

## Theme Session on Rebuilding Programmes for Threatened Fish Populations (W)

### ICES CM 2005/W:01

#### How can rebuilding plans achieve the objective of recovery for overfished stocks?

Andrew A. Rosenberg and Charlotte B. Mogensen

Overfishing results in valuable fishery resources being depleted to low abundance levels, with remaining fish of smaller size and often with a reduced range of distribution. Resources usually have the potential to recover if steps are taken to end overfishing, and if plans are implemented urgently. Such plans must be comprehensive in space and include targets, time, and multi-species. Key issues that will need to be addressed are that all sources of fishing mortality, including both landings and discards are considered. Bycatch reduction methods, controls on fleets with a substantial bycatch, and intensive monitoring of bycatch and discards through observer programs are essential. Overfishing should be ended over the range of the stock, such that protections are not just for one sub-stock or area. Habitat protection is an important consideration in the design of comprehensive rebuilding plans. Long-term habitat protection can be provided by the use of environmentally friendly fishing gear or the creation of closed areas.

Limited access and capacity reduction programs in directed and associated fisheries are needed. Rapid reductions in fishing mortality rates to as low a level as possible through a combination of quota or effort controls and closed areas are a key ingredient of any recovery plan. If fishing mortality rates are not reduced quickly and held at low levels a sustained recovery will not occur. It is essential that major reductions in fishing mortality occur even if the final recovery targets are still uncertain.

To achieve the objective of rebuilding depleted resources, studies indicate that reducing the catch quota is not sufficient and there is a need to implement a combination of quotas, closed areas, or effort controls and closed areas to buffer against. This is because the closed area provides insurance against mis-estimation of the quota or other uncertainties such as illegal catches or excessive bycatch. In order for this positive effect to be realized the closed area must be large enough to protect a significant portion of the stocks of the species in need of rebuilding, should be closed to all fishing capable of impacting the depleted species, be year round, and be strictly enforced.

Keywords: recovery plans, bycatch, effort reduction, closed areas.

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### ICES CM 2005/W:02

#### Strangford Lough – A unique opportunity for a coastal sea-trout fishery in the British Isles

Philip Johnston, Graham Savidge, and Derek McCallan

Strangford Lough is a large marine sea-lough on the north-east coast of Ireland approximately 29 kilometres long by 7 kilometres wide. It is the largest marine conservation site in Ireland and is a designated Specially Protected Area and candidate Special Area of Conservation under EU designation. In 1995 the Ards and Down Salmonid Enhancement Association (ADSEA) was formed as an umbrella body for local anglers with the aim of improving the depleted stocks of native sea-trout and to form the basis for the development of a new coastal sea-trout angling venue. ADSEA has developed close and productive working partnerships with local Councils and Queen's University of Belfast, enabling a range of in-river surveys and tank-based trials of sea-trout culture to be carried out in order to evaluate their suitability as a candidate enhancement species. The river-survey reports will form the basis of a habitat rehabilitation programme to maximise natural recruitment; estimates show that even if enhanced, the systems could only produce by natural recruitment 20 000 smolt per year and would not support a projected angling activity of 30 000 anglers per year. Extensive discussions have been carried out with statutory Government Agencies and local politicians to assist in the realisation of the project.

The presentation will describe the technical achievements of ADSEA to date, including results of sea-trout survival, growth rates and reproductive capability of captive held fish, requirements for successful sea-trout stock production, and the economic and environmental sustainability of the project.

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### ICES CM 2005/W:03

#### The use of stock rebuilding programmes in the precautionary management of salmon stocks

Ted Potter (CEFAS) and Peter Hutchinson (NASCO)

