DEPARTMENT OF FISHERY AND WILDLIFE BIOLOGY

M E M O

December 8, 1967

TO: All Fishery Graduate Students

FROM: Harry Everhart, Chairman Fishery Major

SUBJECT: Fishery Seminar and General Summary of Our December 4th Meeting

1. Graduate courses to be offered in Department of Fishery and Wildlife Biology
   1. World Fishery Resources FW 600 S 3 (3-0). The nature and distribution of fish and shellfish resources of the world emphasizing evolution, distribution, taxonomy, anatomy, and basic physiology.
   2. Ecology of Fishes FW 720 W 3(3-0) Prerequisite: FW 300. Z 440. Intra-specific, inter-specific, and environment relationships of marine and freshwater fishes.
   3. Systematic Ichthyology FW 630 S 4(2-6) Prerequisite: FW 300 or Z 310. Knowledge of fishes; process of speciation; methods and techniques of classification. Comparative fish anatomy, dissections, skeletonizing of specimens; investigation of inter-and intra-specific variability.
   4. Zoogeography of Fishes FW 725 S 2(2-0) Prerequisites: FW 300. Distribution of fishes and reasons for these distributions.
   5. Fishery Seminar - 795a (for this winter quarter only), 797a for spring 67 and thereafter). F,W,S 1 (1-0). Time- Weekly on Wednesdays from 12:00 to 1:30.

      Your professors intend that this seminar will be an opportunity for the fishery scientists on the campus to meet together. When fishery scientists meet they talk about fisheries. The seminar should serve then
      1. for everyone to get acquainted.
      2. to give you a chance to practice the presentation of a technical paper.
      3. to give you a chance to practice conducting and taking part in a discussion.
      4. to provide for an exchange of information about projects and facilities in the CSU program.
      5. to obtain the constructive criticism of your professors and fellow students before or during your research.
      6. to broaden your general appreciation of fishery problems.

   Here are some general guide lines for the seminar:
      1. Speakers should plan to distribute an outline of subject together with 5 or 6 pertinent suggested readings no later than one week before they are scheduled. Outlines and readings combined should not exceed two typewritten pages. The Cooperative Fishery Unit and the Department of Fishery and Wildlife Biology will help with the typing and mimeographing. Secretaries should have at least a week's time to do your work.
      2. Confine opening remarks to not more than 30 minutes. Speakers at technical sessions at national scientific meetings are rarely given this much time. More care and planning is necessary for the short, to-the-point presentation.
      3. While there will be some rustling of papers as those attending consume their sack lunches if they wish, this will also be good experience as most national scientific meetings are characterized by various kinds of unplanned but expected disturbances.

      4. As discussion leader you should feel free to call on those in attendance for comment and to stimulate discussion as you see fit. We'll all help!

5. We recognize that everyone will not be able to remain till 1:30, but so many times good discussion must be cut off that we thought the luxury of the extra half-hour might be appreciated.
6. We will remain flexible and responsive to any suggestions for improving the seminar. For example, the winter quarter is planned around student thesis projects and the spring quarter will be planned around the general theme of "Coexistence of Fish Species". We can decide at the end of the spring quarter what general format we'll follow in subsequent quarters.

Professor Everhart will be in charge of the winter quarter seminar this academic year, and Professor Vincent will be in charge of the spring quarter seminar. An outline of our seminar program for the winter quarter is attached for your convenience. Special Note: Dr. Vincent has invited us out to his home for our first meeting on Wednesday, January 3, at 7:30 p.m. Dr. Vincent lives at 3043 Moore Lane, Fort Collins, and will distribute a map for easy location of his home.

II. If there was any general agreement regarding minimum requirements for graduate students it seemed to be that these should be very general and left largely to the graduate committee.

III. In the future all fishery graduate students will have been notified of their initial adviser prior to arriving on campus. The initial adviser will be particularly qualified in the fishery specialty corresponding to your interests as expressed in your application. Likely most of you will have been corresponding with your adviser before you arrive on the campus. The sooner you become established with proper guidance, the sooner you'll be making the most of your graduate study.

IV. Your thesis proposal should be a detailed and specific document outlining your proposed project. This proposal should include your committees names, any special facilities you may need, and pertinent literature references. Make the proposal as long as necessary to be absolutely certain that everything you plan to do is obvious to the reader.

Circulate copies of your proposal to your Committee, the Head, Department of Fishery and Wildlife Biology, and all the fishery professors.

