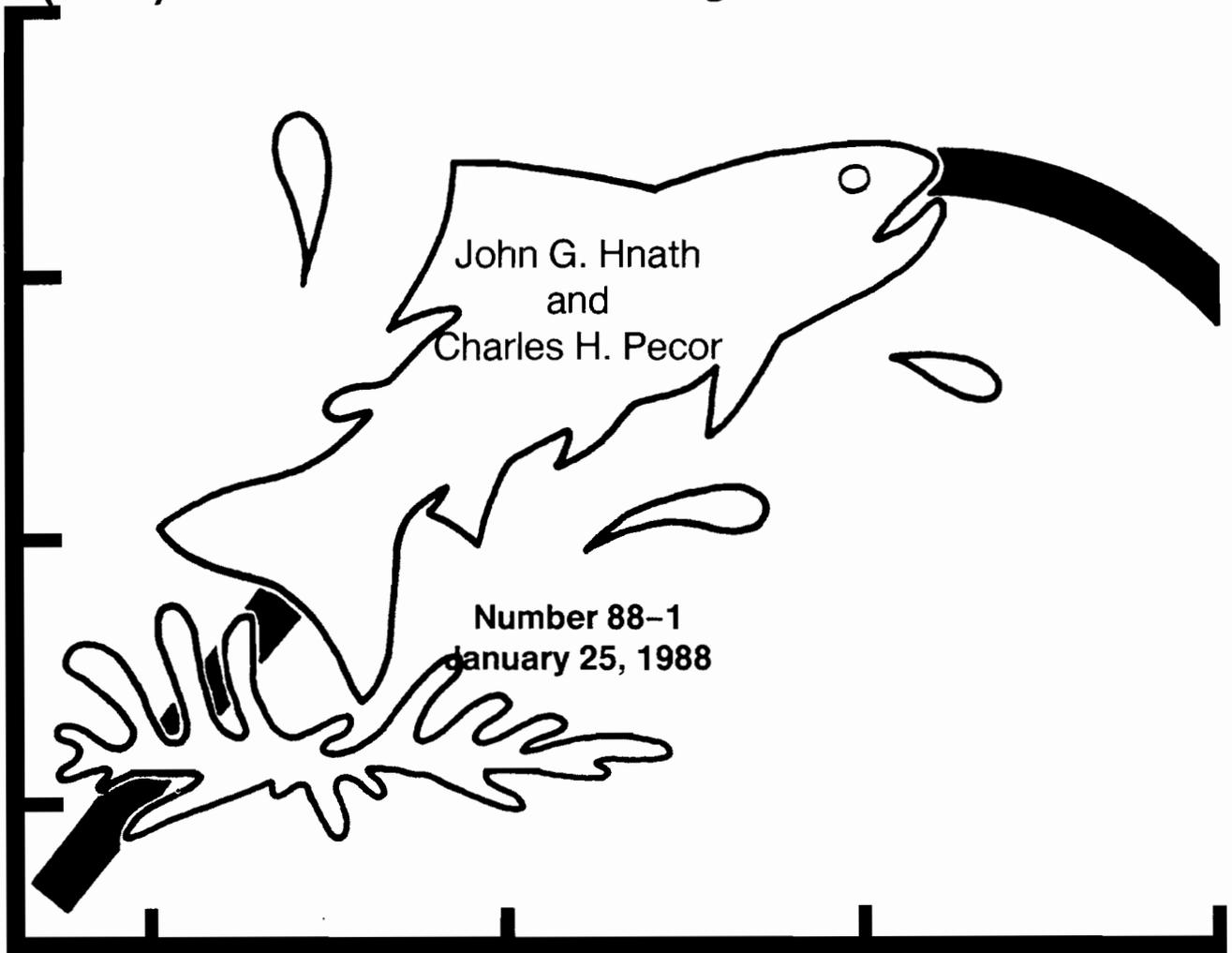


# FISHERIES DIVISION

## TECHNICAL REPORT

### Viral Erythrocytic Inclusion Body Syndrome (VEN)-Like Disease in Michigan Coho Salmon



Michigan Department of  
Natural Resources

**MICHIGAN DEPARTMENT OF NATURAL RESOURCES  
FISHERIES DIVISION**

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**VIRAL ERYTHROCYTIC INCLUSION BODY SYNDROME  
(VEN)-LIKE DISEASE IN MICHIGAN COHO SALMON**

