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Report of the Workshop on Fish condition (WKFICON)

17–18 November 2016

Girona, Spain



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Preface

Only one day before WKFICON workshop started in Girona, Professor Georgiy Shulman passed away at the age of 88. Georgiy Shulman was a renowned marine zoologist specializing in fish condition. His research was carried out at the Institute of Biology of the Southern Seas in Sevastopol. We all mourn the loss of an excellent scientist and we hope to continue his work.

Executive summary

The ICES workshop on fish condition (WKFICON) was held at the University of Girona (Girona, Spain) on 17 and 18 November 2016, and was chaired by Josep Lloret (University of Girona), Pierluigi Carbonara (Coispa, Italy) and Claire Saraux (Ifremer-Marbec, France). The workshop was attended by 16 participants from different countries (Spain, France, Italy, and Germany). The WKFICON workshop was aimed at opening up new directions in marine fish condition (FC) research with a potential impact on the assessment and management of exploited resources and marine ecosystems. It brought together marine scientists with different expertise in the field of fish condition (e.g. fish physiology, fisheries biology, fish reproduction, fish parasitism) to discuss, in a European context, the future research needs, and the necessity to integrate fish condition indicators to better manage fishery resources to safeguard the quantity and quality of marine resources. Participants discussed on recent advances in that field, the gaps in knowledge, the future research needs and the use of fish condition as indicator of population and marine ecosystem conditions. A major consideration of the workshop was how fish condition indices can be used as indicator of stock health and ecosystem status. This is especially important in the context of fish stock assessment but also of the Marine Strategy Framework Directive (MSFD), which aims at defining indicators of the health of the seas and more particularly of exploited species. After introductory presentations by all participants, the workshop held plenary sessions to address four different topics: (1) State-of-the-art, (2) Methodological aspects (3) Application of condition indices in the assessment of marine resources and ecosystems and (4) Future research and monitoring. The following main conclusions / recommendations were drawn:

Because condition is proved to be a good indicator of stock and ecosystem health, it is recommended to monitor regularly fish condition (e.g. individual length-weights and liver and gonad weights) in the new national Data Collection Programme (landings, discards, and surveys).

Because fish condition affects other life-history traits of fish such as growth, reproduction, and natural mortality, it is recommended that body condition indicators must be included in stock assessments.

Based on the evidences that body condition is a good indicator of habitat quality, it is recommended using fish condition in the implementation of spatial management measures including the effect of habitat protection (Marine Protected Areas, spatio-temporal closures). Condition should be also considered in the Integrated Ecosystem Assessment (IEA).

The activity of the WKFICON group needs to be continued in order to answer the open questions regarding the methodological aspects and the integration of the FC into the stock assessment models. Taking into account that only 60% of participants of this group are involved in the Data Collection Framework (DCF), it is essential that a specific financial support is provided to continue in future its activities.

1 Introduction

Condition, or the magnitude of stored energy reserves, is a particularly important attribute of individual fish which affects population success through its influence on growth, reproduction, and survival. Low energy reserves may lower the chances of survival of fish, leading to an increase of natural mortality. Starvation due to exhaustion of energy reserves, particularly during the non-feeding and reproductive periods, weakens individuals rendering them more susceptible to predation and fishing, diseases (e.g. parasitic infections) and to a variety of environmental stressors. Inadequate reserves (particularly during the prespawning phase) have also been implicated in the lower reproductive potential of several fish species through reduced fecundity and/or quality of eggs and larvae or delayed maturation. A reduction in energy reserves not only affects the population dynamics but can affect the populations of predators and therefore ecosystem functioning. The condition of a fish reflects the physical and biological circumstances experienced during some previous period, and is affected by interactions among food availability (nutritional status), environmental and habitat characteristics, contamination, diseases (including parasitism), and the physiology (e.g. reproductive status, overwintering, spawning stress) of the individual.