V. You are all rightfully concerned about the preliminary examination. We would advise you to discuss the examination with the members of your Committee. They can advise you as to what they expect and how you can best prepare for this stimulating event.

A successful examination should demonstrate to your committee that you have assimilated information from background and specialized courses into a pool of knowledge from which you can draw associations in solving and understanding fishery problems.

cc - Dr. Swanson
Dr. Behnke
Dr. Hagen
Dr. Post
Dr. Vincent

FISHERY SEMINAR (795ax)

Winter Quarter

Wednesdays, 12:00-1:30 p.m.

January 3 - Hooking mortality*	Mr. Leo Marnell
January 10 - Problems in net sampling	Mr. Thomas Powell
January 17 - Fish Audiology	Mr. Gary Brown
January 24 - Problems in fry enumeration	Mr. Wayne Deason
January 31 - "Brainstorming" graduate study	Students and Staff
February 7 - Toxicity of insecticides	Mr. Thomas Schroeder
February 14 - Tapeworm parasite of trout in Parvin Lake	Mr. M. P. Ackerman
February 21 - Trouts of the Upper Kern River Basin, California	Mr. C. B. Schreck
February 28 - Taxonomic problems in the South Platte	Mr. H. W. Li
March 6 - Increasing fathead minnow production	Mr. S. A. Flickinger
March 13 - Midge production in high mountain lakes	Mr. C. J. Walters

* Special evening meeting at home of Dr. Robert Vincent at 7:30 p.m.

Steve Flickinger
CFU

SEMINAR IN FISHERY SCIENCE
FW-795a
Winter, 1967

DATE: Wednesday, January 3, 1968

TIME: 7:30 P.M.

PLACE: Home of Dr. Robert Vincent, 3043 Moore Lane, Ft. Collins

SUBJECT: Hooking mortality of cutthroat trout at Yellowstone Lake

SPEAKER: Leo Marnell - CSU Fisheries Graduate Student

Concern over the prospect of unobserved post-release mortality in fishes released from the angler's hook has given rise to widespread controversy. Aesthetically, the concept of "catch and release" fishing is acceptable. But what about the biological merit of the practice? Should the idea be encouraged in all sport fishing waters? - In some waters? How do you determine whether a catch and release program will benefit a fishery? Answers to these and other questions are being sought by fishery biologists across the country. A comprehensive hooking mortality investigation is currently in progress at Yellowstone Lake, Wyoming. Research objectives are aimed at answering the following questions: - (1) Do cutthroat trout in pre-spawning condition have higher post-release mortality than non-spawning trout of similar size? (2) Is there survival-advantage to leaving the hook in the fish as opposed to forced removal of the hook? (3) How long does it take for a conventional hook to "rust out" of a cutthroat in Yellowstone Lake? (4) Can trout feed with hooks inside them? (5) How does post-release mortality vary in response to changes in water temperature? (6) Does hooking and handling of cutthroat trout increase their susceptibility to fungal infection? (7) Will post-release mortality of trout increase significantly as a result of deliberate "fatiguing" for periods up to ten minutes?

At least one more summer's data will be obtained. Formulation of firm conclusions will not be attempted until the project is terminated.

References

Klein, W. D. 1965. Mortality of rainbow trout caught on single and treble hooks and released. Prog. Fish Cult. 27:171-172.

Lennon, R. E., and P. S. Parker. 1960. The fishing-for-fun program in Great Smoky National Park. Soc. Amer. Forest Proc. Washington, D. C. (Nov. 1960), p.106-112.

Mason, J. W., and R. L. Hunt. 1967. Mortality rates of deeply hooked rainbow trout. Prog. Fish Cult. 29:87-91.

Shetter, D. S., and L. N. Allison. 1955. Comparison of mortality between fly-hooked and worm-hooked trout in Michigan Streams. Mich. Dept. Conserv. Misc. Publ. No. 9. 44p.

Thompson, F. A. 1946. Experiment proves small fish are worth saving. State of New Mexico, Dept. Fish and Game Tech. Rep. 11-F. 2-p.

Notes

SEMINAR IN FISHERY SCIENCE

FW-795ax

Winter, 1967-68

DATE: Wednesday, January 17, 1968

TIME: 12:00 A.M.

PLACE: Room 107 Forestry Building

SUBJECT: Electroacoustical signals emitted by rainbow trout.

