTEMIC SAPROLEGNIOSIS IN JUVENILE WHITE STURGEON, *ACIPENSER TRANSMOTANUS*

C. S. Friedman and R. P. Hedrick
Aquaculture and Fisheries Program, Department of Medicine, School of Veterinary Medicine, University of California, Davis, CA 95616

Mycotic diseases of fish are generally considered to be secondary or opportunistic in nature. Despite this fact, a few fungi, such as *Saprolegnia* spp., have been implicated as primary etiological agents of disease. Although fungi are primarily external parasites, several investigators have observed systemic fungal infections of juvenile fishes. Generally, fungal hyphae penetrate the hosts' epidermis from an initial colonization on the body wall and invade underlying tissues. Occasionally mycotic infections have been observed to initiate in the lumen of the gut and then spread into the coelomic cavity and internal organs of juvenile fish.

As part of a nutritional evaluation of artificial and natural feeds, juvenile white sturgeon, *Acipenser transmotanus,* were fed an experimental diet of tubifex worms. In the third week of the study, sturgeon fed the experimental diet began dying, while control fish fed a Silver Cup diet remained healthy. Mortalities reached 50-60% by the end of the fourth week. An examination of tissue squashes prepared from gut tissues of five of the morbund fish revealed slender (13 um diameter), bullet-shaped, asexual zoosporangia and sparsely-branched, aseptate hyphae. Tissue samples from five fish plated onto potato-flake agar grew 'cottony' white mycelia which were reluctant to produce any reproductive structures. These findings are characteristic of members of the genus *Saprolegnia.*

Paraffin sections of another five experimental fish and three control fish were stained with Periodic Acid-Schiff (PAS) stain to detect the presence of fungal elements. Tissues of two of the five experimental fish were infiltrated by PAS-positive, sparsely-branched, aseptate hyphae which were 10 um in diameter and 25-160um in length. Hyphae penetrated all tissues within a 700um radius of the stomach. The fungi seemed to lack tissue specificity as connective tissue, kidney, liver, heart, right and ventral body walls were infiltrated. No apparent inflammatory response was detected in histologoical sections made from infected fish. The left and dorsal body walls, which are most distant from the stomach, were not invaded by fungal hyphae. In addition, no hyphae or spores were observed on the exterior of juvenile sturgeon with localized infections of the gut. Tissues of three of the remaining experimental fish showed no invasion of internal organs, although an abundance of hyphae were detected in the gut contents. The control fish (fed Silver Cup) showed no evidence of fungi in either the gut or internal tissues.

These findings suggest that under certain conditions *Saporolegnia* infections can originate in the gut and then invade the coelomic cavity causing substantial mortality in juvenile white sturgeon. These observations are consistent with those made by previous investigators in fish species other than white sturgeon. Yet unanswered is the role of tubifex worms as potential vectors of mycotic infections.

BRIEF REPORTS

The special FHS member price for the *Fish Health Blue Book* has expired. All future orders must be placed with the AFS office in Bethesda, MD. Costs will be $12.00 for AFS members and $15.00 for nonmembers.

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The North Central Division/AFS has recently announced availability of special publication #7, *The Paddlefish: Status, Management and Propagation.* To obtain a copy, checks payble to the North Central Division-/AFS for $9.00 *U.S. funds) should be sent to Joe Dillard, Missouri Dept. of Conservation, 1110 College Ave., Columbia, MO 65201. The book contains an extensive bibliography of 555 references listing all known publications on paddlefish through 1985.

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SEASONAL OCCURRENCE OF THE INFECTIOUS STAGE OF PROLIFERATIVE KIDNEY DISEASE (PKD) IN CALIFORNIA

J. S. Foott, R. Rosemark and R. P. Hedrick
School of Veterinary Medicine, University of California, Davis, CA 95616

Proliferative kidney disease (PKD) of salmonid fish caused by the myxosporidan 'PKX' has been observed to have a seasonal occurrence from May to November. The disease is not often observed at temperatures above 15°C and declining water temperatures seem to reduce both PKD-induced morbidity and mortality. We have conducted a sentinel trout study at the American River Hatchery in California, U.S.A., to determine how the observed onset of PKD is related to a seasonal presence of the infectious stage in the water supply, to water temperatures and to fish introduction schedules.

In our study, groups of 30 rainbow trout (5-10g) were exposed to hatchery water for four weeks and then transferred to the Fish Disease Laboratory at the University of California, Davis to be incubated for four additional weeks in 18°C well water. This procedure was repeated on a monthly basis for one year. During the winter, one group was exposed to ambient hatchery water and a second group to the same water heated to 17°C. To complement this sentinel study, several hatchery production lots were surveyed monthly for the presence of PKX. Histological sections (5um) made from the kidney of all fish were used to evaluate the presence of the early (interstitial) and later stages (intraluminal) of PKX and the accompanying pathology.

