The Icthyogram

Newsletter of the Fisheries Experiment Station

Utah Division of Wildlife Resources

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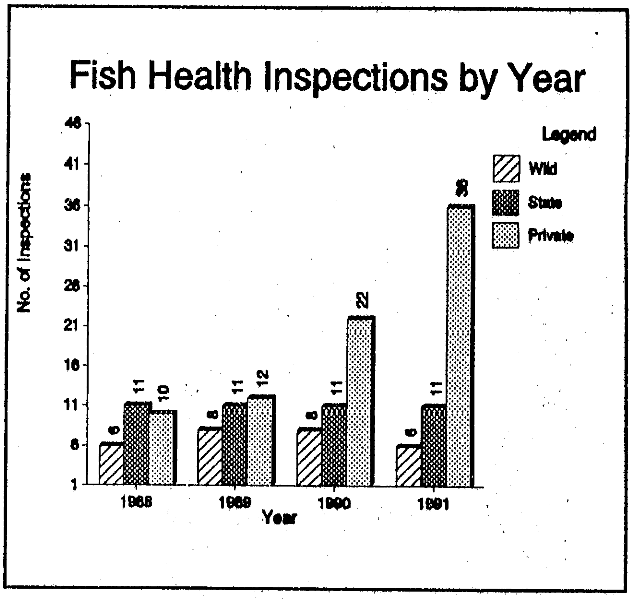
FISH HEALTH INSPECTION SEASON BEGINS AT FES - RAPID INCREASE IN PRIVATE AQUACULTURE INSPECTIONS CONTINUES

The fish health inspection season has begun at the Fisheries Experiment Station. The unprecedented increase in requests for private aquaculture inspections which began in the late 1980's has carried over into 1991. As of publication time, the number of inspection requests have increased 63% over 1990 (from 22 to 36, see accompanying figure).

Much of this increase can be attributed to the desire of private fish culturists to sell fish to California, which has increased its requirements to two inspections annually. Other sources of the increase include new facilities which desire to sell live fish, which must complete two inspections prior to initial fish health approval.

Meeting this change in work demand is hindered by the inability of state and federal agencies to expedite matching increases in workforce and budgets. Legislative controls severely limit the addition of new employees needed to provide these services. The USFWS laboratory at Ft. Morgan has been forced to adopt a policy of limiting the number of laboratory samples it can accept during any one week. This may result in scheduling delays of several weeks or months for an inspection. The FES has initiated several steps in order to try to meet this demand. In January, private fish culturists were contacted and asked to complete inspection requests by February 1. This allowed early scheduling of most inspection dates with the USFWS laboratory. In order to meet the inspection schedule, two collection crews are being formed to allow simultaneous inspections. This has necessitated purchase of new vehicles and supplies, additional hiring of contract workers and utilization of state hatchery workers specially trained for this task. Other measures being considered include the elimination of other current services such as the Fish Disease Diagnostic Lab and the possible legislative creation of a fee to cover the cost of second inspections. This measure would hopefully help to eliminate casual requests for unnecessary inspections which currently are free.