NASCO and its Contracting Parties have agreed to apply a Precautionary Approach to the conservation, management, and exploitation of Atlantic salmon, and in this context it has been proposed that Stock Rebuilding Programmes (SRPs) should be developed for river stocks that are below their Conservation Limits. NASCO has therefore developed guidance on the process for establishing an SRP for a salmon stock and what such a plan

might contain. The nature and extent of the programme will depend upon the status of the stock and the pressures that it is facing. While the short-term response to a stock failing to exceed its conservation limit may be to reduce or eliminate exploitation, salmon stocks frequently face a range of other pressures in both freshwater and marine environments. SRPs will therefore be expected to include an array of measures, to both evaluate and address the causes of the stock decline. In more serious situations, there may be a need for a comprehensive programme of research and management, which may be undertaken by or have impacts upon a number of user groups. It is important, therefore, that the SRP also addresses the socio-economic impacts of any proposed actions and that the benefits and costs are evaluated when setting priorities. Finally, SRPs should include a forecast of timescales and the expected outcomes of the proposed measures against which their effectiveness can be assessed.

Keywords: Atlantic salmon, NASCO, Stock Rebuilding Programmes, Precautionary Approach, Conservation Limits.

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#### **ICES CM 2005/W:04**

##### **Marine protected areas as a tool to rebuild both commercial and threatened fish stocks**

Ronald Fricke

Marine fish populations have worldwide declined dramatically during the past century. Decades of fisheries management did not successfully reverse this trend. A major decrease is observed in both commercially used and bycatch stocks; some trends are irreversible when present fisheries management regimes continue to be applied. Effective measures for the conservation of marine fishes and their habitats are urgently needed.

For the case of the North Sea, tools for conservation and potential management regimes are discussed. It seems inevitable to establish marine protected areas (MPAs) on a larger scale, including core areas without any commercial exploitation. Examples of successful MPAs in other parts of the world, especially in the Great Barrier Reef Marine Park (Queensland, Australia) and the Exmouth Gulf (Western Australia), are presented, and the necessary extent of the sites and legal elements of conservation are discussed.

It is estimated that MPA core areas extending across approximately one third of the area of the North Sea need to be established. The remaining two thirds should be exploited alternately every second year. Such management regime is predicted to increase both commercial and threatened fish stocks, and should in the long term induce improved fish commercial catches.

A set of MPAs for the North Sea is proposed which would meet the demands of marine fish conservation. The MPAs are suggested to be established under the Oslo Paris Convention (OSPAR) and the EU Habitats Directive; the latter directive should be revised to meet the demands in marine habitats.

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#### **ICES CM 2005/W:05**

##### **Interdisciplinary probabilistic network to examine the possibility to restore potential Baltic salmon rivers**

Catherine G. J. Michielsens, S. Kuikka, P. Haapasaari, S. Kulmala, A. Romakkaniemi, and J. Erkinaro

Restoration projects of potential salmon rivers in the Baltic Sea have known relatively limited success. In order to identify the possible factors currently limiting the re-establishment of salmon populations in potential salmon rivers, we compare a wild salmon river (Simojoki) with potential salmon rivers in terms of the biological characteristics of the salmon population, the fishing pressure on the population, and the river's socio-economic and biological environment. The differences in biological and socio-economical circumstances between rivers can be examined through separate biological, economical, and socio-economic studies. The results from the different disciplines can later be linked together within one single probabilistic or Bayesian network model. The probabilistic network has the advantage that the different conditional relationships can be obtained through different methodologies. In the case of Baltic salmon, the biological estimates within the Bayesian network are obtained through a probabilistic mark-recapture model of tagging data, the economic dependencies are obtained through bio-economic models and contingent valuation, while the social dependencies come from questionnaires and in-depth interviews with key people. Network modelling allows us to examine not only what has happened in the past but, through the expression of causal relationships within the model structure, it also allows us to examine what would happen to the salmon populations if certain biological, economical, and social conditions in potential salmon rivers were different. It is therefore possible to examine the effect of different management actions on the fishing behaviour of the fishermen in the different rivers and to examine for each river which combination of management actions has the highest probability of successfully restoring the salmon stocks.

Keywords: potential salmon rivers, interdisciplinary, Bayesian network.

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## ICES CM 2005/W:06

### Survey of river and sea lampreys in German waters of the Baltic Sea – basis of successful rebuilding programmes

Ralf Thiel, Helmut M. Winkler, Philip Riel, and Renate Neumann

In order to support successful population rebuilding programmes, it was necessary to investigate the status of diadromous lamprey species within the German waters of the Baltic Sea. Furthermore, to provide such information is particularly relevant to fulfill the requirements of the European Habitat Directive, the EU water framework directive, and of coastal zone management and conservation.