SPEAKER: G.L. Brown - Fisheries Graduate Student

The possibility of using sound production of fish for purposes of identification has been studied by several investigators. The results of these investigations indicate that sound production does not provide a reliable method for identification. However, recient investigations by Minto and Hudson (1967) have brought to light a previously unrecognized type of electroacoustical signal emitted by fish. In their work they found that each of the 130 species of fish studied emitted electroacoustical signals characteristically different from other species in carrier frequency, pulse, duration and intensity. Also, they discovered that each of the species of fish studied emitted signals of a uniform quality that permitted identification by comparison with known signals.

The purpose of this study is to examine the various aspects of electro-acoustical signal emission by rainbow trout. The study was designed with the following specific objectives. (1) To refine the amplification and recording set up and therefore produce high quality tapes suitable for sono-graphic analysis. (2) To study electroacoustical signal emission under various environmental and behavioral conditions, and determine the effects on signal emission. (3) To determine the effects of age, size and sex on signal emission.

(4) To determine if the electroacoustical signal can be used for identification of rainbow trout.

Refrences

Minto, W.L., and Hudson (Unpublished), 1967. Hydronic signals from fish. Presented at Thirty-first Annual Meeting of the Florida Academy of Sciences, Biological Sciences Section at University of South Florida, Tampa, Florida.

SEMINAR IN FISHERY SCIENCE

FW 795ax

Winter, 1967-68

Date: Wednesday, March 13, 1968

Time: 12:00 PM

Place: Room 236, Forestry Building

Subject: Trouts of the Upper Kern River Basin, California

Speaker: C.B. Schreck, Fisheries Graduate Student

The upper Kern drainage is in the southern Sierra Nevada Mountains of California. Five species of trouts were named from this dendritic basin in the late 19th and early 20th centuries. Various theories have been proposed to explain the origins and affinities of these trouts named, *Salmo gairdneri gilberti* Jordan, *S. mykiss aguabonita* Jordan, *S. whitei* Evermann, *S. roosevelti* Evermann, and *S. rosei* Jordan and McGregor, but due to the paucity of systematic and zoogeographic information regarding these fish, many contradictory views have been proposed. Presently, no adequate descriptions of these trouts exist.

The objectives of this study are to obtain information on the systematics, origins, affinities, and present distributions of the Kern area trouts. Character analyses of the type specimens will be used in conjunction with taxonomic data taken from specimens collected during this study to derive the taxonomic status and distribution of these forms. A study of the morphogeny of this basin as well as the zoogeography of other southern California fishes should point out origins of these Kern trouts and possible zoogeographic routes.

Trouts were collected extensively throughout the Kern waters, especially in localities where it was felt that pure genotypes of the

native species might still exist. Taxonomic investigation and literature review revealed that *roosevelti* is now considered to be synonymous with *aguabonita* and that *rosei* is not a valid species because it was found to be an introduction and a hybrid (probably *aguabonita* x *whitei*). Widespread and indiscriminate stocking of trouts into the waters of the Kern endangered the genotypes of *gilberti* and *whitei*. Stocking records and examination of specimens collected during the summer of 1967 indicated that *gilberti* probably no longer exists in pure form. However, barriers on some sanctuary stream may have kept exotics from polluting the gene pool of *whitei*.

It is suggested that *aguabonita* has close affinities with inland cutthroats and other golden-like trouts, *S. gilae* and *S. chrysogaster*, east of the Sierras. The Apache trout of Arizona has the same karyotype as *aguabonita*, a karyotype more readily derived from that of the inland cutthroat than from that of the coastal rainbow. Sierran geomorphogeny also hints at a Great Basin origin of the golden trout rather than the currently accepted hypothesis of the speciation of *aguabonita* from an isolated coastal rainbow. Consequently, it is hoped that this study will lead to a better understanding of North American *Salmo* as a whole.

Evermann, B.W. 1906. The golden trout of the southern High Sierras. U.S. Fish and Wildl. Ser. Fishery Bull., 25(1905):1-51.

Hubbs, C.L. 1943. Criteria for subspecies, species, and genera, as determined by researchers on fishes. Ann. New York Acad. Sci., 44, Art. 2: 109-121.

Mayr, E. 1968. The role of systematics in biology. Science, 159 (3815): 595-599.

SEMINAR IN FISHERY SCIENCE
FW-795ax

March 13, 1968

SERUM PROTEIN POLYMORPHISMS IN SOME SALMONID FISHES

Richard A. DeLong

The objectives of this study are:

1. To differentiate between different species in the genera Salmo and Salvelinus by use of immunological methods.

2. To differentiate between recognized subspecies of Salmo clarki and of Salmo gairdneri by use of immunological methods.