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## INTRODUCTION

At the Platte River State Fish Hatchery in Michigan, coho salmon (*Oncorhynchus kisutch*) production yearlings frequently experience significant mortalities (10% to 20%) overwinter and prior to spring plantout. Often the mortalities are associated with external lesions of coldwater disease (*Cytophaga psychrophila*) and anemia. Rich Holt, Department of Microbiology, Oregon State University, Corvallis (personal communication), reports a similar phenomenon in Oregon that he feels is directly correlated with the presence of viral erythrocytic necrosis (VEN). Steve Leek (1987) reported a similar condition in chinook salmon (*Oncorhynchus tshawytscha*) at the Little White Salmon Hatchery in Cook, Washington. Preliminary examinations of peripheral blood smears from Platte River coho indicated that a VEN-like inclusion body was present in the red blood cells of these fish.

The study (over three rearing cycles) was intended to determine: (1) if VEN is present in coho reared in Michigan, (2) if there is a peak incidence period for VEN, (3) if the incidence varies with diet, and (4) if VEN is associated with periods of significant mortality.

## METHODS

The study was conducted using three rearing cycles (1984–85, 1985–86, and 1986–87) of coho collected and reared to smoltification at the Platte River Hatchery.

Fish samples varied during the study of the three cycles. During the first part of the study (1984–85), 100 randomly selected “healthy” yearling fish from each of two diet groups, Oregon moist pellets (OMP) and low phosphorus dry diet, were tested in March 1985. During the second part of the study (1985–86), 72 randomly selected “healthy” fish from each of two diets (OMP and a modified low phosphorus dry diet) were tested on five dates between June 1985 and March 1986. In addition, another group of sick and moribund fish was tested in March 1986. During the last part of the study (1986–87), 100 fish were selected, 72 “healthy”, and 28 sick or moribund from the OMP diet, and tested in March 1987.

The laboratory tests for VEN remained the same for all years: the fish were anesthetized with MS-222 and then one heparinized microhematocrit tube (1 mm I.D.) of blood was taken. One blood film was prepared from each fish using a drop of blood from the tube. These blood films were air-dried for 30 minutes, then fixed in methanol for 5 minutes. Blood films were stained with Giemsa or pinacyanol chloride (Leek 1987) and examined under oil immersion for inclusion bodies in red blood cells. Microhematocrit tubes were centrifuged 5 minutes in a microhematocrit centrifuge to determine hematocrit levels.

## RESULTS AND DISCUSSION

VEN-like inclusion bodies were found in coho from all three rearing cycles. During the first rearing cycle, VEN was present at levels of 4% in the fish on both diets. Hematocrits for fish with positive VEN averaged 30.96%; those with no VEN, 39.23%.

The sampling for the second period was more extensive and the results are given in Table 1. VEN was apparent during the first sampling in June in the dry diet fish, and was likely present also in the OMP fish at the same time, but recorded as "in doubt". The incidence in dry diet fish remained low (4.2% to 6.1%), but was slightly higher in OMP-fed fish (8.3% to 13.9%). There did not appear to be any significant correlation between VEN and mortalities; however, Rohovec and Amandi (1981) reported mortality in coho juveniles with only a 1.7% incidence of VEN, and low percentage of erythrocytes infected. In our study the incidence appeared to peak in February-March for the OMP diet fish, but actually showed a slight decline in dry diet fed fish throughout the study. Although there was no correlation with mortality, the virus must be assumed to lower the resistance to other pathogens (such as the coldwater disease organism) which leads more immediately to death. Rich Holt (personal communication) says that in cases of coldwater disease in coho on the West Coast, VEN is also present. He also indicated that injections of blood from sick fish into healthy ones produce anemia in 1 month, along with a reduction of the white blood cell count, thus paving the way for other infections. MacMillan et al. (1980) indicated a threefold greater mortality rate from vibriosis (a secondary bacterial infection) in VEN-infected fish and a significantly decreased tolerance to oxygen depletion. (Control fish died at 1.5 ppm dissolved oxygen whereas VEN-infected fish died at 3.5 to 4.5 ppm.) Smail (1982) refers to experimental work in cod and herring which showed infected fish to be more susceptible to handling stress than normal fish.