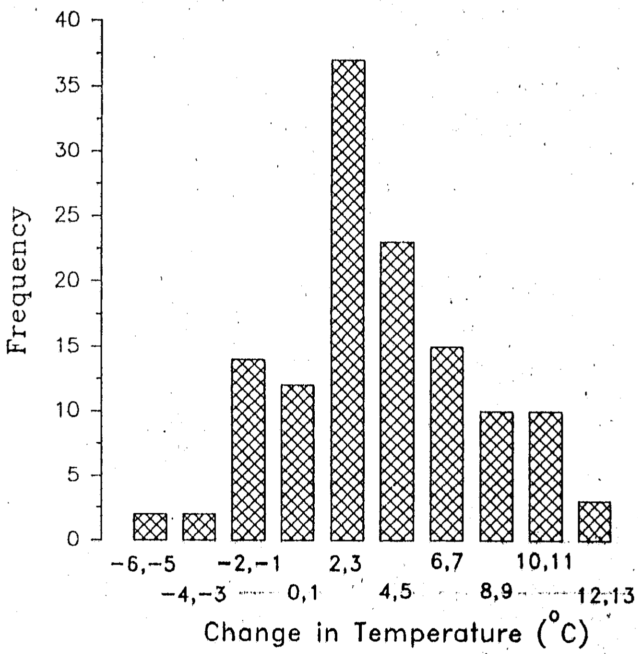
In this issue

FEDERAL AID RESEARCH UPDATE

TEMPERATURE STRESS

Temperature changes a fish has to endure when it is stocked can be stressful and lethal. I have begun to review stocking records for the past 3 to 4 years to find out what temperature changes a hatchery fish in Utah might face. Maximum temperatures of the receiving water can reach 26°C (78°F) during the summer months. Although not all the data has been summarized yet, the graph below shows the frequency of stocking trips in which fish experienced a change in temperature within the range labeled below the bar. The data is summarized from the last four years of records from the Egan Hatchery.

Note that most stocking is within 6 or 7 degrees of the truck tank temperature, but that fish can encounter temperature differences of up to 12 to 13°C (23°F). A good way to get fish to survive in these cases is to acclimate them at intermediate temperatures for a period of time. Currently, when the temperature difference between tank and lake exceeds 6°C (10°F), the fish are tempered for up to a half hour by pumping lake water into the truck tank, mixing the two waters. Is this enough time? The scientific literature suggests acclimating for periods of at least 24 h or greater, but no minimum time has ever been proposed, to my knowledge.



We are beginning to test both juvenile and adult trout to see what the minimum acclimation time may be to eliminate mortality. The first stage of testing has been to determine what the lethal limits are for various species under the experimental conditions. Thus far, working with adult fish raised at 8 to 9° C (47° F), the results are:

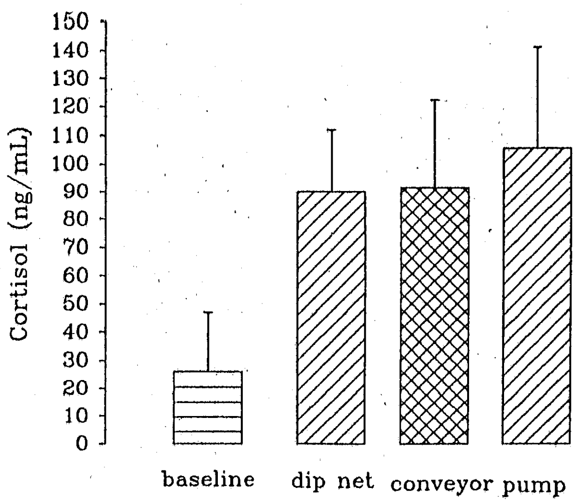
Species	Strain	Age(YR)	Temp. Change	Survivors/Total
Rainbow Trout	Sand Creek	6	9-10	8/8
Rainbow Trout	Ten Sleep	6	10-11	6/8
Brown Trout	Sheep Creek	3	9-10	8/8
Brook Trout	Owhi	5	11-12	5/8

Results of the first acclimation trial with brook trout (5 yr) resulted in 2 of 4 surviving upon direct transfer, 2 of 4 surviving after acclimation for 4 hours, and 3 of 4 surviving after 8 hours of acclimation. Preliminary results indicate that short term tempering has little or no benefit, and 8 hours or more are necessary.