3. To establish the immunogenetic basis of serum protein polymorphisms.

4. To use serum protein immuno-reactions to estimate the taxonomic distance between species and subspecies.

The choice of serum proteins for this study is based upon the following observations. Relatively stable systems represented by cytochrome c hemoproteins and eye lens proteins are useful in demonstrating phylogenetic relationships at the higher taxonomic levels of family, order, class and phylum. At the species level high molecular weight, eye lens proteins show wide cross-reactions between species; i.e., they share many components, and thus exhibit slow rates of evolutionary changes. In this respect they must have retained antigens derived from more primitive ancestors. Serum proteins are more limited in their cross-reactions, indicating faster rates of evolution. In addition, serum proteins are synthesized by a variety of cells which have different rates of evolution. Unlike eye lens proteins serum proteins show immunochemical similarities within a taxonomic range mainly restricted to the same class, i.e., Class Actinopterygii in this study.

Electrophoretic patterns of serum proteins from various vertebrates including fish are species specific. Many of the protein fractions are polymorphic, i.e., two or more forms of the fraction persist in the same population with the rarest form in a frequency too high to be accounted for by mutation alone. When heterozygotes are favored over homozygotes, the establishment of a gene-frequency equillibrium creates a balanced polymorphism.

It is important to note that the relationships of one taxonomic group to another is usually not clear from electrophoretic mobility data alone. Certain immunodiffusion techniques have extraordinary abilities to distinguish between molecules and permit finer differentiating tests to be applied to members of a given genus or species. A combination of immunodiffusion and electrophoresis, immunoelectrophoresis (IEA), permits the resolution and definition of the components of complex mixtures according to properties unrelated to their immunochemical characteristics.

The evolution of gamma globulins in vertebrates is illustrated by comparing immunoeletrophoretic patterns of serum from hagfish, lamprey, dogfish and human.

Immunoelectrophoresis of serum from various families of the order primates reveals the following:

1. Grouping patterns according to presumed phylogenetic relationships reveals definite group characteristics.
2. Conservatively changed proteins are readily distinguished from those more rapidly modified during the evolution of the species concerned. Bands of precipitate for the latter are weak or absent from the patterns of the species more distantly related to the reference species.
3. The investigator obtains a subjective impression of the relative distance of relationship of the several species to the reference species.

Previous immunoelectrophoretic studies of fish sera include those of Fine and Drilhon, who studied eel serum, and those of Bargetzi, who demonstrated differences between the sera of two forms of whitefish. Krauel and Ridgway demonstrated polymorphisms of prealbumin and postalbumin fractions in sera from Oncorhynchus nerka.

Preliminary immunoelectrophoretic studies of serum of two strains of Salmo gairdneri from Manchester, Iowa, and New Zealand indicate the existence of an albumin polymorphism in the New Zealand strain. Nyman has reported the existence of an albumin polymorphism in Salvelinus alpinus.

Various remnant populations of rare and endangered Salmo clarki subspecies will be studied by immunoelectrophoresis. A suspected remnant population of Salmo clarki stomias, Greenback cutthroat trout, from Forest Canyon, Rocky Mountain National Park will be investigated. Studies of subpopulations of Salmo clarki from tributary streams of Yellowstone Lake are planned for the 1968 summer season.

References

Bargetzi, J.P. 1958. Application das methodes d'analyse biochimique a une etude taxonomique: les coregones due lac de Neuchatel. I. Methodes immunologiques. Experientia 14: 187-188.

Barrett, I. and H. Tsuyuki. 1967. Serum transferrin polymorphism in some scombroid fishes. Copeia. No. 3: 551-556.

Creyssel, R., G. Richard, and P. Silberzahn. 1966. Transferrin variants in carp serum. Nature 212: 1362.

Crowle, A.J. 1961. Immunodiffusion. Academic Press, New York. 333 pp.

Krauel, K.K., and G.J. Ridgway. 1963. Immunoelectrophoretic studies of red salmon (Oncorhynchus nerka) serum. Int. Arch. Allergy 23: 246-253.

Malecha, S.R. 1968. Studies on the serum protein polymorphisms in some populations of introduced fresh water fishes. M.S. thesis, Univ. of Hawaii. 122 pp.

Manski, W. and S.P. Halbert. 1965. Immunochemical investigations on the phylogeny of lens proteins. in: H. Peeters (Ed.), Protides of the Biological Fluids, Elsevier Publishing Co., New York. pp. 117-134.

