

REPORT OF THE
ICES Symposia

ICES Symposium on Environmental Effects of Mariculture (ICES SEEM)
Seventh International Conference on Artificial Reefs and Related Aquatic Habitats
ICES Symposium on 100 Years of Science under ICES

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ICES Symposium on Environmental Effects of Mariculture (ICES SEEM)

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St Andrews, NB, Canada

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Mariculture, the culture of plants and animals in the sea, is a recent development in the commercial production of seafood or industrial chemicals. Extensive mariculture has a relatively long history; for example, oyster culture was known to the Romans. By contrast, modern, intensive mariculture is only approximately 30 years old. Intensive mariculture produced a steadily increasing proportion of the World's seafood during the 30-year period. Thus by 1996, aquaculture (inclusive of freshwater fish production), represented about one-fifth of the World total and is still expanding, whilst traditional fishing production is declining. Mariculture is a competitor for space in the nearshore coastal zone and it is generally believed that its development and daily operations must be compatible with existing coastal zone uses. Such uses include traditional fishing, recreational use, industrial and municipal waste disposal, mineral resource extraction, as well as commercial shipping.

Two major questions were addressed during the Symposium: 1) what are the environmental effects of fish and bivalve farming in the coastal zone and 2) how does the local environment affect mariculture productivity? Research on the first question focussed on: eutrophication in seawater and harmful algal blooms, organic enrichment gradients in sediments, how the mariculture environment enhances disease/parasitic epidemics, how chemicals in use by the mariculture industry affect coastal ecosystems, remediation measures for organically impacted fish farms, and how farmed fish escapees affect wild fish stocks by genetic contamination. Consequently, the first question was addressed in five theme sessions (with session chairs indicated within the brackets) as follows:

- Harmful algal blooms and mariculture (Patrick Lassus)
- Sediment biogeochemistry and mariculture (Marianne Holmer)
- Disease/environmental factors in mariculture (James Stewart)
- Environmental monitoring in mariculture (David Wildish)
- Other ecological issues in relation to mariculture (Maurice Héral)

The last session included presentations on remediation and the genetic consequences of escaped fish.

As well as updates on research for each of the environmental problems mentioned above, one session dealt with various ways to monitor environmental effects of mariculture. Practical methods of monitoring for organic enrichment in Norway, Canada and the USA were presented and demonstrated a lack of consensus on how to do this. Operational criteria to aid in the choice of practical monitoring include: scientific defensibility, statistical validity, relevant decision points (to trigger remediation measures) and cost effectiveness. Besides organic enrichment, other subjects covered included chemical contamination and bacterial contamination of cultured mussels. For the latter, monitoring involved rain gauges in New Zealand that indicated, with a few days lag, when coliform counts would be high due to runoff in the Marlborough Sound. The few days warning allowed farmers to plan harvesting prior to them becoming contaminated by coliform bacteria. All 32 papers from the five sessions addressing the first question will be considered for publication, following peer review, in *ICES Journal of Marine Science* and slated for publication in the first issue of 2001. Because of the delay in publication, the full text of each paper accepted after the review process is completed will be published on the web site at <http://www.ices.dk/symposia/eem.htm>. The guest editors are David Wildish and Maurice Héral.

The second question posed was addressed in one other session chaired by Jon Grant. Papers presented in this session considered how environmental variables affect the productivity of shellfish and finfish farms. This

included the design of predictive models to determine carrying or holding capacity. The work is of obvious practical importance in choosing the best sites for mariculture and in predicting the production capacity sustainable at each site. Because of the different nature of the question associated with this session, the papers from it will be submitted to a different journal. Jon Grant will act as guest editor and papers are to be submitted to Can. J. Fish. Aquat. Sci.

The event was organized by Maurice Héral and David Wildish (co-chairs) with scientific advice from members of the ICES Working Group on Environmental Impacts of Mariculture. The latter included: Hans Ackefors, Ian Davies, Arne Ervik, and Harald Rosenthal. Besides support from ICES, financial support was obtained from Fisheries and Oceans Canada and IFREMER.