LOADING STRESS

Three loading methods were compared for rainbow and cutthroat trout to determine if there were differences in the stress response. Rainbow trout were stressed more or less equally by fish pump, dip net, or conveyor. There were significant differences among loading methods based on chloride and cortisol data. Cutthroat trout had higher chloride and lower cortisol values using the conveyor compared to trout loaded by the fish pump. The mean cortisol values (see figure next page) of the cutthroat were in a narrow range, suggesting that the statistical significance may not be biologically significant.

pH-TEMPERATURE STRESS



In the fall 1990 *Icthyogram*, preliminary results of the pH-temperature experiment were presented. In this experiment, the response of rainbow trout to an increase in either pH, temperature, or both was evaluated using physiological indicators and mortality. Mortality was highest in the treatment in which fish were subjected to both a temperature and pH increase. Glucose and chloride concentrations were not significantly different among the various pH-temperature combinations. Plasma cortisol concentrations did not indicate any synergistic effect of pH and temperature. Instead, fish from the high temperature treatments had lower cortisol concentrations than fish transferred to water of approximately the same temperature. One would expect an increase in cortisol in response to a stressor such as temperature change or pH increase, which we saw relative to the baseline, but cortisol concentrations were greater at the lower temperature. This may be related to efficiency of certain enzymes at the acclimation temperature of the fish.

THYMUS INDEX/HCP

We have made observations for the past 7 months on the dynamics of the thymus index of the Health Condition Profile developed by Ron Goede. We observed no seasonal fluctuation in the indices of rainbow trout, as was observed in fish sampled from the Green River. There were only a few fish observed with hemorrhaged thymi and fewer as time went on. The metal Monel tags in the opercles caused lesions in many fish on the body where it touched the tag. Several tags were lost during the course of the study (16%). ERIC WAGNER

The Impact of Disease on Wild Fish Populations
A Review

Wild fish populations, as well as wild terrestrial animals, are constantly exposed to a wide variety of parasites, bacteria, viruses, etc. A fish's environment may contain pollutants and may experience drastic fluctuations in temperature, water level, or pH. In addition, there may also be changes or reductions in food supplies. These variables all illustrate the complexities involved when trying to ascertain disease impacts. One must consider all the factors that may be acting on the fish population in order to determine what effect is attributable to a disease. Another difficulty is the widespread distribution of a wild population over a large geographic area and, therefore, the difficulty in observing changes as they occur. Fish raised in a confined setting are generally observed several times a day and illness can be spotted easily. This is not the case with a wild population. In the wild, detection of an undesirable impact is usually only noted after considerable time has past.

Some of the manifestations detected on a population level which may be associated with disease include: a decline in yield, changes in catchability, changes in population structure or size, reduced growth rate, behavioral alterations, increased reports of obvious lesions, or changes in recruitment (in or out) of the population. Some of these impacts may only be discovered after fisheries biologists have conducted a creel census or a length-frequency distribution study. Many conditions which have a high potential to alter the entire population size occur during the early life stages of fish. This is the time of life when predation is highest, energy reserves are lowest, and the immune system of the fish is still underdeveloped. Certain diseases, such as IPN, primarily affect fish less than 1 year of age.

The direct impacts of disease on wild fish may be exhibited in a variety of ways. These can be classified as either lethal or sublethal effects, with a multitude of different effects falling within the sublethal category. A disease might occur as a consequence of resident pathogen buildup, or may be introduced from stocked carrier fish.

Mass mortality is perhaps the most obvious and attention-getting impact of disease. Many such episodes have been documented and studied over the past several decades. A bacterial kidney disease

(BKD) outbreak was studied in Wyoming where deaths had been observed for 4 years. The source of the infection was thought to be infected trout stocked 9 years earlier from a hatchery with a history of BKD. This was the only hatchery to plant fish in that area. Natural occurring mass mortality caused by the fungal organism *Ichthyophonus* has been documented in marine fish in the north Atlantic and in the oceans of other countries. Estimates were given of 1/2 of the herring population killed in 1954-55 in the north Atlantic as reflected by the reduction in catch rates. Along the Texas gulf coast, an anaerobic bacteria identified as a *Catenabacterium* was isolated from various tissues in association with massive die-offs of grey mullet and redfish. Current research in the Great Lakes region and the Pacific Northwest is attempting to evaluate the role of BKD in steelhead trout and salmon mortalities.