Manski, W., S.P. Halbert, T. Auerbach-Pascal and P. Javier. 1967a. On the use of antigenic relationships among species for the study of molecular evolution. I. The lens proteins of the agnatha and chondrichthyes. Int. Arch. Allergy 31: 38-56.

Manski, W., S.P. Halbert, T. Auerbach-Pascal and P. Javier. 1967b. On the use of antigenic relationships among species for the study of molecular evolution. II. The lens proteins of the choanichthyes and early actinoptergii. Int. Arch. Allergy 31: 38-56.

Moeller, D. and G. Naedual. 1966. Serum transferrins of some gadoid fishes. Nature 210: 317-318.

Nyman, L. 1965a. Inter- and intraspecific variations of proteins in fishes. Ann. Acad. Reg. Sci. Upsaliensis 9:1-18.

Nyman, L. 1965b. Protein variations in Atlantic salmon (Salmo salar). Lantbruk Shogsk. Ann. 31: 225-230.

Nyman, L. 1965c. Species specific proteins in freshwater fishes and their suitability for a protein taxonomy. Hereditas 53(10):117-126.

Nyman, L. 1966. Biochemical systematics in fishes. Acta Zoologica, Vol. 47, pp. 1-16.

Papermaster, B.W., R.M. Condie, J. Finstad, and R.A. Good. 1964. Evolution of the immune response. I. The phylogenetic development of adaptive immunologic responsiveness in vertebrates. J. Exptl. Med. 119: 105-130.

Parris, B.B. 1964. Notes on the identification of subpopulations of fish by serological and biochemical methods, the status of techniques and problems of the future application. FAO Fish. Tech. Paper, No. 30, 9 p.

Sanders, B.G., and J.E. Wright. 1962. Immunogenetic studies in two trout species of the genus Salmo. Ann. N.Y. Acad. Sci. 97(1):116-130.

Sanders, B.G. 1964. Electrophoretic studies of serum proteins of three trout species and the resulting hybrids within the family Salmonidae. in: C.A. Leone (Ed.), Taxonomic Biochemistry and Serology. The Ronald Press Co., New York. pp. 673-679.

Thurston, R.V. 1967. Electrophoretic patterns of blood serum proteins from rainbow trout Salmo gairdneri. J. Fish. Res. Bd. Canada 24: 2169-2188.

Williams, C.A., Jr. 1960. Immunoelectrophoresis. Sci. Amer. 202: 130-140.

Williams, C.A., Jr. 1964. Immunochemical analysis of serum proteins of the primates: A study in molecular evolution. in: J. Buettner-Janusch (Ed.), Evolutionary and Genetic Biology of Primates. Vol. II., Academic Press, New York. pp. 25-71.

Williams, C.A., Jr. 1965. Immunological similarity as an indicator of phylogenetic relationship of protein homologues. in: H. Peeters (Ed.), Protides of the Biological Fluids. Elsevier Publishing Co., New York, pp. 62-69.

DEPARTMENT OF FISHERY AND WILDLIFE BIOLOGY

MEMORANDUM

June 12, 1968

TO: All Fishery Graduate Students

FROM: Harry Everhart, Chairman, Fishery Major

SUBJECT Fishery Biology Seminary 797

Three of us, Dr. Swanson, Dr. Vincent, and I summarized what we considered the recommendations reached at our last seminar this past quarter when we had the interesting discussion. I will now attempt to condense our three opinions and also inform you of what action we've taken. There were 20 graduate students and 5 professors present at this policy making session.

1. Everyone was in favor of the seminar and continuing it.

2. Although other meeting times were discussed general agreement was reached that Wednesday from 12:00 to 1:30 is still the most convenient time.

3. There was general criticism of the meeting room so I have arranged for us to meet in Room 168 in the Student Center. This room is suitable for sack lunches or you can obtain your lunch from the cafeteria. Further, it is far enough down the hall so that I believe noise from the cafeteria will be negligible. We will be able to sit around the table and speak directly to each other.

4. Attendance at the seminars was discussed and it was the general conclusion of the students there that some policy of required attendance should be instituted. Agreement was reached on required attendance for three quarters during your residence. The feeling here was that after 3 quarters students will have acquired the "seminar habit".

5. Grading will be on a basis of Satisfactory or Unsatisfactory based on attendance, participation, and presentations.

6. Some in attendance spoke in favor of allowing time each Wednesday for "Recent Developments" announcements. This might be particularly a pertinent paper you feel we would all profit from or some new item of equipment.