Despite its intrinsic biological and ecological importance, fish condition has often been largely overlooked in the monitoring and management of marine resources and ecosystems. The vulnerable state of many of the world fisheries, the poor health status of many fish stocks (decrease of energy reserves, increase of parasites, and pollution) and the need for sensitive indicators of ecosystem status provide strong incentives for better defining the spatial and temporal linkages between fish condition, stock productivity (natural mortality, growth, reproductive potential), and habitat quality.

European scientists working in the field of fish condition are geographically dispersed and use very different approaches ranging from lipid to morphometric analyses. Although ICES and STECF have considered fish condition in the frame of other workshops or meetings, such as the ICES Study Group on Growth, Maturity and Condition in Stock Projection in 2002 or the STECF meeting in 2010, this ICES workshop has been the first to exclusively focus on fish condition.

2 Objectives

The WKFICON workshop was aimed at opening up new directions in marine fish condition research with a potential impact on the assessment and management of exploited resources and marine ecosystems. It aimed to bring together marine scientists with different expertise in the field of marine fish condition to discuss on recent advances in that field, the gaps in knowledge, the future research needs and the use of fish condition as indicator of population and marine ecosystem conditions. It also wanted to foster collaboration among scientists working on exploited fish condition from an ecological and fisheries management perspective. The workshop also aimed at developing consensus on how the routine monitoring of fish condition can be used for assessment, for planning time or area closures or to develop management actions to allow more effective conservation of fisheries as well as to safeguard seafood quality. Finally, the workshop aimed to allow participants to outline future research perspectives that could allow a joint interdisciplinary effort for the investigation of fish condition.

3 Meeting overview

The workshop was held at the University of Girona on 17 and 18 November 2016. It brought together for the first time marine scientists with different expertise in the field of fish condition (e.g. fish physiology, fisheries biology, fish reproduction, fish parasitism) to discuss, in a European context, the future research needs, and the necessity to integrate fish condition indicators to better manage fishery resources to safeguard the quantity and quality of marine resources. A major consideration of the workshop was how fish condition indices can be used as indicator of stock health and ecosystem status. This is especially important in the context of fish stock assessment but also of the Marine Strategy Framework Directive (MSFD), which aims at defining indicators of the health of the seas and more particularly of exploited species (Descriptor 3). The agenda of the workshop is given in Annex 2.

The workshop was attended by 16 participants from different countries (Spain, France, Italy, and Germany). All attendees participated in the conference in an open, informal and helpful manner. During the morning session of 17 November, all participants gave a short introductory presentation on their research topics (Figure 3.1). Furthermore, seven key theme presentations were carried out by the participants in order to present a background on the main topics to be discussed (a summary of these presentations is given in Annex 3). This first session was open to all scientific community, several students and young scientists from different universities and research centres attended to listen and learn about the topic of fish condition.



Figure 3.1. A participant giving a key theme presentation

During the afternoon session on 17 November and the morning session on 18 November, discussions were held on several topics (see section 4). Furthermore, on the morning on 18 November, participants from Ifremer showed the use of the Fatmeter (see section 5.3.1 for an explanation of this device) they brought from their laboratory. On the afternoon on the 18, participants agreed on the recommendations of the workshop and explored ways to continue the activities of the group in the coming years. The workshop benefited from a mix of senior and young scientists (pre and postdocs) working on fish condition. It also benefited from the positive inputs of two scientists

working on fish condition in freshwater ecosystems, where the available knowledge is much greater than for marine ecosystems and where condition indices have been long applied to the evaluation and management of riverine fish.

In view of the topic and its relevance to the EU Data Collection Framework (DCF), the Workshop attracted interest from ICES and GFCM Member States. The workshop also attracted great interest in the social networks (Facebook, Twitter, etc.) thanks to ICES Secretariat and the enthusiasm of the young participants of the workshop. The website of the University of Girona also displayed the news about the workshop, which helped to disseminate the importance of the topic at the university community and local media.