Therefore, a study was performed to describe and analyse: (1) the past distribution of lampreys in Subdivisions 21–28 of the Baltic Sea, (2) the temporal and spatial characteristics of the historical commercial catch of lampreys in the southwest Baltic Sea, and (3) the recent distribution of lampreys in German Baltic waters.

During a 20-month period from August 2003 until March 2005 the occurrence and distribution of lampreys in German waters of the Baltic Sea was investigated based on the analysis of the following sources of data: (i) research fisheries with otter trawls, (ii) records from commercial and recreational fisheries, (iii) records from ichthyological museum collections, and (iv) commercial catch statistics, relevant publications and grey literature.

The analysis of ichthyological collections resulted in 46 records of river lampreys and 55 records of sea lampreys in the southwest Baltic Sea from 1800–1999. About 64% of the records date from the 20<sup>th</sup> century. 85% of all records of both river and sea lampreys were estimated for Subdivisions 22–24. Offshore records of lampreys were rare. About one hundred years ago, the river lamprey was a commercial species in the Szczecin Lagoon and adjacent waters, in the Bay of Gdansk, in the Vistula Lagoon, and in the Curonian Lagoon. Generally, lamprey populations have decreased in Germany since the mid-1950s. However, more than 80 individuals of river lamprey but only 4 individuals of sea lamprey were recorded in German Baltic waters from 2000–2004. Nowadays, no actual reproduction of sea lamprey and no regular annual spawning of river lamprey are known from rivers of the German Baltic Sea area.

Keywords: river lamprey, sea lamprey, Baltic Sea, past distribution, commercial catch, recent records.

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## ICES CM 2005/W:07

### Commitment – an indicator of fishers' support to salmon stock recovery program?

Timo P. Karjalainen, Päivi Haapasaari, and Kalle Reinikainen

Finland's goal in the Salmon Action Plan program of IBSFC is to restore salmon stocks of Bothnian Bay rivers. The multidisciplinary Bireme-SAP research project works for this objective. The sociological part of the project has brought the issue of commitment into sharp focus. For us commitment means finding the best ways to increase the probability of successful restoration, so that the process has the fishers' approval. We have modelled with Bayesian belief networks the probability of the fishers to commit to the program. In building the probabilistic network the cultural and historical background of the fishers is crucial: whether they fish for a living or for recreation, where they live, and where they fish. We have separated two kinds of prerequisites for the commitment. First there is the cognitive side, which includes the fisher's knowledge and perceptions of the wild salmon, of river conditions, and of the effect of fishing on salmon stocks. Secondly we see the emotional side, which largely results from the past. Do the fishers trust other actors around salmon? Do they feel they are being treated justly? Do they trust fishing regulation and salmon research? The policymakers can try to improve the commitment by different combinations of management, knowledge, and commitment actions. The probable influence of these actions can be evaluated with Bayesian modelling. At its best the outcome of the modeling is an elegant representation of reality, which can be a useful tool for planning the recovery programs.

Keywords: commitment, salmon stock restoration, Bayesian belief networks, social sciences, fisheries management.

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## ICES CM 2005/W:08

### Evaluating management options for Baltic salmon (*Salmo salar*) using species-tailored operating models in a generic simulation framework

Polina Levontin and Murdoch McAllister, based on the work of the contributors to EFIMAS and COMMIT, Framework 6 EC projects