The usual purpose of a scientific symposium is to bring together members of an "invisible college" to discuss recent research findings. Commonly, this would involve a narrow discipline, e.g. benthic ecology. In the case of ICES SEEM, the common factor was the fish or bivalve farm, with participants representing a multidisciplinary approach to a central practical problem; thus: geneticists, disease specialists, parasitologists, biochemists, analytical chemists, engineers, physical oceanographers, sediment geochemists, physiologists and ecologists. Participants also included resource managers and mariculture industry representatives who use scientific information in their daily management decisions. Communication was enhanced during an afternoon trip to see the local salmon culture industry of the Bay of Fundy, at the Symposium dinner and folk music entertainment afterwards, and for the few left on the Saturday following the Symposium, a wonderful canoe trip down the St. Croix River.

Seventh International Conference on Artificial Reefs and Related Aquatic Habitats (7th CARAH),
7–11 October 1999.
San Remo, Italy
Dr. Josianne G. Støttrup.

More than 230 participants from 21 different countries attended the five-day Seventh International Conference on Artificial Reefs and Related Aquatic Habitats (7th CARAH) held in San Remo during 7–11 October 1999.

The objectives of the Symposium were:

- To provide an international forum for the exchange of new technical information on all aspects of artificial reefs and related habitats.
- To promote new research, programmes and policies which advance artificial habitat enhancement and management technologies.
- To summarise existing programmes on artificial habitat technology, including evaluation of effectiveness at the international level.

The Symposium was organised in six thematic areas:

- Function and ecology of artificial reefs
- Planning and design of Artificial Reefs
- Artificial substrata - Artificial reefs
- Rigs to reefs
- Aquaculture, FAD and Fisheries
- Monitoring, Mitigation and Assessment

The success of the Symposium was due to the efforts of the Organising Committee, chaired by Giulio Relini and Antony Jensen. Also helping to organise the Symposium were Giovanni Bombace, Stefano Cataudella, Ken Collins, Francois Doumenge, Cristina Siccardi, Paula Mattioni and Giuseppe Notarbartolo Di Sciara. Giulio Relini of the University of Genoa in Italy welcomed the participants to the Symposium, which was held at the Grand Hotel Londra and the Hotel Astoria West End. In addition to ICES sponsorship, a wide range of local, national and international organisations provided funding and logistic support.

In his opening talk, Dr. Antony Jensen reviewed the European development on artificial reefs which has been ongoing for around 30 years and described the initiation of an EU-funded 3-year project, the European Artificial Reef Research Network (EARRN) in 1995. Despite the termination of this EU-project, EARRN continues to function thus ensuring co-ordination of European artificial reef research and the organisation of thematic Workshops or meetings.

William Seaman, Tony Pitcher and Margaret Miller gave the opening plenum keynote talks. William Seaman emphasised the need to focus research on artificial reefs ensuring well-defined objectives, quantifiable aims, and identification of success criteria, which can be measured. The need to improve efforts on modelling was emphasised, together with an appeal for the adaptation of coral systems technology to artificial reef research. The application of ecosystem models to evaluate the success of deployment of artificial reefs was the main theme of the talk given by Tony Pitcher. His talk centred on the static mass-balanced ecosystem model ECOPATH, which describes the trophic flow among functional groups, and on ECOSPACE, in which spatial modelling of the system linked to defined habitats is driven by movements derived from foraging, predator-avoidance and dispersal rates. ECOSPACE could be used for forecasts for partially open areas and is very useful at showing trophic cascades, but there is a need to further refine existing models as well as parameter estimates for the model. Margaret Miller pointed out the advantages of artificial reefs for exploring ecological processes and encouraged their use for manipulative ecological experiments. At the same time care should be taken in interpreting data from artificial reefs to natural ecological processes since the type of data generated from the studies are intrinsically different. Five days of presentations and posters, and three discussion sessions followed. In total, around 90 oral papers run in parallel sessions and 27 posters were presented at the Symposium.