4 Topics discussed during the workshop

The topics discussed during the workshop were:

4.1 TOPIC 1: State-of-the-art

Participants discussed the biggest gaps of knowledge in understanding condition of marine exploited species, the potential primary anthropogenic and environmental factors that can affect fish condition (e.g. fisheries, parasitism, pollution, habitat characteristics) and the influence of fish condition on productivity (growth, reproduction, and mortality) of fish populations. The discussion, which took into account the regional/sea peculiarities (Mediterranean, Black Sea, North Sea, Baltic Sea, North Atlantic), considered the following questions:

Why is it important to conduct more detailed studies on fish condition? What are the biggest gaps of knowledge in understanding condition of marine exploited species?

What are the potential primary factors impinging on fish condition, and how do we prioritize them? What are our gaps in knowledge?

How does fish condition affect life-history traits (e.g. reproductive potential, survival) of exploited marine species? In this regard, what are our biggest unknowns?

4.2 TOPIC 2: Methodological aspects

The workshop presented a wide range of approaches being used to better understand the condition of fish and to promote discussion of fish condition themes critical to sustainable fisheries. Participants discussed the pros and cons of the different methods to estimate fish condition and look for the new methods that are being developed to evaluate fish condition. The topic also discussed on the existing long-term databases on fish condition regarding the possibility of developing standardized inventories to make comparisons possible. The participants provided their opinions considering the ecosystem and species peculiarities. The discussion considered the following questions:

What are the best methods in term of cost/benefit to efficiently evaluate the condition of fish for stock assessment purposes?

Can we develop an inventory of existing long-term databases on fish condition in order to compare standard indices across stocks and ecosystems?

If routine monitoring is possible, when (season, life or reproductive stage) and how (research surveys, fish market) should it be done?

4.3 TOPIC 3: Application of condition indices in the assessment of marine resources and ecosystems

The topic discussed on the possible applications of fish condition indices into the assessment of fish populations and the marine habitats where they live, and discussed on how fish condition variables could be better integrated in fish population and ecosystem models. A major consideration of the session was how fish condition indices can be used as population and ecosystem status indicators. The discussion considered the following questions:

How the analysis and monitoring of fish condition could contribute to improve stock assessment and management? How could condition indices be incorporated in stock assessment models (through e.g. natural mortality?).

Could fish condition be used as an indicator of ecosystem and habitat conditions? Can fish condition be used to identify habitats that are more valuable for fishery production?

Definition of meta-analysis on a large spatial scale to summarize exploited fish condition and try to link it with stock status, management, etc.

4.4 TOPIC 4: Future research and monitoring

The main research and monitoring priorities as well as future available funding opportunities were discussed. The discussion considered the following questions:

What are the research and monitoring priorities in the field of fish condition?

What funding opportunities are available? Who else can do this type of research?

5 Main outcomes from the discussions

5.1 Fish condition: a useful way to measure the status of fish stocks and the health of marine habitats

According to the case studies presented and reviewed during the workshop, the condition of fish may help to evaluate not only the well-being of fish stocks but can be also used as a broad indicator of marine environmental health. In freshwater ecosystems, simple condition indices have been long used to evaluate the status of fish stocks and the health of rivers and lakes. However, in marine ecosystems very few marine fish stocks and habitats are managed in a way that takes fish condition into consideration (Lloret *et al.*, 2014). At present, most marine fish stocks are assessed using standard procedures (VPAs, XSA, etc.) and evaluation of the quality of marine habitats, such as the identification of essential fish habitats (EFHs), or the evaluation of reserve effects, rarely takes into account the condition of fish. Hence, the participants urge to consider fish condition in the evaluation of the status of fish stocks and the health of marine habitats.