This study indicated that the infectious stage was present in the water supply from April through November with the peak prevalence of infection occurring in June. Infections were not observed in the winter months (December-March) in sentinel groups exposed in ambient or heated hatchery water. Both groups showed first infections after the April exposure (ambient water temperature 12°C). The 18°C incubation, a temperature conducive to the development of the disease, supports the conclusion that the infectious stage of PKD was truly absent or below threshold levels able to induce infections during the winter.

Temperature may, however, effect the onset of PKD particularly when concentrations of the infectious stage are minimal as shown by monthly examinations of a production lot of rainbow trout introduced to the hatchery on October 12, 1984. PKX parasites wre not detected in these fish throughout the winter. The first parasites were observed in June 1985 (ambient 15°C) even though the sentinel group exposed from October 17 to November 12, 1984 showed that the infectious stage was present for at least part of this period. The fish in the sentinel study were also better indicators of the presence of the infectious stage in the spring as fish exposed from April 17 to May 15, 1985 showed PKX infections one month in advance of the production fish (June) in ambient water.

In conclusion, the seasonal occurrence of PKD at our study site is primarily correlated to the presence of the infectious stage in the water supply. Our study further indicated that the parasite is able to infect the trout at lower temperatures but higher temperatures are more conducive to the progress of infection and subsequent development of the disease. This most likely relates to the effect of temperature on the parasite's development within the host and the host's immune response. Both of these aspects are being investigated in our laboratory.

Four new AFS publications: *Role of the U.S. Government in Aquaculture: Nonfederal Perspectives; Symposium on Hydropower and Fisheries; Biology and Management of the Muskellunge; and Reservoir Fisheries Management: Strategies for the 80's* are now available for the AFS at $5.00, $25.00, $32.50 and $15.00 respectively.

* * * * * *

Biomed Research Laboratories has been awarded the Phase II, U.S. Fish and Wildlife service contract to support development of a vaccine against *Flexibacter columnaris* for use in striped bass.

* * * * * *

PASSIVE SERUM TRANSFER PROTECTS CATFISH FROM CHANNEL CATFISH VIRUS INFECTION

R. P. Hedrick and T. McDowell
Aquaculture and Fisheries Program
Department of Medicine, School of Veterinary Medicine
University of California, Davis, CA 95616

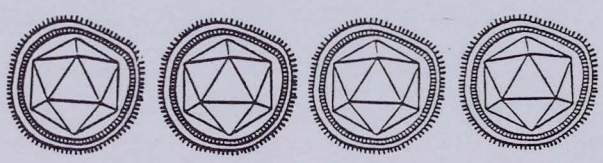
Channel catfish (*Ictalurus punctatus*) are known to respond to virus exposures or infections by producing specific anti-virus neutralizing antibodies. The purpose of this study was to determine if serum containing neutralizing antibodies parenterally administered to catfish fingerlings would protect them from subsequent waterborne challenges with channel catfish virus (CCV). The results of this experiment demonstrated that anti-CCV antibodies are quite effective in preventing initial infection, replication, and mortality induced by CCV.

Six hundred channel catfish (ave. wt. 22.1 g) were divided into three groups of equal number. Each group received one of the following treatments: intraperitoneal injection of 0.1 ml of (1) saline or (2) anti-virus serum or (3) normal serum. The anti-virus serum was collected from broodstock at a farm with a known history of fish with neutralizing activity. The serum neutralization index of the pooled serum at a dilution of 1:50 was $10^{2.62}$. The activity of the serum (normal) collected from broodfish at a farm with no history of CCV antibodies was $10^{0.5}$. Twenty-four hours after administering the treatments, the fish were placed into 5-gal aquaria so that within each treatment there were 10 tanks with 20 fish each. Fish in five tanks from each treatment were then challenged with CCV at 5.6×10^4 $TCID_{50}$ per ml for 30 min before the water flow was resumed. The remaining fish in each group received the same volume of cell culture fluid from uninfected channel catfish ovary (CCO) cells. The ambient water temperature during the experiment ranged from 78 - 82°F.

Mortalities were collected daily and examined for virus during the early and late stages of the infection and the virus concentrations of the visceral organs of 15 were titered by $TCID_{50}$ analysis on CCO cells. After 13 days the mortalities had ceased and the experiment was terminated. At this time, the visceral organs from five fish from each tank were pooled and examined for the presence of virus.