The population of the wild Baltic salmon has undergone in the last century a severe decline, due to dam building, overfishing, and pollution. The international effort to reverse this decline can claim success in some of the main Baltic rivers where stocks are seen to be recovering, yet some wild stocks remain highly depleted. From a policy perspective, there is a desire to identify a man-

agement strategy that would have a high probability of safeguarding the stocks while minimising economic and social hardships of regulation. The difficulty in designing experiments in the real world, make simulation an attractive realm in which to evaluate alternative management regimes. We utilise operating models that are designed to simulate a complex bio-economic reality. We consider both structural and parameter model uncertainty, by using Bayesian methods that allow us to incorporate information from a variety of sources – both data and expert knowledge. We evaluate management procedures for Baltic salmon in a generic simulation framework based on the statistical programming language R. Within the scope of the planned simulations, it is possible to explore many factors and scenarios, for example, the ecological effects of changes in the predator population (seals) and in the availability of food (sprat). The simulation-evaluation of harvest control rules is linked to the analysis of socio-economic changes associated with each regulation regime. The goal is to identify those stock rebuilding programs that are most robust to various sources of uncertainty and that are more likely to secure commitment from fishermen.

**Keywords:** Baltic salmon, operating model, state-space model, simulation, harvest control rules, management procedure, implementation error.

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## **ICES CM 2005/W:09**

### **Estimation of total allowable catch of Atlantic salmon using precautionary approach principles**

Igor Studenov

One of the most serious problems for researchers is estimating the number of spawning stocks and total allowable catch (TAC) with methods, which correspond to precautionary approach principles. Using traditional methods for stock and TAC estimation has the following obstacles: difficult age structure, significant differences of hydrological conditions in the sea feeding areas in the long migration ways, and the long-lasting period of migration in the offshore and mouth parts of spawning rivers. In this case smolt counting was selected as a prognosis estimation of the spawning stock's number. The counting of smolts was conducted in rivers where salmon spawning-and-growth areas (SGA) had been estimated.

The MBAL (minimum biological acceptable level) was used in the process of TAC estimations as limiting reference points. In the classical understanding MBAL is the biomass value of the spawning stock below which the probability of small generations appearing increases. For Atlantic salmon the spawning stock's MBAL is possible to express through a quantitative factor because the main estimation of a spawning stock is normally calculated in quantity rather than in weight. In this case the meaning

of limiting reference points is without changes because it reflects the number of the spawning stock, below which the probability of the appearance of small generations increases.

The present scheme of spawning stock estimations, MBAL, and TAC estimations is being directed both at stock conservation and for use in different types of fishery. The present model can be used for work with other migratory fish stocks.

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## **ICES CM 2005/W:10**

### **Comparison of two periods of North Sea herring stock management; success, failure and the value of management**

E. J. Simmonds

In 1970 and 1995 North Sea herring abundance and catches were similar. The stock had declined from an earlier high; it was in a depleted state with SSB at around 400 000 t, which was below the current precautionary biomass limit of 800 000 t. The fisheries were similar in magnitude and too high at 600 000 t annually. The paper compares and contrasts the scientific knowledge, the advice, the management action, and the resulting outcome for the periods leading up to these points in time. The paper compares the information, actions, and outcome over subsequent years. This comparison provides some insight into fisheries management issues. The paper concludes that good scientific information plays an important role when confronting difficult management issues. It sets the scene and provides the basis for further decisions. There are, however, other critical aspects to management, such as political will, the need for a decision-making organization, and economic feasibility. To illustrate the value of good science the costs of management advice and industry benefits from successful management of this large marine stock are compared.

**Keywords:** herring, North Sea herring, stock management, cost benefit.

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## ICES CM 2005/W:11

### **A decade of determining the continent-of-origin of Atlantic salmon collected at west Greenland with microsatellite DNA: A review of the findings and a look at what the future holds for molecular genetic methods of mixed-stock assignment**

Tim L. King, Tim Sheehan, Dave Reddin, Russell Brown, John Kocik, and Barbara Lubinski