7. Subject matter is the most difficult to summarize. Everyone was in agreement that students should present their thesis projects. As a compromise let's require all students to present their thesis research in as near final form as possible. This will be good training for orals.

The theme idea was discussed, but most favored not pursuing the theme for as much as a whole quarter.

Significant papers were suggested for the fall quarter next year. However, programs will always be flexible enough to take advantage of any visitor specialists on campus.

8. Dr. Robert Behnke will be in charge of the seminar fall quarter.

cc - Dr. Swanson, Dr. Hagen, Dr. Post, Dr. Vincent, Dr. Behnke

GRADUATE FISHERIES SEMINAR, FW 797 AX
FALL QUARTER, 1968
ROOM 168, STUDENT CENTER

There will be no set theme for the fall quarter seminars. The topics are flexible and will be selected by the students. The subject matter of a seminar might be: 1. Results of graduate thesis research (every student in fisheries is expected to present a seminar of his thesis research before receiving a degree). 2. A comprehensive review of the literature and current knowledge of a specific subject (this is suggested for a student about to undertake a thesis problem pertaining to such a subject). 3. An in-depth review and evaluation of a significant publication in fisheries or related fields (the attached list offers many suggestions covering a wide range of topics). 4. Discussion of some significant current event pertinent to fisheries biology and the implications and challenges presented to future fishery scientists (for example, thermal pollution effects from rapidly expanding power demands--or the present and potential impact of Pacific salmon in the Great Lakes).

GRADING: on a satisfactory or unsatisfactory basis, judged on attendance, participation, and presentation.

ATTENDANCE: Every graduate student in fisheries is required to register for three quarters of seminar as part of the degree requirement. Attendance of all seminars by all graduate students is highly urged.

PARTICIPATION: All students are urged to engage in the discussion. If you have some viewpoint or information tell the rest of us. If you have a question --ask it!

PRESENTATION: Limit the actual formal presentation to 30-40 minutes. This will allow some discussion time for those who must leave at 1 P.M.. If sufficient discussion develops (hopefully, this will be the case at each seminar), we can continue until 1:30 P.M.. Priority will be given to students presenting seminars for the first time, and to those presenting the results of their thesis research.

OUTSIDE SPEAKERS: When we can take advantage of a visit from an outstanding authority to arrange a seminar, the scheduled seminar of that date and all subsequent seminars will be adjusted to one week later.

BIBLIOGRAPHY

Allen, K.R. 1951. The Horokiwi System. New Zealand Marine Dept. Fish., Bull. 10:231pp.

Am. Zool. 8(1) Feb. 1968.
1. Energy Flow and Ecological Systems
2. Animal Nutrition

Averett, R.C. and F.A. Espinosa. 1968. Site selection and time of spawning by two groups of kokanee in Odell Lake, Oregon. Jour. Wildl. Mgt., 32(1):76-81.

Brocksen, R.W., G.E. Davis, and C.E. Warren. 1968. Competition, food consumption, and production of sculpins and trout in laboratory stream communities. Jour. Wildl. Mgt., 32(1):51-75.

Chapman, D.W., H.J. Campbell, and J.D. Fortune. 1967. Summer distribution and food of kokanee and trout in Elk Lake, Oregon. Trans. Am. Fish. Soc., 96(3):308-312.

Hayne, D.W. and R.C. Ball. 1956. Benthic productivity as influenced by fish predation. Limnol. and Oceanogr., 1(3):162-175.

Ivlev, V.S. 1966. The biological productivity of waters. Jour. Fish. Res. Bd. Canada, 23(11):1727-1759. (Translation of 1945 paper)

Johannes, R.E. and P.A. Larkin. 1961. Competition for food between redside shiners (Richardsonius balteatus) and rainbow trout (Salmo gairdneri) in two British Columbia lakes. Jour. Fish. Res. Bd. Canada, 18(2):203-220.

Kevern, N.R. and R.C. Ball. 1965. Primary productivity and energy relationships in artificial streams. Limnol. and Oceanogr., 10:74-87.

Larkin, P.A. 1956. Interspecific competition and population control in freshwater fish. Jour. Fish. Res. Bd. Canada, 13(3):327-342.

Lindermann, R.L. 1942. The trophic-dynamic aspect of ecology. Ecology, 23(4):399-417.

Lindstrom, T. and N.A. Nilsson. 1962. On the competition between white-fish species. In: The exploitation of natural animal populations. E.D. LeCren ed., John Wiley and Sons:326-340.

