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Report on the EIFAC-Symposium on New Developments in the Utilization of Heated Effluents and of Recirculation Systems for Intensive Aquaculture, supported by ICES

by

K. Tiews

(ICES Observer)

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nicht relevant

The EIFAC/FAO Symposium on New Developments in the Utilization of Heated Effluents and of Recirculation Systems for Intensive Aquaculture was held in Stavanger, Kingdom of Norway, from 28 - 3o May 198o with the support of ICES.

The objectives of the Symposium, dealing with the intensive Aquaculture of freshwater and marine organisms, were:

a) to review the present state of knowledge on the utilization of heat from both natural and industrial sources;

b) to review the present state of knowledge of methods of efficient water use, including recirculation systems;

c) to link together the significant facts, identify the areas requiring further research, to consider the development of a format for presenting results of experience, and to recommend actions to be taken.

The Symposium was attended by some 240 participants from 29 countries from Europe, North and South America, Africa and Asia and international, intergovernmental and non-governmental agencies among which scientists from 17 of the 18 member countries of ICES. It was held in English and French, with simultaneous interpretation also in German by courtesy of the Government of the Federal Republic of Germany.

The Symposium was opened by Professor K. Tiews, Chairman of the Steering Committee and President of EIFAC. Dr. D. Møller (Norway) served as Chairman of the Conference and Dr.A.G. Coche (FAO) as Technical Secretary.

The Symposium was held in the following 6 sessions, each session being organized in the form of panel discussions:

1. Water quality and water supply
2. Engineering and technological aspects of equipments and facilities
3. Biological aspects of aquacultural practices
4. Cultural systems, their management and economics
5. Socio-economical aspects
6. Conclusions and recommendations

The main documentation consisted of 20 review papers prepared by invited authors (Panel members) and 74 experience papers, contributed by specialists from different countries (see App. 1).

In each of the sessions, except the last, panel members introduced the more important topics for discussion, with a review of the Symposium documents relevant to the topic. Following each panel presentation, the other participants were invited to contribute information or ask questions to the panel. On the basis of the above presentation and discussion, panel members prepared a summary report. In the last session, the main recommendations, drafted by the Panel Leaders and the Rapporteurs, were discussed and adopted.

The following conclusions and recommendations were made:

1 Water quality aspects

1.1 The effects of intensive aquaculture facilities effluents on natural fish populations should be studied. It is recommended that such water quality aspects be taken into consideration by EIFAC - Sub-commission III - Fish and polluted water.

1.2 The need for research was stressed to obtain additional information in particular for the species which have or may have significance for intensive aquaculture (air-breathing fish) in heated effluents and/or recirculation systems on the following:

(a) Water quality requirements of all life stages
(b) relative effects on fish growth and food conversion of the chemical and mechanical antifouling methods used in power stations
(c) Dissolved oxygen requirements, ammonia toxicity and the effects of site-specific pollutants already present in the water before its use in cooling circuits, in relation to water temperature.

1.3 It is recommended to EIFAC and ICES Member Countries to develop an improved collaboration between the industries discharging heated effluents, the aquaculturists using such effluents, and the pollution control authorities.

2 Engineering aspects

2.1 An ad hoc Correspondence Group should be activated by EIFAC to propose terminology, format and units of measurement related to flow-through systems and to recirculation systems. Attention should also be given to freshwater quality and in particular to (i) analytical procedures; (ii) a standardized presentation of selected chemical concentrations and (iii) to the revision of certain criteria, which should all be directed to fish farm application by the producers themselves. THe marine aspects should be similarly considered by the ICES Chemistry Group, in collaboration with the General Fisheries Council for the Mediterranean.

2.2 The studies of culture systems should be encouraged as well as the dissemination of criteria using the formats and terminology developed as above. In particular, EIFAC and ICES should promote the preparation of a technical manual on bio-engineering criteria for the design of recirculation systems and flow-through systems by qualified consultants.

2.3 Culture systems now in service should be described in detail in a language and format useful both for their management and their economic feasibility evaluation, to the biologists, the design engineers, and the economists.

3 Biological aspects

Further research was identified and recommended for the following subjects:

(a) Screening aquatic species for resistance to accumulation of metabolites in water as well as for suitability in intensive culture

(b) Testing prospective species in intensive aquaculture systems

(c) Studying the bio-energetics of warmwater fish species, in order to enhance rational design as well as use of natural and artificial warmwater resources for intensive aquaculture.