Sublethal impacts may be reflected in reduced growth rates, deformities of the spine or other tissue, increased predation, decreased reproductive ability, or increased susceptibility to pollutants or other environmental stressors. A study of IPN carrier brook trout revealed that the carrier fish were 5 - 8% smaller in size than non-carriers. Sublethal infection with the whirling disease organism has been found to result in spinal deformities that interfere with swimming and leave the fish more vulnerable to predation or starvation. The protozoa, *Eimeria*, can invade the testicles of certain fish species and produce what is termed "parasitic castration". Weight loss and reduced fecundity have been documented in cod and haddock due to an infestation of the copepod parasite, *Lernaeocera*. Findings of another study of wild sockeye salmon smolts suggest that infestation with tapeworms and roundworms interferes with orientation and out-migration from their native streams. This could potentially have a dramatic effect on the number of smolts surviving to reach the ocean as well as on the level of the future population.

In order to effectively manage wild fish populations in conjunction with stocking operations and disease control programs, an adequate knowledge and understanding of these impacts seems necessary. However, it is not uncommon for programs and policies to be geared exclusively around culture operations with no regard for the impact on fish in the wild. Stocking out progeny of fish which are known to be pathogen carriers may lead to irreversible damage to wild stocks. The future survival of some small isolated populations, such as many of the cutthroat subspecies, may depend on how well enhancement policies address these impacts. Considering the wide variety of challenges facing our wild fish, it seems imperative that fisheries programs avoid introducing diseases into these populations.

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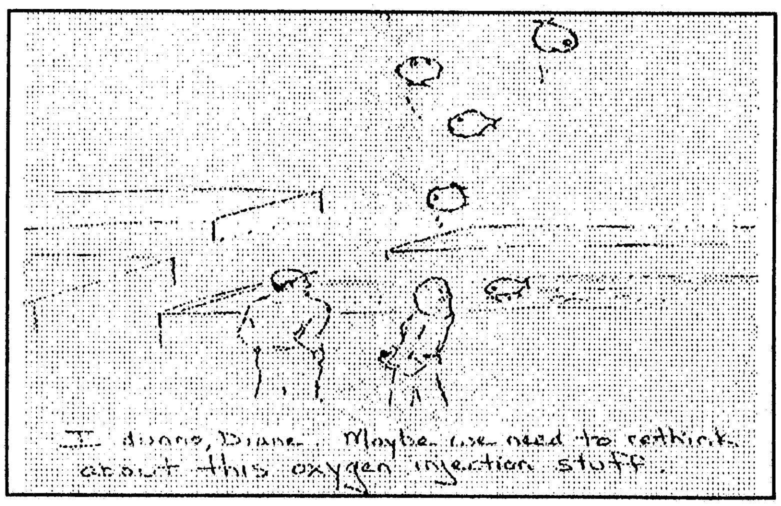
The Icthyogram is the newsletter of the Fisheries Experiment Station, Division of Wildlife Resources. Comments and suggestions are welcome. Please address to: The Ichthyogram, 1465 W 200 N, Logan UT 84321.



Erythrocytic Inclusion Body Syndrome Survey

Erythrocytic inclusion body syndrome (EIBS) is a condition of apparent rhabdoviral origin which was first described in the Pacific Northwest during the 1980's, occurring in several species of pacific salmon. It was first encountered when fish showing signs of anemia and bacterial kidney disease were discovered to have inclusion bodies in the cytoplasm of the red blood cells.

Clinically, fish with EIBS may show varying amounts and patterns of mortality, ranging from no losses, long term chronic loss or acute episodes with significant mortalities. Acutely affected fish may show classic signs of anemia both externally and internally, e.g. pale gills, pale viscera etc., although the virus has also been detected in subclinical cases in which the hematocrit is reduced only marginally. It is not uncommon to detect secondary infections of fungal, bacterial or parasitic origins. Diagnosis is usually made by a combination of clinical signs and the demonstration of pale pink or lavender inclusions 0.8 - 2.0 μ within the red blood cells when selectively stained with pinacyanol chloride. Confirmation of this diagnosis can be made through the demonstration of hexagonal viral inclusions by the use of transmission electron microscopy.