McDowall, R.M. 1968. Interactions of the native and alien faunas of New Zealand and the problem of fish introductions. Trans. Am. Fish. Soc., 97(1):1-11.

Minshall, G.W. 1967. Role of allochthonus detritus in the trophic structure of a woodland springbrook community. Ecology, 48(1):139-149.

Nilsson, N.A. 1958. On the food competition between species of Coregonus in a North Swedish lake. Inst. Freshw. Res. Drottingholm, Rept. 39: 46-161

_____, 1960. Seasonal fluctuations in the food segregation of trout, char and whitefish in 14 north Swedish lakes. ibid., Rept. 41: 185-205.

_____, 1965. Food segregation between salmonid species in north Sweden. ibid., 46:58-78.

Rupp, R.S. and S.E DeRoche. 1965. Standing crops of fishes in three small lakes compared with C^{14} estimates of net primary productivity. Trans. Am. Fish. Soc., 94(1):9-25.

_____ , and M.A. Redmond. 1966. Transfer studies of ecologic and genetic variations in the American smelt. Ecology, 47(2):253-259.

Warren, C.E., J.H. Wales, G.E. Davis, and P. Doudoroff. 1964. Trout production in an experimental stream enriched with sucrose. Jour. Wildl. Mgt., 28:617-660.

Fall Quarter, 1968
Final Fisheries Seminar
December 4

THE ROLE OF MACROPHYTES IN THE AQUATIC ECOSYSTEM: Relationships to Fish Production

Panel Discussion

Bruce May, Richard Duchrow, Pat Davies, and Bob Lackey

This topic was selected for a general discussion session because it is one that is not well known. Hopefully we can all learn something, or at least focus attention on what we don't know and what we should know.

Most recent publications on fish ponds stress the need to control or eliminate higher aquatic vegetation to maintain predator-prey balance. The basis for this assumption lacks detailed factual documentation.

Basically, we pose the question: How effectively do aquatic macrophytes direct energy into fishes? No species of North American fishes are strictly herbivorous, thus the energy transfer is not direct.

Does energy by higher plants contribute to fish production or is their main role one of providing cover and habitat for organisms fed on by fish?

There are antagonistic effects between macrophytes and phytoplankton. Would you expect more fish production per equal amounts of energy if it was incorporated in phytoplankton or in macrophytes? Do macrophytes extract nutrients from the substrate and release them on decay which would not otherwise be available to the ecosystem?

What are the desirable attributes of the ideal macrophytes most beneficial for fish production?

Suppose you were writing a thesis on farm fish-ponds in Colorado; how would you plan your research to obtain factual information on the relationships of macrophytes to fish production?

These are a few of the questions suggested for discussion. The discussants are expected to be sufficiently informed to handle such questions and lead the discussion. Everyone should at least read chapter 11 in Welch.

References

Berg, C.O. 1949. Limnological relations of insects to plants of the genus Potamogeton. Trans. Am. Microscop. Soc., 68(4):279-291.

Fish, G.R. 1966. Some effects of the destruction of aquatic weeds in Lake Rotoiti New Zealand. Weed Res., 6(4):350-358.

Frohne, W.C. 1938. Contribution to knowledge of the limnological role of the higher aquatic plants. Trans. Am. Microscop. Soc., 57(3):256-268.

Goldman, C. (ed.). 1966. Primary productivity in aquatic environments. Univ. Calif. Press: 464 pp. Section 4: Productivity of higher aquatic plants and periphyton.

Moore, E. 1915. The Potamogetons in relation to pond culture. Bull. U.S. Bur. Fish., 33:255-291.

Mracheck, R.J. 1968. Macroscopic invertebrates on the higher aquatic plants at Clear Lake, Iowa. Proc. Iowa Acad. Sci., 73:168-177.

Penfound, W.T. 1956. Primary production of vascular aquatic plants. Limnol. and Oceanog., 1(2):92-101.

Pond, R.H. 1905. The biological relation of aquatic plants to the substratum. Rept. U.S. Comm. Fish. for 1903:485-526.

Swingle, H.S. 1966. Biological means of increasing productivity in ponds. In: Proc. World Symposium on warmwater pond fish culture. FAO Fish. Rept. No. 44:1-21.

Welch, P.S. 1952. Limnology, 2nd ed. Mc-Graw-Hill, New York: 538 pp.