5.1.1 Fish condition and stock status

The case studies presented and reviewed during the workshop have provided strong incentives for better defining the linkages between fish condition and stock productivity (natural mortality, growth, reproductive potential). It is clear that an increasing number of fish stocks in EU waters are suffering “**condition distress**”, with a reduction in the condition of their individuals over the last years or decades. Some examples reviewed during the workshop provide evidence of the importance of fish condition as indicator of the recent developments in stock status. For example, the coincidence of the collapse of the cod stocks in the Gulf of St. Lawrence and the Baltic with the decline in the condition of these stocks (ICES, 2016). Second, the decline in the fat content of anchovy and sardine stocks in the Gulf of Lions during the last decade coinciding with the collapse of landings of these stocks in this area (where fisheries are not thought to be a main driver of these changes) (Brosset *et al.*, 2016). Although the causes of these decreases are far from being well understood, these examples stress the importance of considering fish condition in the assessments of the status of fish stocks. Clearly, it is important to study the link between condition and life-history traits such as growth, natural mortality and reproductive potential, which may play a key role in understanding the impact of fish condition on stock status through these life-history traits.

From all these variables that can be affected by fish condition, the **reproductive potential** appears as a key one, according to the presentations and discussions held during the workshop. The degree of the impact largely depends on the reproductive strategy of the species. Participants recognized that stock reproductive potential is not only influenced by the Spawning-stock biomass (SSB), but also by the quality of spawners (i.e. condition of spawners). Spawning is the most metabolically demanding activity for a fish and therefore the influence of fish condition on reproductive variables (maturation size, egg production and quality, timing of reproduction) is one of the most important things to consider. Furthermore, not only fish condition influences their reproductive potential, but also the maturity status of fish is important to determine its condition. For that reason the studies on fish condition should also consider the maturity status of fish (visual inspection of gonads and histological anal-

yses), especially for comparative purposes among different stocks/Ecoregions at a wide spatial scale but also in time-series analysis.

Natural mortality (M) is another important life-history parameter that is essential to effective management of exploited fish populations. There are recent studies reviewed during the workshop (e.g. Casini *et al.*, 2016) showing that natural mortality is affected by fish condition, and therefore can be adjusted to condition in stock assessments. This method could be used for adjusting natural mortalities for other stocks where changes in condition are observed. Further discussions need to be implemented in the next meetings, as it becomes more and more obvious that fish condition affects survival of fish under certain conditions (e.g. overwintering, post-spawning).

5.1.2 Habitat quality

According to the presentations and case studies reviewed during the workshop, the assessment of the quality of marine habitats is a fundamental aspect for the improvement of the management of marine resources. Human activities, particularly fishing, threaten the quality of the habitats, producing a loss of abundance and biomass of the target and non-target populations, a decrease of diversity and presence of dominant species, changes in the structure of communities and a modification of the habitat. All this has effects on prey (food) supply of fish, and therefore on their condition. Hence, the study of fish condition is necessary to improve the current techniques of assessment of habitat quality and to improve fisheries management in the frame of an ecosystem-based approach. And vice versa, results support the importance of the protection of habitats to enhance fish condition and therefore, stock productivity. In this sense, the particular characteristics of each habitat and species should be taken into account when using the fish condition as an indicator of habitat quality. Furthermore, condition can be used as an indicator of habitat protection in marine protected areas. One presentation showed that habitat protection (marine reserves) can affect positively the condition of sea bream (*Diplodus sargus*) in the NW Mediterranean, and therefore condition should be used as a complementary indicator (apart from traditional variables such as fish abundance, biomass, diversity, and mean length/age) to test the so-called “reserve effect” (i.e. the positive effect of habitat protection on fish). According to one presentation of the workshop, the link between habitat quality and condition is even stronger in freshwater ecosystems, providing another sound example of the importance to consider habitat characteristics in fish condition studies. Following the discussions, participants proposed that the next workshops should further discuss about which specific species are best to be used as well as which indices could be the best approximation for the assessment of each particular habitat (aspects that still remain poorly known).