Having in mind that intensive aquaculture projects (especially those using recirculation) are a risk due to fish pathogens and noting that presently available methods of avoidance and control do not always give satisfactory results:

(d) Assessing the operation of water sterilization or disinfection methods in large recirculation systems;

(e) Developping methods of disinfection fish eggs from species other than salmonids and some cyprinids;

(f) Developing further vaccines for aquaculture species.

4 Socio-economical aspects

4.1 Taking into account the potential of heated effluents and recirculation systems for exotic aquaculture candidates, a code of practice - following the example of the existing ICES Code of Practice on the introduction of non-indigenous marine species - should be prepared to be presented and discussed at the next EIFAC Symposium by a consultant.

4.2 Noting that there are discrepancies in performance between laboratory scale and production-scale intensive aquaculture units (especially among those using recirculation), it is recommended that within the EIFAC Region greater emphasis be placed on establishing and operating large scale pilot projects (i) to define their biological (water quality/fish health) and technological suitability; (ii) to carry out economical evaluations (iii) to provide extension and advisory services as well as educational training. Such pilot projects should demonstrate the economic and technical feasibility of culturing organisms for commercial production in heated effluents and/or recirculation systems.

It is intended to publish the Proceedings of Symposium after careful editing by an Editorial Board.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE

ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

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EUROPEAN INLAND FISHERIES ADVISORY COMMISSION

Eleventh Session

Stavanger, Norway, 28 - 30 May I980

SYMPOSIUM ON NEW DEVELOPMENT IN THE UTILIZATION OF HEATED EFFLUENTS AND OF RECIRCULATION SYSTEMS FOR INTENSIVE AQUACULTURE

LIST OF DOCUMENTS

A. REVIEW PAPERS

I.RI - NASH, C.E. and C.L. PAULSEN - Water quality changes relevant to heated effluents and intensive aquaculture.

R2 - WICKINS, J.F. - Water quality requirements for intensive aquaculture a review.

R3 - ASTON, R.J. - The availability and quality of power station cooling water for aquaculture.

II.R5 - KERR, N.M. - Design of equipment and selection of materials - an engineer's assessment.

R6 - LIAO, P.B. - Treatment units used in recirculation systems for intensive aquaculture.

R7 - SOWERBUTTS, B.J. and FORSTER, J.R.M. - Gases exchange and reoxygenation.

R8 - ROSENTHAL, H. - Ozonation and sterilization.

III.R9- WEDEMEYER, G.A. - The physiological response of fishes to the stress of intensive aquaculture in recirculation systems.

RI0- MUNRO, A.L.S. - Disease prevention and control.

RII- EGUSA, S. - Fish diseases and their control in intensive culture utilizing heated effluents or recircular systems in Japan.

RI2.I- CHIBA, K. - Bio-technical considerations of aquatic animal culture by using heat effluent and recirculating systems - especially on stocking rate.

RI2.2- PETIT, J. - Considérations biotechniques régissant la culture en etang, en cages ou en bassins des principaux organismes aquatiques.

A. REVIEW PAPERS - cont'd.

IV. R.I4.I - FRIDMAN, A.L. - Recirculation systems in Eastern Europe.

R.I4.2 - BERKA, R., B. KUJAL and K. LAVICKI - Recirculation systems in Eastern Europe.

R.I5 - MAYO, R.D. - Recirculation systems in Northern America.

R.I6 - CHIBA, K. - Present status of flow through and recirculation systems and their problems in Japan.

R.I7 - BACKIEL, T. - Utilization of heated effluents for aquaculture in Europe.

R.I8 - CARROLL, B.B. - Flow-through systems/Northern America.

R.I9 - HORVATH, L. and TÖLG, I - Juvenile fish production systems in warm water.

R.20.I - KARLSSON, A.S. - Production of juvenile invertebrates.