A significant Atlantic salmon (*Salmo salar*) mixed-stock subsistence fishery exists off the western coast of Greenland. This fishery is composed of both western and eastern Atlantic origin one-sea-winter age fish. These fish would otherwise return to natal waters as two-sea-winter fish. Therefore, it is essential to the proper management of this valuable resource on both continents that the relative contributions of these diverse stocks to the west Greenland fishery are determined. Levels of genetic variation at 11 microsatellite DNA loci have been determined for over 5000 *S. salar* sampled from over 35 anadromous river populations from south-central Maine, USA to northern Spain. This suite of moderate to highly polymorphic loci revealed over 300 alleles (5–37 / locus) in this range-wide baseline dataset. Using genotypic assignment tests based on maximum-likelihood, this genetic variation provided 100% correct classification of *S. salar* in the baseline dataset to continent-of-origin and averaged nearly 83% correct classification to region-of-origin across continents. This talk will summarize the results for assignment to continent-of-origin of over 6700 *S. salar* landed from 1995–2004 at seven west Greenland locations ranging from Sisimiut to Qaqortoq. In general, the mixed-fishery appears to be evenly distributed between eastern and western Atlantic origins in salmon landed in the southern-most portion of the study area. However, western Atlantic fish constitute the majority of the fishery as collections move north and west along the coast. New less costly techniques, such as single nucleotide polymorphisms, will likely play a role in this research in the coming years.

Keywords: *Salmo salar*, assignment tests, continent-of-origin, region-of-origin, multilocus genotype.

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## ICES CM 2005/W:12

### **Rebuilding Irish salmon stocks: a genetic perspective**

Philip McGinnity and Niall Ó Maoileidigh

Irish salmon are now quantitatively different, being smaller and maturing at a younger age, than they were several decades ago. They are also considerably less abundant, 30% of the numbers observed in the 1970s.

Salmon stocks in a large proportion of Irish Fisheries Districts (8 out of the 17 in 2004) have not met their conservation limit in many years. The failure to meet estimated spawning targets is attributed to overfishing, deteriorating water and habitat quality, and poor marine survival. It is assumed that a significant reduction in fishing effort, possibly a moratorium, would facilitate a rapid return to historical abundance levels. Although, it is accepted that this would be constrained by the environmental conditions that would pertain subsequent to such a reduction. In making this assumption, no consideration is taken of the evolutionary changes that may have occurred in Irish salmon populations during the intervening period. The potential causes of evolutionary significant genetic change would include size-selective and run-time selective fisheries, introgression of wild and cultured fish (stocking and farm escapes), indirect genetic effects mediated through disease, and directional climate change. We discuss here mechanisms for such factors to affect the prospects for a quick return to historical levels of productivity and life history variation. We also evaluate a range of stock rebuilding strategies (harvest rules, hatchery interventions, etc.) for Irish salmon fisheries, their compatibility with the principles of 'Darwinian Fisheries Science', and their likelihood of success.

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## ICES CM 2005/W:13 – Withdrawn

## ICES CM 2005/W:14

### **The importance of historical baselines to fisheries management – An abundance estimate of ling (*Molva molva*) in the northeastern North Sea, 1872**

Andrew B. Cooper and René Taudal Poulsen

Modern stock assessments suffer from historical myopia, going only thirty or forty years back in time. Estimates of historical fish stock abundances can alleviate the problem by identifying long-term ecosystem changes. Historical abundance estimates are highly relevant for establishing baselines for rebuilding programmes for threatened fish populations.

Situated within the field of historical ecology, this paper will present findings on the abundance of ling (*Molva molva*) in the Skagerrak and northeastern North Sea in the 1870s. Calculations are based on historical CPUE and catch data. In the 1870s North Sea fisheries took place from sailing vessels only. More efficient catching technology and vessels were introduced only in the 1890s with the launch of steam trawlers.

Keywords: historical stock abundances, baselines for rebuilding programmes for threatened fish populations, *Molva molva*.

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### ICES CM 2005/W:15

#### A rebuilding and recovery plan for Baltic ground-fish stocks by long-term profit maximization

Eckhard Bethke

An important aim of fishery management is the conservation and sustainable exploitation of fish stocks, whereas the maximization of profit is the aim of fishermen. At first view this seems to be contradictory. The main tools of the management in controlling the stock exploitation are the technical measures fishing effort and mesh opening, whereas biological or economic parameters are beyond direct control. The new approach includes the control of mesh opening for profit optimization apart from the current exclusive control of fishing effort. This is shown for example in the cod fishery in the Baltic Sea. But the model can also be applied to stocks exploited jointly in a similar way. A main result of modelling is that cod stocks must be exploited sustainably with a much larger mesh size and this ensures an improved stock conservation. Starting from now the stock recovery can only be achieved stepwise and the harvest rules have to be redefined regularly according to the development of biological and economic parameters. An economically sensible limit of exploitation is given by the MSY-curve while the precautionary approach must be regarded as the final line of defence for the protection of stocks against collapse. The precautionary approach only calls for changes in technical measures if there is a violation of its principles.