The first thematic area on the function of artificial reefs included 26 oral presentations covering a wide range of usage of artificial reefs. These are used to protect the *Posidonia* meadows from illegal trawling, a relatively inexpensive, but effective form of fisheries management enforcement. Artificial reefs may also be deployed to remove nutrients in eutrophicated areas. In most cases artificial reefs are deployed to concentrate fish and increase production of biological resources. Ample evidence was provided for the attraction and enhanced local production of fish or benthos due to artificial reefs. Although the general application of artificial reefs was often well justified, the potential impact on the ecosystem from the introduction of new habitat, often different to the indigenous habitat, was not examined.

The second thematic area on planning and design of artificial reefs looked at larger scale environmental, socio-economic and cost-efficiency of these structures. Several of these large-scale artificial reef programs are an integral part of fisheries resource management and often aimed at enhancing local marine resources. On a smaller scale, the structural complexity of the artificial reefs was shown to be important as a fish refuge and for biotic colonisation. Structural resistance and stability of artificial reefs relative to the environment of their deployment was a major concern. An optimal design would ensure the reefs success relative to its purpose and prevent damage to surrounding areas from unstable reef structures or components.

The third thematic area comprised 4 oral presentations devoted to the most controversial subject concerning artificial reefs, and possibly the primary cause for prejudice; material used for artificial reefs. The talks and were devoted to assessing the environmental impact of different materials used for artificial reefs such as coal fly ash, steel slag and scrap tyres. The general conclusion was that such structures were intended as a positive approach to dealing with a terrestrial waste disposal problem and provided effective habitat for fish assemblages. However, it was important to assess the environmental impact of the substances constituting these artificial reefs, their stability and durability. In many cases relatively stable concrete-bound structures are possible, but also here caution was advised and the need for long-term studies including leaching and concentration of heavy metals.

Reuse of steel was indirectly also the main theme of the forth area; rigs to reefs. During their operational period, rigs provide hard substrate on which develop biotic communities and associated fish assemblages. The presence of fish assemblages, some representing species heavily impacted by over-fishing and environmental changes, around these structures is well documented and provides the basic justification for transforming rigs to reefs. These biota and fish assemblages have been closely examined in USA, Mexico and in Norway, the principal countries concerned with these issues and providing 70% of the 14 oral presentations in this area. However, the resource benefits may not be sufficient to prevent these artificial reefs being regarded as an excuse for solid waste disposal and to prevent rigs from being removed. More information is needed on the environmental benefits of dismantling decommissioned rigs as compared to constructing reefs.

Eleven oral presentations addressed different aspects of aquaculture, sea ranching or fish attraction devices (FAD). Environmental amelioration is another function of artificial reefs, which could be combined with production either directly or indirectly by placing these near marine net-cage cultures to mitigate aquaculture environmental impact. The Japanese programmes combine the deployment of artificial reefs with mass release of fish, often hatchery-reared, for enhancing local coastal marine resources. Acoustic control of feeding has been developed to enable a more advanced form of sea ranching.

The sixth thematic area with 14 oral presentations focused on monitoring, mitigation and assessment. Acoustics are useful for estimating abundance and biomass of fish as well as for delimiting the boundaries of artificial reefs and shifts such as relocation, subsidence or sand burial of artificial reefs, which may impact their function. Different reef designs have been developed aimed at compensating losses to giant kelp forest and tested for their subsequent performance. Emphasis was on defining goals for artificial reefs and for implementing technological advances to evaluate their success in quantifiable estimates. Within this thematic area, the impact of artificial reefs on the surrounding ecosystem was examined by at least two of the papers with diversified results recalling the need to examine consequences of deploying reefs even if these are built and positioned correctly for their purpose. The final paper addressed the main topic of content within the artificial reef community, the attraction-

production controversy and suggested attraction and production hypothesis as being two opposing ends of a continuum influenced by density-dependant factors.

Of the 90 or so presentations and 27 poster papers, around sixty are expected to be submitted for consideration with a final fifty being accepted for publication in a special volume of the ICES Journal of Marine Science to be edited by Nils Daan with assistance from Antony Jensen and anonymous reviewers of the papers. A complete set of abstracts was distributed to the participants on arrival at the meeting and a book of unreviewed, unedited conference papers was provided for delegates during the last day of the conference and comprised a weighty document 3-4 cm thick.