Symposium on new developments in the utilization of heated effluents and of recirculation systems for intensive aquaculture, Stavanger 28-30 May 1980

E X P E R I E N C E - Paper

Number	Author(s) /address	title
E 1	H.H.Reichenbach-Klinke Institut für Zoologie und Hydrobiologie,Fachbereich Tiermedizin der Universität München Kaulbachstraße 37,8000 München 22	The influence of temperature and temperature changes upon the outbreak and intensity of fish diseases Panel 3
E 2	H.Kuhlmann and H. Koops Institut für Küsten- und Binnenfischerei der Bundesforschungsanstalt für Fischerei, Palmaille 9, 2000 Hamburg 50	New technology for rearing elvers in heated waters Panel 2
E 3	H.Koops and H. Kuhlmann same address	Annual variation of feeding and growth rate of eels farmed in thermal effluents of a conventional power station Panel 3
E 4	H.Koops and H. Kuhlmann same address	Eel farming in the thermal effluents of a conventional power station in the harbour of Emden Panel 4
E 5	V. Hilge same address, but Wulfsdorfer Weg.2070 Ahrensburg	Rearing of channel catfish (Ictalurus punctatus Raf.) in a closed warm water system Panel 3
E 6	S. Kaushik Centre de Recherches Hydrobiologiques, Institut National de la Recherche Agronomique Saint Pel- Sur-Nivelle Ascain/France	Influence of a rise in temperature on the nitrogen excretion of rainbow trout (Salmo gairdneri R.) Panel 3
E 7	B. Kujal Hydroprojekt Bezrucovo nabrezi 7 Ceske Budejovice,CCSR	Pre-treatment of water for intensive aquaculture by means of filters with inverted water passage Panel 1
E 8	L.Sasso and G. Velászquez Biól.Leonardo Sasso Yada Jefe de la Oficina de Cultivos Commerciales. Direc.Gral. de-aquacultura. Av.Alvaro Obregón No. 269-70 P., Mexico 7, D.F.	Preliminary results on the growth of rainbow trout in raceways with water supply-from a temperate spring Panel 3
E 9	D. A. Reid, 89 Carlingview Drive Rexdale (Toronto), Ontario M9W 5E4 Canada	Development of Canadian thermal effluent aquaculture systems Panel 2
E 10	M.G.Poxton[1)],K.R.Murray, B.T. Linfoot and A.B.W.Pooley 1)Address for correspondence: Department of Brewing and Biological, Heriot-Watt University Chambers Street, EdinburghEH 1 1HX Scotland	The design and performance of biological filters in an experimental mariculture facility Panel 2
E 11	Ch.Melard et J.C.Philippart Institut de Zoologie de l'Université de Liége, Service d'Ethologie et Psychologie animales-Aquarium Quai van Beneden, 22 B-4020, Liege/Belgique	Pisciculture intensive de Sarotherodon niloticus dans les effluents thermiques d'une centrale nucléaire en Belgique Panel 4
E 12	O. Ingebrigtsen Institute of Marine Research Matre Aquaculture Station N-5198 Matredal/Norway	Use of heated effluent water from Matre power plant (Norway) for the raising of fingerlings of salmonids at Matre aquaculture station Panel 4

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E 13	A.Jones[1] and J.A.G.Brown[2] 1)Shearwater Fish Farming Ltd 109/111 Lowther Street Carlisle, Cumbria 2)Central Electricity Generating Board, Wylfa Power Station Cemaes Bay, Anglesey United Kingdom	Progress towards developing methods for the intensive farming of turbot (Scophthalmus maximus L. in cooling water from a Nuclear power station Panel 4
E 14	R. Trzebiatowski Akademia Rolnioza,Instytut Akwakultury i Techniki Rybankiej ulKazimierza krelewicza 3 Szczecin/Poland	Fish rearing in the "Dolna Odra" power station cooling waters Panel 4
E 18	J. Petit Institut National de la Recherche Agronomique,Laboratoire de Physiologie des Poissons Universite de Rennes-Beaulieu Avenue du Général-Leclerc B.P. 25 A, F 35031 Rennes Cedex France	Possibilités offertes par la décantation lamellaire suivi d'une filtration sur biolite et composés similaires Panel 2
E 19	K. Rasmussen Water Quality Institute 11 Agern Alle DK 2970 Hørsholm,Denmark	Culture of whitefish (Coregonus sp.) in recirculated water with reuse of dissolved nutrients Panel 3
E 20	T. Jespersen and J. Hodal Water Qaulity Institute 11 Agern Alle DK 2970 Hørsholm/Denmark	Fingerling production in a recycled system Panel 3
E 21	B. Descamps,B.Grognet et L. Foulquier Commissariat à l'Energie Atomique, DPR/SERE Laboratoire d'Etudes de Pollution des Eaux Centre d'Etudes Nucléaires de Cadarache, F 13115 Saint-Paul-Lez-Durance France	Etude éxperimentale du grossissement des anguilles par l'utilisation des eaux réchauffées Panel 3