Fall Quarter, 1968
Final Fisheries Seminar
December 4

THE ROLE OF MACROPHYTES IN THE AQUATIC ECOSYSTEM: Relationships to Fish Production

Panel Discussion

Bruce May, Richard Duchrow, Pat Davies, and Bob Lackey

This topic was selected for a general discussion session because it is one that is not well known. Hopefully we can all learn something, or at least focus attention on what we don't know and what we should know.

Most recent publications on fish ponds stress the need to control or eliminate higher aquatic vegetation to maintain predator-prey balance. The basis for this assumption lacks detailed factual documentation.

Basically, we pose the question: How effectively do aquatic macrophytes direct energy into fishes? No species of North American fishes are strictly herbivorous, thus the energy transfer is not direct.

Does energy by higher plants contribute to fish production or is their main role one of providing cover and habitat for organisms fed on by fish?

There are antagonistic effects between macrophytes and phytoplankton. Would you expect more fish production per equal amounts of energy if it was incorporated in phytoplankton or in macrophytes? Do macrophytes extract nutrients from the substrate and release them on decay which would not otherwise be available to the ecosystem?

What are the desirable attributes of the ideal macrophytes **most** beneficial for fish production?

Suppose you were writing a thesis on farm fish-ponds in Colorado; how would you plan your research to obtain factual information on the relationships of macrophytes to fish production?

These are a few of the questions suggested for discussion. The discussants are expected to be sufficiently informed to handle such questions and lead the discussion. Everyone should at least read chapter 11 in Welch.

Hutchinson, G. E. vol. III ?

97387

Dorofeeva zhelan
Zool. Zhur.
1967
46(9):1362

1966
FAO Fisheries Rept. No. 44, vol. 3
World Symposium on warm-water pond fish culture.

Folio
SH 331
F2

Folio
SH331
F2
No. 44 v. 1
No. 44 v. 2
v. 3 ?

Limnol. Ocean.
- Pennfoull - early issue L, O,
- Journ. Ecology - 66-67.

References

Berg, C.O. 1949. Limnological relations of insects to plants of the genus Potamogeton. Trans. Am. Microscop. Soc., 68(4):279-291.

Fish, G.R. 1966. Some effects of the destruction of aquatic weeds in Lake Rotoiti New Zealand. Weed Res., 6(4):350-358.

Frohne, W.C. 1938. Contribution to knowledge of the limnological role of the higher aquatic plants. Trans. Am. Microscop. Soc., 57(3):256-268.

Goldman, C. (ed.). 1966. Primary productivity in aquatic environments. Univ. Calif. Press: 464 pp. Section 4: Productivity of higher aquatic plants and periphyton.

Moore, E. 1915. The Potamogetons in relation to pond culture. Bull. U.S. Bur. Fish., 33:255-291.

Mracheck, R.J. 1968. Macroscopic invertebrates on the higher aquatic plants at Clear Lake, Iowa. Proc. Iowa Acad. Sci., 73:168-177.

Penfound, W.T. 1956. Primary production of vascular aquatic plants. Limnol. and Oceanog., 1(2):92-101.

Pond, R.H. 1905. The biological relation of aquatic plants to the substratum. Rept. U.S. Comm. Fish. for 1903:485-526.

Swingle, H.S. 1966. Biological means of increasing productivity in ponds. In: Proc. World Symposium on warmwater pond fish culture. FAO Fish. Rept. No. 44:1-21.

Welch, P.S. 1952. Limnology, 2nd ed. Mc-Graw-Hill, New York: 538 pp.

FISHERY SEMINAR (795ax)

Winter Quarter

Wednesdays, 12:00-1:30 p.m.

January 3 - Hooking mortality*	Mr. Leo Marnell
January 10 - Problems in net sampling	Mr. Thomas Powell
January 17 - Fish Audiology	Mr. Gary Brown
January 24 - Problems in fry enumeration	Mr. Wayne Deason
January 31 - "Brainstorming" graduate study	Students and Staff
February 7 - Toxicity of insecticides	Mr. Thomas Schroeder
February 14 - Tapeworm parasite of trout in Parvin Lake	Mr. M. P. Ackerman
February 21 - Trouts of the Upper Kern River Basin, California	Mr. C. B. Schreck
February 28 - Taxonomic problems in the South Platte	Mr. H. W. Li
March 6 - Increasing fathead minnow production	Mr. S. A. Flickinger
March 13 - Midge production in high mountain lakes	Mr. ~~G. J.~~ Walters R. DeLong

* Special evening meeting at home of Dr. Robert Vincent at 7:30 p.m.