Were the objectives met? An excellent forum for the exchange of new technical and scientific information on all aspects of artificial reefs and related habitats was provided. Recommendations for further work, future programmes and policies were put forward towards artificial habitat enhancement, including encouragement to use artificial reefs for manipulative ecological experiments. Existing programmes were evaluated and methods for the evaluation of effectiveness of these structures were discussed. However, there is still a need for more work on larger-scale environmental impact of deployment of artificial reefs and the encouragement of participants from related fields, such as those working on rehabilitation of natural reefs.

The social events, in particular the visit to Montecarlo Institute of Oceanography and Aquarium, at the special invitation of the Director of the Institute, Professor François Doumenge, deserves a special mention. The bus tour from San Remo to Monaco provided a beautiful scenic drive along the Ligurian coast. Monaco itself was magnificent and the aquarium was housed in a building of impressive architectural stature. Traditional aquariums were filled with impressive live corals of various forms and sizes, accompanied by a myriad of fish in all forms, sizes and colour patterns. An impressive sight pre-empted by delicious champagne and savouries, the trip was a memorable one, inspiring and awesome at the same time. Thank you again to our Italian hosts.

ICES Symposium on 100 Years of Science under ICES

1–4 August 2000
Helsinki, Finland

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Is ICES like an old man who proudly remembers how good he was in the old days and who is grateful for still being somewhat useful, or is ICES like a well-established company that meets the demands of an ever-changing market? I asked those questions in my summing-up of the recent Symposium on "100 Years of Science under ICES". Nearly 100 scientists met in Helsinki, Finland, 2–5 August 2000, and 71 papers and 10 posters were presented. The sessions were chaired by the keynote speakers for twelve themes on the development of techniques and concepts in fisheries research and related fields of oceanography (see list in the May issue of the ICES newsletter, No. 35).

Until the 1960s ICES was the leading marine science organization in the world. Since then it has had to share influence and responsibilities with other regional and global bodies, but it is still Number One in fisheries science and advice to fishery management in temperate and cold waters. Very early ICES picked up pollution research and monitoring, and it has participated successfully in marine research on global climate change.

ICES has initiated and coordinated international expeditions and surveys resulting in long time series of physical, chemical, and biological parameters and of fish stock data. Bob Dickson called those data sets the crown jewels of ICES. Other services by ICES to marine science include its long-standing activities as central laboratory for the development, standardization, and intercalibration of instruments and methods, as data centre, and as scientific publisher of "white" and "grey" literature. Countless methodological workshops and assessment working groups have provided training on the job for generations of young scientists.

My hit list of outstanding talks includes, *inter alia*, Katherine Richardson on plankton and fisheries, Mike Sinclair on the notion that fish form stocks, François Gerlotto *et al.* on acoustic methods (presented by Paul Fernandez), Rob Stephenson on herring investigations, Sidney Holt on whale research and whaling, and Jens Meincke on fishery oceanography. I was intrigued by the Scandinavian contributions on herring, where the 19th century's migration concept met with the current stock concept. Many fascinating (hi)stories focused on ICES heroes like the great "outsiders" Hensen, Hardy, Holt, and Steemann Nielsen. The three "looks forward" by Scott Parsons, Warren Wooster, and Jake Rice on the new challenges of ICES all came from across the Atlantic.

What did I miss? More time for in-depth discussions and transatlantic dialogues on the history of key concepts like overfishing, fishery oceanography, and the triad of field observations–experiments–modelling. The hobby-historians of the ICES marine science community would have benefited from a stronger participation by professional historians.

What did I enjoy apart from many of the talks? The arrangements by the host Pentti Mälkki and his staff, and the preparation of the Symposium by its Chair, Emory Anderson. I am looking forward to his stringent editing of the proceedings to be published well in time for the ICES Centenary in 2002. That will be the proper occasion to answer my question about ICES being an old man or a vivid company that is reactive and proactive to demands of marine science and its application to the needs of society.

[This report by Prof. Hempel was originally written for the ICES Newsletter]