5.1.3 A holistic approach must be considered

During the process of evaluation of the links between fish condition, stock status and habitat quality, participants realized that a holistic approach is more appropriate to separate and prioritize the factors that have a cumulative effect on fish condition. Cumulative effects are missing as we often look at the effect of a single parameter on condition. Yet, as the marine environment is especially complex, several parameters could act at the same time either purely additively or in synergy. Among these factors that may have a cumulative effect are fisheries, environmental factors (including abiotic parameters and prey fields), competition, and parasitism. While the participants of the workshop showed how fisheries can reduce fish condition through a

reduction in prey availability, such as it occurs with *Mullus barbatus* in the Mediterranean, environmental factors seem to be also changing zooplankton abundance and diversity (and hence the condition of zooplanktivorous species such as sardine and anchovy) in the Gulf of Lions, where competition with a third species (i.e. sprat) might also operate. Parasitism was also considered a factor that may have negative effects on condition in particular species. For example in the family Sparidae, with a specific case for *Pagellus erythrinus*, it has been observed that the nematode *Philometra filiformis* is able to induce regression of the gonad and produce castration. In particular cases like this, it is recommended to analyse at least the prevalence of these kinds of parasites. For such a holistic approach to succeed, it is important to integrate all kinds of works regarding fish condition. Information needs to be shared, and participants agreed to find the best way to share this information in the coming meetings.

5.2 Link to fish stock assessments

The workshop discussions were very fruitful in showing the diversity of approaches to fish condition science and the impact of condition in key life-history traits such as growth, reproduction and natural mortality. However, the discussions showed that the links between condition and these other life-history traits are not always well understood and therefore, attendees agreed that new studies should be conducted regarding the condition of exploited species, if marine resources are to be properly managed in EU waters. Moreover the fish condition parameters are influenced by environmental factors as well as habitat quality, prey availability, effects of fishing, environmental factors (temperature, salinity, sea currents etc.) and other variables such as parasitism or contaminants. So for its intrinsic biological and ecological importance, fish condition has often been largely overlooked in the monitoring and management of marine resources and ecosystems. Moreover, given the great variability of assessment methods currently used across the range of stocks and ecosystems for which expert working groups (e.g. STECF, NAFO, ICES and GFCM working groups) give advice, fish condition indices could be promising biological parameters that may be of potential use within Integrate Ecosystem Approach (IEA) (ICES, 2015).

Two aspects in the stock assessment process should receive increasing attention regarding the incorporation of fish condition information in the assessment models:

a) Stock recruitment relationships

In stock recruitment relationships the condition of the spawning stock as well as the condition of the recruits should be considered. Condition of the recruits reflects the potential recruitment success (Adams, 1999) and the condition of the spawners influences the reproductive potential of the stock (Marshall *et al.*, 1999; Kell *et al.*, 2016).

b) Natural mortality

Condition of individual fish affects their probability of survival (Casini *et al.*, 2016). The bottleneck for this approach is to define a threshold of lethal condition. This can be estimated with experiments, which is a challenge, but we recommend to investigate this issue with statistical-empirical relationships. Proportion of individuals (Nygard and Lassen, 1997) below the lethal threshold is used to estimate natural mortality rates which can be incorporated in the assessment schemes. The sensitivity of assessment outputs to inclusion of fish condition should be tested.

In both elements it is important to consider seasonal and spatial scales in order to calculate fish condition because for most species the ecological processes are spatially

and temporally structured. In this regard the final objective is that to find a relationship between fish condition and a biological aspect (e.g. recruitment, fecundity, natural mortality) to include this field in the stock assessment.