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E 22	P.Balligand,J.Tronel-Peyroz, B. Descamps,A.Grauby, L. Foulquier et M.Dumas Commissariat à l'Energie Atomique DPR/SERE, Laboratoire d'Etudes de Pollution des Eaux Centre d'Etudes Nucléaires de Cadarache F 13115 Saint-Paul-Lez-Durance France	Réalisation d'un pilote industriel utilisant des eaux de réfrigération d'une usine pour le grossissement des anguilles Panel 4
E 23	M.G. Saroglia and G. Scarano Centro Ricerca Termica e Nucleare Bastioni Porta Volta 10 I 20121 Milano (Italy)	Water quality cryteria for aquaculture in thermal effluents. Threshold of risk for residual antifouling products Panel 1
E 24	K.R. Murray, M.G.Poxton, B.T.Linfoot,D.W.Watret Heriot-Watt University Department of Chemical and Process Engineering Chambers Street Edinburgh EH1 1HX,Scotland	The design and performance of low pressure air lift pumps in a closed marine recirculation system Panel 2
E 25	A. Wandsvik and J.Wallace Universitetet i Tromsø Institutt for Fiskerifag Dramsvegen 201,Postboks 790 N 9001 Tromsø, Norway	An attempt to utilise the sea as a heat source for smolt production in north Norway Panel 2
E 26	G.R. Bouck National Fisheries Research Center-Seattle,U.S.Fish and Wildlife Service Building 204,Naval Support Activity Seattle, Washington 98115, USA	Air supersaturation: Causes, effects and prevention of gas bubble disease in aquaculture systems Panel 3
E 27	G.R.Bouck,S.D.Smith,I.Burger and D. Adams same address	Post-medication intolerance to seawater in steelhead trout and coho salmon Panel 3
E 28	A. Rogers and A. Cane Central Electricity Generating Board, Fisheries and Environmental Group,Scientific Services Department Glyn Rhonwy Llanberis,Gwynedd, LL55 4LP United Kingdom	The operation of a 15 tonne rainbow trout rearing unit in power station cooling water Panel 4
E 29	P.Koske[1)],U.Witt[2)],D.Olrogge[1)] and J. Lenz[3)] 1)Forschungszentrum Geesthacht GmbH,Reaktorstraße 1 D 2054 Geesthacht-Tesperhude 2) Forschungszentrum Geesthacht GmbH ,Aquakulturversuchsanlage D 2301 Dänischenhagen-Bülk 3)Institut für Meereskunde der Universität Kiel,Düsternbrooker Weg 20, D 2300 Kiel	The use of sewage water as a heat resource for aquaculture basins, technological aspects and first biological results Panel 2

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E 32	G.B.Ayles,J.Barica,J.G.I.Lark and K.R. Scott Department of Fisheries and Oceans-Western Region,Freshwater Institute 501 University Crescent Winnipeg Manitoba,Canada R37 2N6	Coupling of a solar collector with water recirculation units in a fish culture operation Panel 2
E 33	O.Sumari[1] and K. Westman[2] 1)Finnish Game and Fisheries Research Institute, Laukaa Fish Culture Research Station SF 41360 Valkola,Finland 2)Finnish Game and Fisheries Research Institute P.O.Box 193,SF-00131 Helsinki 13 Finland	Biological and economic aspects in the use of heated water for salmon smolt production as compared with traditional rearing Panel 4
E 34	A.M. Sutterlin Marine Sciences Research Laboratory Memorial University of Newfoundland St. John's, Newfoundland Canada A1C 5S7	Diversion methods and water quality problems associated with the utilization of hydro-electric waste heat in salmonid culture Panel 1
E 35	Christine Claus,Lievia van Holderbeke, H.Maeckelberghe, A. van de Velde and G. Persoone Laboratory for Mariculture State University of Ghent J. Plateaustraat 22 B 9000 Ghent/Belgium	Nursery culturing of bivalve spat in heated seawater Panel 3
E 36	U.Saint-Paul and U. Werder Instituto Nacional de Pesquisas da Amazônia (INPA) Caixa Postal 478, BR-69000 Manaus-M Brazil	The potential of some Amazonian fishes for warmwater Panel 3
E 37	Gabriele Peters, H. Delventhal, H. Klinger Institut für Hydrobiologie und Fischereiwissenschaft der Universität Hamburg Olbersweg 24, D 2000 Hamburg 50	Stress diagnosis for fish in intensive culture systems Panel 3