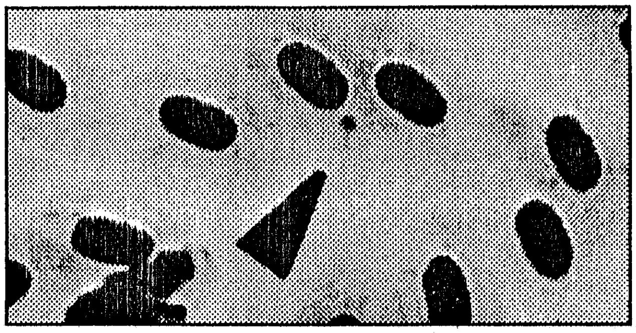
At this time, pacific salmon (chinook and coho), seem to be the principle species showing clinical outbreaks of the disease. Rainbow and cutthroat trout have been demonstrated to experience infections in the lab and there are unpublished reports suggesting that rainbow trout have experienced outbreaks in hatchery situations. Formal investigations into the occurence of the disease in cultured trout have been rare. Transmission seems to be principally horizontal (fish to fish). As with most viral diseases, there is no effective treatment. Preventive efforts involve prompt diagnosis, isolation of affected populations and adequate sanitation to contain spread of the disease.

This fish health survey was initiated at the Fisheries Experiment Station as part of a continuing effort to detect and contain potential fish pathogens prior to their expression in an outbreak. This pathogen was specifically targeted in response to high coefficient of variation in hematocrit readings from one state culture facility. This finding was detected as part of the routine health condition profile. The wide variation in hematocrit was suspected as a possible clinical sign of EIBS.

Blood was collected from 25 - 30 fish at all state and private culture facilities as well as populations of wild fish which are inspected at spawning. The collection period extended from January 1989 to December 1990. These collections were done only during inspections; no suspicious outbreaks occurred during the course of this survey.

Blood smears were examined for the presence of pale pink or lavender inclusions using pinacyanol chloride stain at 1000x magnification. Each slide was examined by viewing 100 fields with a scanning time of approximately 5 minutes per slide. Two or more of these typical inclusions needed to be found on a slide before a sample was classified positive.

The criterion used to identify an inclusion body as a suspect for EIBS was a circular, pale blue or pink staining structure 0.8 - 2.0 μ in diameter (see figure). Two inclusions meeting this description on one slide constituted a positive sample, and one inclusion on a slide was termed suspect. No positive samples were found during the course of this survey. Fifty five slides demonstrated one viral inclusion which met the morphologic criteria for EIBS. These slides were designated as suspect.



A common problem inherent with this type of survey is that by the time the samples are collected, processed and read, the fish are either stocked out, widely dispersed (as in the case of wild populations), or sold. Therefore, obtaining additional samples of the suspects for confirmation by electron microscopy was impossible. Samples were collected as part of routine health inspections and the fish exhibited no signs of illness at the time. By taking only 25 or 30 samples out of the tens of thousands of fish at each location, the chances of finding infected individuals is greatly reduced. Since the viremic stage lasts between 5 and 30 days depending on the water temperature and precedes any drop in hematocrit, any sampling that does not coincide with this stage will yield negative results.

It was concluded that EIBS is not a problem in this state, based on the lack of positive slides and the few number of suspect slides found in comparison to the number of slides viewed (55/1810 = 3%), as well as the lack of clinical signs of disease. The survey has been terminated in favor of diagnostic investigations if a suspicious scenario occurs.