For small pelagics and/or demersal species, it could be very informative a regular monitoring of fish condition. It is important to detect trends in the condition of fish populations, to identify sensitive periods (e.g. prior or after spawning) and to evaluate if condition is enough for a stock to be rebuilt. Indeed fish condition could help us to better know how fish populations react to environmental and anthropogenic changes

Biomass, abundance, size, and growth and reproduction are variables used in the stock assessments. We should incorporate fish condition to better evaluate fish stocks status, particularly the link of fish condition with reproductive potential and natural mortality

Reference points such as F_{MSY} must consider fish condition. Poor fish condition may have an effect on the sustainable fishing mortality F_{MSY} , under certain conditions, F_{MSY} may be close to 0 due to reduced stock productivity/condition. The sustainable F_{MSY} has to be re-estimated if fishing or natural selection patterns change. In particular for small pelagics, such sustainable F_{MSY} may change quickly. Indeed, the fish condition may serve as a very useful indicator for the need to re-evaluate the sustainable management reference F_{MSY} . Many stocks showed poor conditions and in that stock status continuing fishing activity could lead them to a collapse.

In all cases, we need to first show that there is a quantitative relationship between condition, M and recruitment, and that it affects population dynamics. Regarding M , one solution is to experimentally get values of condition that lead to starvation and mortality. But this cannot be done at a large-scale, another solution would be to try to estimate natural mortality by following cohorts and remove captures and then investigate whether this mortality is related to body condition. Regarding stock-recruitment relationship, one could try to look whether condition of spawners is related to the stock/recruitment relationship. Changes in fish condition that can likely influence the reproductive potential have thus to be included in the predictions of future year classes. Quantitative functional relationships could be modelled with multivariate analyses taking into account all variables involved (e.g. fecundity, maturity, size composition of the spawner population, spawning-stock biomass, fish condition etc.).

Finally, we need to underline that even if cannot be incorporated in stock assessment model, it might be very useful to produce trends of body condition as a complement, or as only information for data limited stock to get a qualitative advice. For many stocks we cannot run stock assessment (because there is not enough data) so condition indices would be useful as indicator of the general status of the stocks. Further research should be done on each species before it can be applied to stock assessments, particularly regarding the lethal threshold in condition (link with M), and the condition-reproduction relationship (link with recruitment), which are species-specific.

5.3 Methodological aspects

Fish condition can be assessed using a variety of criteria, ranging from simple morphometric measures to physiological and biochemical measures. WKFICON has provided an analysis of the pros and the cons of the different methods to estimate fish condition and looked for the new methods that are being developed. Moreover, the workshop participants held discussions in order to select a list of fish species (Table

5.3.1) according to their commercial importance and/or the availability of stock assessment recommendations for which it is needed to continue or implement body condition investigation/monitoring, from commercial fisheries and/or surveys. Because each species store the energy in different parts of the body, different condition indices are proposed for each of these species (Table 5.3.1). Anyway for future perspective other information on methodological aspects has to be considered (e.g. sampling sources, number of samples).

5.3.1 Review of the main methods to assess fish condition

Morphometric indices

The use of a morphometric index (based on length/weight relationship) is recommended by this group because weight and length observations are often available at much larger temporal and spatial scale. This method also offers several advantages in time and cost efficiency, so that sample sizes can be larger and more representative of the population. It is also non-destructive, so that it can be done at fish market or on professional boats without impairing the quality of the fish for its later sale. Regarding the selection of morphometric indices, the working group considered the use of the relative body condition index (Le Cren, 1951) more appropriate to marine species than the most common Fulton's index, which assumes an isometric growth. Nonetheless, it is important to underline that a validation step comparing with direct biochemical measurements on a small subsample of fish is of outmost importance before using morphometric indices on a new species. Finally, the group wished to emphasize that comparisons of body condition could be complicated by the use of le Cren index due to the different length/weight relationships depending on areas and/or populations. This results on the need to share raw measurements in order to do large-scale comparisons. The group thus recommends the establishment of a common database at least for a number of predefined species of common commercial interest.

Physiological indices

The suitability of "instantaneous" condition indices as proxies for energy allocation may depend on the temporal correspondence between periods of feeding and ovarian development. Lipid storage and dynamics within the organism are a particularly important attribute of fish condition because the lipids are along the proteins, the major organic nutrients as sources of metabolic energy.