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E 39	G.Palmegiano and M.G. Saroglia same address	Winter shrimp culture in thermal effluents. Physiological aspects Panel 3
E 40	P. Bronzi and P. Ghittino same address Fish Diseases Lab. Via Bologna,Torino	Floating cages and/or raceways:Two different systems of utilizing warm waters discharged by power stations in inland fishculture. P.2
E 41	K.I. Dahl-Madsen Water Quality Institute 11, Agern Alle DK 2970 Hørsholm,Denmark	The potential for use of heated effluents for intensive mariculture in Denmark Panel 1
E 42	G.Giorgetti,G. Ceschia and G.Bovo Istituto Zooprofilattico Sperimentale delle Venezie,Aggregato Alla Universita di Padova,Laboratorio di Ittiopatologia Via delle Roggia 70 I 33030 Basaldella di Campoformido Italy	Utilization of warm artesian fresh water for eels breeding; comparisons between two groups of different origin eels Panel 3
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E 44	R.E.Flatow REFCO Purification Systems Inc. P.O.Box 2355, 2010 Farallon Drive San Leandro,California 94577,USA	High dosage ultraviolet water purification: An indispensable tool for recycling,fish hatcheries and heated effluent aquaculture Panel 1
E 45	M. Ladle,H.Casey,A.F.H.Marker,J.S.Welton Freshwater Biological Association River Laboratory, East Stoke Wareham Dorset BH20 6BB United Kingdom	The use of large experimental channels for ecological research Panel 3
E 46	P.Tuunainen[1],K.Westman[1],O.Sumari[2] and E. Virtanen[1] 1)Finnish Game and Fisheries Research Institute,Fisheries Division P.O.Box 193,SF-00131 Helsinki 13 Finland 2)Laukaa Fish Culture Research Station SF-41360 Valkola,Finland	Comparative rearing experiments with baltic salmon (Salmo salar)fingerlings in heated brackish-water effluents and fresh water Panel 3

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E 48	J. Seltz,Ministère de l'Agriculture Centre Technique du Génie Rural, des Eaux et des Forêts 30 Rue Jules Guesde-Celleneuve F 34100 Montpellier,France	Utilisation des eaux rechauffees en aquaculture intensive le point de l'experience Francaise Panel 4
49	K. Nemoto Nemoto Consulting Engineer Office 13-5, Giynga-oka, Sendair-shi Miyagiken, Japan	Eel culture in a recirculation and filtration system utilizing heated fresh water effluents Panel 4
E 50	C. Meske and U.V.Rakelmann Institut für Küsten- und Binnenfischerei der Bundesforschungsanstalt für Fischerei, Außenstelle Wulfsdorfer Weg D-2070 Ahrensburg	Experiences with warm water circuits for aquaculture purposes by using activated sludge Panel 2
E 51	L.E. Keup Physical Science Administrator U.S. Environmental Protection Agency 401 M Street, S.W., Room 2824 Mall (WH-585) Washington, D.C. 20460, U.S.A.	Wastewater Aquaculture in the United States: Potentials and Constraints Panel 4
E 52	D. Møller and Ø. Bjerk Department of Aquaculture Institute of Marine Research Directorate of Fisheries C. Sundts G. 37 , Bergen/Norway	Smolt production in a recirculation system in Northern Norway Panel 3
E 53	J. Petit Institut National de la Recherche Agronomique,Laboratoire de Physiologie des Poissons, Universite de Rennes-Beaulieu Avenue du Général-Leclerc B.P. 25 A,F 35031 Rennes Cedex France	Amélioration des performances des tubes en U Panel 2
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E 57	W. M. Lewis Fisheries Research Laboratory Southern Illinois University Illinois, USA	On the maintenance of water quality for closed fish production systems by means of hydroponically grown vegetable crop Panel 1
E 58	W.van Toever and K.T. MacKay The Ark Projekt Institute of Man and Resources R.R. # 4 Souris, Prince Edward Island Canada C0A 2B0	A modular recirculating hatchery and rearing system for salmonids utilizing ecological design principles Panel 4
E 59	H. Rosenthal[1], R. Andjus[2] and G. Krüner[1] 1) Biologische Anstalt Helgoland Palmaille 9, D 2000 Hamburg 50 Federal Republic of Germany 2) Institute for Biological Research 29 Novembra 142 YU 11000 Beograd, Yugoslavia	Daily variations of water quality parameters under intensive culture conditions in a recycling system Panel 4
E 60	M. Leopold and Maria Bnińska Inland Fisheries Institute blok 5 PL 10-957 Olsztyn-Kortowo, Poland	Some economic problems of cage fish culture in heated waters Panel 4
E 61	Anna Korycka and B. Zdanowski Inland Fisheries Institute blok 5 PL 10-957 Olsztyn-Kortowo, Poland	Some aspects of the effect of cage fish culture on lakes, with special reference to heated lakes Panel 1
E 62	A. Kittelsen and T. Gjedrem Department of Animal Genetics and Breeding, Agricultural University of Norway Ås-NLH, Norway	Cooling water from hydro power plant used in smolt production Panel 1
E 63	K. Dabrowski[1] and H. Kozlowska[2] 1) Institut of Ichthyobiology and Fisheries, Academy of Agriculture and Technology, 10-957 Olsztyn-Kortowo, Poland 2) Institut of Food Biotechnology, Academy of Agriculture and Technology, PL 10-957 Olsztyn-Kortowo, Poland	Rapeseed meal in the diet for common carp reared in heated waters. I. Growth of fish and utilization on the diet Panel 3