Keywords: age at first capture, Baltic Sea, cod, costs, knife-edge function, precautionary approach, MSY, profit, revenue, spawning stock biomass recruit relation, von Bertalanffy growth function, yield.

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### ICES CM 2005/W:16

#### Developing a Bayesian mark-recapture modelling framework to inform stock recovery and rebuilding strategies for long-lived, anadromous species

Rebecca Whitlock and M. McAllister

The longevity, slow growth, and late maturation of sturgeons make their populations highly susceptible to depletion from exploitation. Their anadromous life history also makes them vulnerable to modifications of the rivers in which they spawn and feed. These factors are responsible for the severe depletion of populations of most sturgeon species throughout their range. Mark-recapture methods provide a suitable means of assessing popula-

tion abundance and estimating key population dynamics parameters and fishery-specific mortality rates, all of which are prerequisites for stock rebuilding and conservation.

White sturgeon (*Acipenser transmontanus*) in the Fraser River, British Columbia supported a commercial fishery which saw peak catches of over 500 tonnes at the end of the nineteenth century; by the 1960s the commercial catch was in the range 4 to 25 tonnes annually. The Department of Fisheries and Oceans Canada (DFO) placed a moratorium on commercial harvest in 1994, since when catch-and-release sport fishing regulations have been in force.

This paper describes a Bayesian mark-recapture model of PIT (passive integrated transponder) tags in the recreational fishery for Fraser River white sturgeon. The Bayesian approach allows incorporation of empirical estimates of the PIT tag reporting rates and probabilistic estimation of age-class specific mortality rates, catchability coefficients, and seasonal movement rates; posterior distributions for these parameters can be used as inputs to an age-structured population dynamics model. This will ultimately be used within a decision-analytic framework to facilitate stock rebuilding and develop area-based management tools for the conservation of Fraser River white sturgeon.

Keywords: mark-recapture, Bayesian, sturgeon.

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### ICES CM 2005/W:17 – Withdrawn

### ICES CM 2005/W:18 – Withdrawn

### ICES CM 2005/W:19 – Poster

#### Usefulness of legal size for the recovery of a European hake stock in a northwestern bottom trawl fishery

Alvaro J. Abella, Michela Ria, and Fabrizio Serena

In Viareggio operates one of the more important bottom trawl fleets of the Western Mediterranean. The use of low selective fishing gears and the high level of effort have driven many demersal species of the fishery to overfishing. For a long time juvenile *Merluccius merluccius* constituted an important target of the fishery, concentrating effort on the nursery grounds where the species is densely concentrated.

In order to enhance the value of the fishery and to increase the reproductive output, since 1995 limitations on fishing effort and legal minimum size limits for several species were gradually enforced. The legal minimum size for hake was fixed at 20 cm. This management measure conditioned the fleet behavior, producing a

drastic reduction of fishing pressure on nursery grounds. Available time-series data proceeding from trawl surveys and from a catch assessment survey made it possible to monitor the evolution of the European hake stock in the process of enforcement of the legal size. Size structure of the catch and at sea, effort allocation, and time-series of abundance and catch rates were analyzed. A progressive increase in mean size in the catch and at sea was observed. Estimates of abundance derived from trawl surveys show a marked increasing trend. On the other hand, commercial catch rates for European hake show a decreasing trend. This apparent paradox can be explained

by the progressive reduction of fishing pressure on the nursery areas characterized by higher catch rates. A progressive shift of effort distribution towards other grounds is demonstrated.

Keywords: European hake, recovery plans, stock assessment, Mediterranean Sea.

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