BIOLEGAL ASPECTS OF FISH HEALTH CONTROL

HISTORY

For many years, control of fish diseases was based upon empirical wisdom passed on by word of mouth. There were some successes, but by and large it was less than adequate and many devastating losses were suffered. The successes were not even always understood. Formal research and development in the fish health scenario was the domain of a few federal and academic research scientists. Often the information developed by these entities did not find its way into the practical world. Both of these groups undertook training of technicians and more research scientists. These in turn trained people and soon there was a cadre of diagnosticians and fish health specialists out in the field to perform diagnostic services. This was applied in the case of substantial losses of fish. It was the policy to do what needed to be done to determine the cause of fish diseases and take what action was necessary to control them. Most of the documented work was done relative to federal and state fish culture programs. These programs were rooted in stewardship of the resource. There was no profit motive involved and conflict of interest was minimized. Transportation and shipping methods were somewhat primitive so the movement of live fish and eggs was limited. For that reason fish diseases were isolated problems. As transportation and shipping methods improved it became easier to move fish and eggs from water to water; facility to facility; state to state; vendor to buyer, etc.. Unfortunately there was a resultant movement of fish pathogens, so that what had been a number of isolated problems became common, world-wide problems. This meant someone having a fish health problem could contaminate someone not having a problem.

Thus was ushered in the era of the "injured party". It was now not only necessary to protect the natural resource but also to protect the public and private producers one from the other. This meant that simple policy would no longer suffice. Regulations had to be developed and programs had to be developed to administer and enforce them. This new regulatory effort meant that it was no longer sufficient to develop the information needed to simply to manage the problem. The new regulations were, of necessity, centered around a system of inspection and "clearance" of fish stocks before they were moved. It was now necessary to establish strict protocols and to "police" the ranks of fish pathologists and health inspectors. There could be no dual sets of standards. It was no longer appropriate to require more of the private sector than of the public sector. It was no longer sufficient to know internally that there was no problem. It became necessary to demonstrate to a "stranger" on the other end of the continent or on another continent that certain stocks and sources of stocks were free of specific diseases or pathogens capable of producing those diseases. Perhaps more to the point it became necessary to accept the assurances of a "stranger" that fish intended for shipment into your area were safe and free of restricted pathogens. It was now necessary to know that the inspection was performed by a qualified, ethical inspector with no conflict of interest. It was now necessary to use methods of detection of a consistent level of sensitivity so as not to introduce unfair market advantage or disadvantage. If a pathogen was found using an extreme level of sensitivity at a private aquaculture facility it would be considered unfair by many unless all other facilities were checked in the same manner.

PRESENT DAY PROBLEMS

Inspection and certification programs now must be conducted in such a manner as to stand up to both professional and legal scrutiny and be ready to move into the adversarial courtroom arena. This means that inspections must be run according to specific protocols in a consistent manner. It is likely that should the matter end up in the courts it will be necessary to follow rules of evidence so records will have to be prepared and administered accordingly. The inspections and regulations must be applied fairly, equally and consistently. The first time regulations are compromised, they stand forever compromised. If we cannot live with a regulation, the regulation should be changed following application of appropriate, documented rationale. Acceptable standard inspection protocols should also be changed only after appropriate documented rationale and due notification. In order for regulations to be enforced fairly they must be administered efficiently and thoroughly. Everything must be done to see that all is carried out expeditiously.

It is now necessary to determine who should pay for all of this. Comprehensive disease control programs are very expensive. Should resource agencies funded by sportsman dollars pay the entire bill, or should general fund monies be appropriated through commodity oriented legislative efforts to subsidize these programs? Should private fish culturists be assessed a fee? All of this has to be considered in the regulation and control programs of today.

FUTURE CHALLENGES

There is currently considerable confusion and disagreement among the inspectors, regulators and the regulated. There have been numerous meetings held nationally, regionally and locally to attempt definition and resolution of the problems. There are numerous meetings scheduled in the near future to continue the deliberations. I offer no solutions but present some of the problems facing these meetings and the general area of fish disease control and fish health management for the both the public and private sectors. It is hoped that much of the trouble will be worked out in the next one or two years and that the result will be a relatively uniform inspection protocol which will support a relatively uniform set of regulations and that all of this will provide protection for the free-ranging fishes of the natural resource as well as the cultured fishes of both the public and private sector. RON GOEDE

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