The source of fat reserves depends on the fish species and the WKFICON discussed about the selection of physiological body condition indices according to species-specific characteristics. In the case of small pelagic fish species as sardine (*Sardina pilchardus*, and more generally clupeids), the energy is stored in muscles, while in the case of demersal species as in *Gadidae* (e.g. *Merluccius merluccius*) the liver plays an essential role in the accumulation of stored energy. For species with the main part of their energy in liver, WKFICON proposes to consider the HSI (Hepatosomatic index) as proxy particularly sensitive. Indeed, significant relationships were underlined between HSI and the total lipid content estimated in muscle and liver as reported by different works presented during the workshop. Regarding the energetic costs involved in reproduction, WKFICON suggested recording maturity stages and Gonadosomatic index (GSI) along with condition.

Biochemical and bioenergetics indices

Biochemical indices provide information about the real availability of energetic reserves describing fish condition more precisely. In particular, the total lipid content is the main biochemical index used in the evaluation of the fish condition. However, its estimation has to be done in the lab and is very time and money-consuming often preventing large-scale monitoring scheme. As a trade-off, the working group promotes discussion on the use of bioenergetics indices such as the estimation of lipid contents through conductance or impedance measurements. In particular, a demonstration and discussion on the use of fatmeter (Kent *et al.*, 1992) was performed dur-

ing the workshop. This is a fast, mobile, non-destructive and reliable tool, which could be also useful and easy to use onboard scientific surveys (Brosset *et al.*, 2015). Currently, the fatmeter could be used to properly estimate the total lipid content (through the water content measurement) of species for which calibration is already available as indicated in Table 5.3.1.1. The development of new calibrations is encouraged by WKFICON, although the use on species which store their energy in the liver has to be tested for.

Table 5.3.1.1. List of fish species for which fatmeter calibration is already available. Data provided by Distell (a company that manufactures the fatmeter).

FISH SPECIES	SCIENTIFIC NAME
Anchovy (South African)	<i>Engraulis encrasicolus</i>
	<i>Engraulis capensis</i>
Argentine / Smelt (Atlantic/North Sea)	<i>Argentina</i> sp
Butterfish	<i>Pholis gunnellus</i>
Carp (Freshwater)	<i>Cyprinus carpio</i>
Arctic Char (Arctic)	<i>Salvelinus</i> sp
Eel (Farmed eel)	<i>Anguilla anguilla</i>
Herring (Atlantic/North Sea)	<i>Clupea harengus</i>
Mackerel – Horse Mackerel, (Atlantic/North Sea)	<i>Trachurus trachurus</i>
Mackerel – Blue Mackerel (Atlantic/North Sea)	<i>Scomber scombus</i>
Mackerel – Jack Mackerel (Pacific, Asiatic)	<i>Trachurus murphyi</i>
Mackerel – Chub Mackerel (Pacific, Asiatic)	<i>Scomber japonicus</i>
Mackerel – West African (Atlantic/Mediterranean)	<i>Scomberomorus tritor</i>
Salmon (Atlantic Salmon)	<i>Salmo salar</i>
Salmon (Pacific salmon)	<i>Oncorhynchus neuka</i>
	<i>Oncorhynchus Kisutch</i>
	<i>Oncorhynchus tshawytscha</i>
Sardine (Atlantic/North Sea)	<i>Sardina pilchardus</i>
Sardine (Pacific/Asiatic)	<i>Sardinops melanoticta</i>
Sardine (Spanish Sardine)	<i>Sardinella aurita</i>
Saury (Pacific)	<i>Saurus</i> sp
Sprat (Atlantic/North Sea)	<i>Sprattus sprattus</i>
Sea Bass	<i>Dicentrarchus labrax</i>
Sea Bream, Black Bream (Mediterranean)	<i>Spondylisoma cantharus</i>
Sea Bream, Gilthead Bream (Mediterranean)	<i>Sparus aurata</i>
Silver Warehou (Pacific)	<i>Serirolella punctata</i>
Trout (Rainbow Trout)	<i>Salmon gairdneri</i>
	<i>Salmon irideus</i>
Tuna – Bluefin (Atlantic, Pacific, Mediterranean)	<i>Thunnus thynnus</i>
Tuna – Bonito (Atlantic, Pacific, Mediterranean)	<i>Sarda sarda,</i>
	<i>Sarda chiliensis</i>
Tuna – Albacore (Atlantic, Pacific, Mediterranean)	<i>Thunnus alalunga</i>
Tuna – Skipjack (Atlantic, Pacific, Mediterranean)	<i>Katsuwonus pelamis</i>
Tuna – Yellowfin (Atlantic, Pacific, Mediterranean)	<i>Thunnus albacares</i>
Whiting – Blue Whiting (Atlantic, North Sea)	<i>Micromesistius poutassou</i>