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E 66	Jeanine Person-le Ruyet, J.-C. Alexandre et A. le Roux same address	Methode de production de juveniles de sole (Solea solea) sur un aliment compose sec en eau de mer chauffee et recyclee Panel 3
E 67	Joan R. Mitchell International Decade of Ocean Exploration, National Science Foundation 1800 G Street, N.W. Washington, D.C. 20550, USA	Constraints to aquaculture research at the pilot-scale level Panel 5
E 68	K. Jauncey Unit of Aquatic Pathobiology University of Stirling Stirling FK 9 4LA Scotland	The effects of varying dietary composition on mirror carp (Cyprinus carpio) maintained in thermal effluents and laboratory recycling systems Panel 3
E 69	R.V. Kilambi Department of Zoology University of Arkansas Fayetteville, Arkansas, USA 72701	Cage culture of channel catfish and rainbow trout and effects of intensive fish culture on resident largemouth bass Panel 3
E 70	H. Wienbeck Institut für Küsten- und Binnenfischerei der Bundesforschungsanstalt für Fischerei, Eichstraße 2970 Emden Federal Republic of Germany	On the oxygen balance of an experimental eel farm operated in thermal effluents of a conventional power station Panel 3
E 71	H. Kossmann Forskningsstation IVL Aneboda S 360 30 Lammhult/Sweden	A warm water recycling plant for production of grass karp (Ctenopharyngodon idella) in Sweden Panel 3
E 72	G. Kjølseth, B.Sc., MNIF. Ing. A.B. Berdal A/S Maries vei 20 Postboks 80 N 1322 Høvik /Norway	Heat exchange from seawater and its use in a smolt production plant in the polar region of Norway Panel 3
E 74	J. Hambrey, Department of Man. Sci. and Technology Studies, University of Stirling, Stirling, FK 9 4LA Scotland	The importance of feeding, growth, and metabolism in a consideration of the economics of warm water fish culture using waste heat Panel 4

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E 76	R. McCauley Department of Biology Wilfrid Laurier University Waterloo, Ontario, Canada N2L3C5	Temperature preference of fish as an index of the optimum temperature range for growth Panel 3
E 77	S. Pettersen, Servicekontoret for Driftserfaringer, Kirkeveien 64 Postboks 5030, Oslo 3/Norway	Supersaturation in water from Norwegian water power station Panel 1
E 78	V. Hilge[1], H.Delventhal[2] and H.Klinger[2] 1) Institut für Küsten- und Binnenfischerei, Außenstelle, Bundesforschungsanstalt für Fischerei, Wulfsdorfer Weg , 2070 Ahrensburg 2) Institut für Hydrobiologie und Fischereiwissenschaft der Universität Hamburg, Olbersweg 24, 2000 Hamburg Federal Republic of Germany	Influences of heated recirculated water and heated well water on several physiological and hematological parameters of channel catfish, Ictalurus punctatus Raf., reared in two stocking densities. Panel 3