The sampling of the third cycle involved 100 fish with the results indicating an overall increase in incidence of VEN. However, the incidence in sick or moribund fish was 19.6% and in healthy fish 31.67%. Again, VEN did not appear to be correlated with sick or moribund fish.

One possible explanation for the increase in 1986-87 is that a large number of mature salmon were passed above the weir at the Platte River Hatchery in the fall, and they may have shed more infectious particles into the river system. This would support a horizontal, water-borne infection route.

In October of 1987 adult coho spawners were sampled by bleeding from the gill arteries with a microhematocrit tube and processing as previously described for smolts. The results are shown below:

| Number of males | Number positive | Percent positive | Number of males | Number positive | Percent positive |
|-----------------|-----------------|------------------|-----------------|-----------------|------------------|
| 52              | 19              | 36.5             | 53              | 13              | 24.5             |

Future studies should be done on other adult salmonids since host records from other areas of the country indicate more than 20 species, representing several families of fish, are susceptible. Natural infections on the West Coast are found in chum, pink, coho, and chinook salmon, steelhead trout, and Pacific herring. Another unanswered question in Michigan is whether VEN occurs in lake herring, and if so, what effect it might have on the those populations.

A comparison of the incidence of VEN-like inclusion in Platte River coho smolts for the three rearing cycles is shown below:

| Cycle   | Dry diet | OMP diet |
|---------|----------|----------|
| 1984-85 | 4.0%     | 4.0%     |
| 1985-86 | 4.2%     | 12.7%    |
| 1986-87 | —        | 24.5%    |

### CONCLUSION

A VEN-like inclusion is present in coho salmon reared at the Platte River State Fish Hatchery and in returning adult coho spawners from Lake Michigan. This is the first such incidence reported from coho from an entirely freshwater environment, and the first report from the Great Lakes basin. There was no apparent seasonal peak in incidence, but the incidence did appear to increase throughout the years of the study, from 4.0% in 1984-85 to 24.5% in 1986-87. There was a slightly higher incidence in OMP diet fish than in dry diet fish. There did not appear to be any significant correlations between VEN and mortalities.

Table 1. Number of VEN-like inclusion bodies found in blood films of Michigan coho salmon reared under two diets in 1985 and 1986.

| Date                      | Number of fish | Number of VEN | Number in doubt | Percent with VEN | Average hematocrit in percent |
|---------------------------|----------------|---------------|-----------------|------------------|-------------------------------|
| <b>OMP Diet</b>           |                |               |                 |                  |                               |
| Jun 12, 1985              | 33             | 0             | 2               | 0                | 39.8                          |
| Aug 30, 1985              |                |               |                 |                  |                               |
| Inside tank               | 70             | 0             | 0               | 0                | 38.6                          |
| Outside tank              | 69             | 0             | 1               | 0                | 37.4                          |
| Nov 18, 1985              | 72             | 7             | 0               | 9.7              | 34.1                          |
| Feb 12, 1986              | 71             | 9             | 0               | 12.7             | 24.2                          |
| Mar 26, 1986              |                |               |                 |                  |                               |
| Random                    | 72             | 10            | 0               | 13.9             | 27.0                          |
| Sick                      | 24             | 2             | 0               | 8.3              | 7.9                           |
| <b>Dry Diet</b>           |                |               |                 |                  |                               |
| June 12, 1985             | 33             | 2             | 1               | 6.1              | 45.5                          |
| Aug 30, 1985 <sup>1</sup> | —              | —             | —               | —                | —                             |
| Nov 18, 1985              | 71             | 4             | 0               | 5.6              | 41.7                          |
| Feb 12, 1986              | 72             | 0             | 0               | 0                | 36.9                          |
| Mar 26, 1986              |                |               |                 |                  |                               |
| Random                    | 72             | 3             | 0               | 4.2              | 35.3                          |
| Sick                      | 24             | 1             | 0               | 4.2              | 20.7                          |

<sup>1</sup>No fish sampled this date—no dry diet on hand.

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