The results indicated that fish receiving serum containing anti-virus antibodies were solidly protected from virus-induced mortalities (Table 1). In contrast, fish receiving normal serum or saline experienced an average mortality of 66 and 71%, respectively. Virus was consistently isolated from the dead fish and the titers during the peak infections ranged from 8.6×10^4 to 1.1×10^7 per gram of tissue. At the end of the experiment, virus could no longer be detected in any of the groups as determined by analyses of the pooled samples from each tank.

The significance of anti-virus neutralizing antibodies in catfish is still uncertain. Our studies, although preliminary in nature, demonstrate that this antibody can be protective under experimental conditions. Plumb (1972, Ph.D. Thesis) showed that two-year old catfish responded to intraperitoneal injections by producing neutralizing antibodies that reached peak levels at 60 days. We have also demonstrated that larger catfish can respond to low levels of waterborne virus by producing antibody (Fish Health Section Newsletter 14:1) and in some cases are susceptible to active infection and mortality (with virus titers of 6.4×10^6 per gram in internal organs). With the recent observations of virus recovery from broodstock (Bowser et al. 1985, J. Fish Dis. 8:557-561) and our observations on the susceptibility of larger fish to CCVD, it is tempting to speculate that rather than always remaining in a latent state that CCV can undergo periods of recrudescence. These episodes may stimulate anti-virus antibody titers to increase and may also be possible sources of virus for vertical and horizontal transmission of the agent.



FUTURE EVENTS

July 22-24, 1986 Joint Meeting of the Fish Health Section/AFS and the Eastern Fish Health Workshop. This meeting (10th annual FHS and 11th annual EFHW) will be hosted by the USFWS National Fish Health Research Laboratory, and held at the Sheraton Inn in Martinsburg, WV. For information contact Dr. R. C. Cipriano, NFHRL, Rt. 1, Kearneysville, WV 25430.

October 21-24, 1986 International Symposium on Ichthyopathology in Aquaculture. The meeting will be sponsored by the Yugoslav Academy of Sciences and Arts Zagreb and the Veterinary Faculty, University of Zagreb. Nearly 100 papers on all aspects of fish pathology will be presented during the three day meeting to be held at the Inter-University Center, Dubrovnik, Yugoslavia. Post-symposium tours are also planned by the organizing committee. For information contact Dr. Nikola Fijan, Veterinary Faculty, Heinzelova 55, P.O.B. 190, Zagreb, Yugoslavia.

August 9-15, 1987 VII International Congress of Virology. This international virology meeting will feature a workshop session on fish viruses. It will be held at the Edmonton Convention Center, Edmonton, Alberta. For information of the fish virus portion, contact Dr. Tats Yamamoto, Dept. of Microbiology, Univ. Alberta, Edmonton, Alberta T6G 2E9.

REPORTS FROM PAST MEETINGS

Proliferative Kidney Disease Workshop

The third PKD workshop was hosted by the Battelle Marine Laboratory, Sequim, Washington on June 23-24. The meeting was attended by over forty fish pathologists who heard presentations on the present geographic and taxonomic status of the parasite before being given an opportunity to examine fresh and fixed material from affected fish. Ralph Elston and Mike Kent of the Battelle staff provided a salmon barbecue and laboratory tour in the evening.

Western Fish Disease Workshop

The 27th annual Western Fish Disease Workshop was held at the Coast Bastion Inn, Nanaimo, British Columbia on June 24-26. The meeting was hosted by the staff of the Pacific Biological Station and saw over 100 fish health professionals in attendance. Twenty-five presentations were given in sessions on bacteriology (chaired by J. Rohovec), parasitology (chaired by L. Margolis), non-infectious diseases (chaired by J. Warren) and virology (chaired by W. Groberg). A complimentary wine and cheese tasting was provided thanks to Syndell Laboratories. The staff of the Biological Station did an outstanding job in all aspects of the meeting including the weather.

Table 1. Mortalities among channel catfish administered either serum containing anti-virus neutralizing activity, normal serum or saline and subsequently challenged with channel catfish virus (CCV).

Treatment	% Mortality in Replicate Groups				
	1	2	3	4	5
Anti-virus serum No CCV	0	0	0	0	0
Anti-virus serum CCV	0	0	0	5	0
Normal serum CCV	45	60	100	40	85
Saline No CCV	0	0	0	0	0
Saline CCV	80	90	55	70	60

FISH HEALTH NEWSLETTER

The Fish Health Newsletter is a quarterly publication of the Fish Health Section of the American Fisheries Society. Submissions of any length on a topic of interest to fish health specialists are encouraged and should be addressed to one of the editorial staff or to a member of the publication committee.

FHS NEWSLETTER
Department of Microbiology
Oregon State University
Corvallis, Oregon 97331

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