A practical demonstration about the use of the Fishmeter was carried out by the Ifremer participants on the second day.

5.3.2 Recommendations on data collection

A combination of scientific survey and fisheries data

Due to the effect of habitat, prey availability and reproductive status on fish condition, this latter often displays a large spatial and temporal variability. As a consequence, the group underlined the importance to monitor fish condition at different seasons and from different places. While fisheries data might be very useful to cover different periods and study the seasonal changes in condition, scientific survey appear as a good tool to get a lot of samples from a large spatial coverage. WKFICON thus encourages combining both sources of data. This might also be important in order to get a good representation of the population as both might target different part of the population. For instance, survey might help monitoring recruit or young fish condition. But in some cases, fisheries might also access fish, which are not sampled in the surveys. A good example is hake in the NW Mediterranean, where long-liners target large individuals, which are often very deep in canyons where MEDITS survey cannot trawl.

Main parameters and species to survey

The group has evaluated the main commercial species to monitor, on which body condition might be of importance either in the Atlantic or in the Mediterranean Sea. The list of species can be found in Table 5.3.2.1.

Based on this list, the group noticed that very few condition data were available on these species and thus wishes to encourage the investigation on condition on more species. For all of them, the group recommends the collection of morphometric condition data (length and weight) as a minimum target and has identified further species-specific characteristics to add. Indeed, depending on the species, the stratification of the sampling for sex, maturity stages, etc. might differ. As stated before liver weight might also be of particular importance for species, which stock lipids in the liver, while gonad weight should be reported during the reproductive season. Researchers are also encouraged to use fatmeters to estimate fish condition for those species for which the index has already been validated. Of course, additional information such

as age through otoliths or scales is always beneficial. Table 5.3.2.1 summarizes the main parameters to collect for each species.

As such, WKFICON recommends that these parameters might be implemented in the new data collection framework.

A common database

In order to compare between areas but also to increase sample size and knowledge of body condition of exploited species, WKFICON strongly recommends the establishment of a common database of raw measurements. This will help future research of course but also the implementation of body condition in stock assessments. Such a database will also help standardizing the gathered information and homogenizing the methodology. One problem that needs to be accounted for though is the difference between the Atlantic and the Mediterranean Sea. Indeed, several species are encountered in both areas and researchers and managers will benefit from sharing information between both. Therefore, the group suggests finding a way to share information between both zones either through a common database or a common structure to two different databases and encourages GFCM and ICES to work together on this.

5.4 Follow up of the group activities

The attendees pointed out the necessity to follow up the activities of the workshop by establishing a new ICES working group called **Working Group on Fish Condition (WGFICON)**. Europe lacks a network of scientists working on fish condition and therefore this group could well fill this gap. However, it must be noticed that around 40% of the participants of the WKFICON workshop belong to universities and research centres that are not under the umbrella of ICES or the Data Collection Framework, and therefore it will be very difficult for them, and for the group itself, to establish successfully as a group if financial support is not found to support the future meetings of the group. Therefore, participants agreed to ask different organizations, with ICES at the forefront, to explore solutions to financially support the annual or biannual meetings of the group. This group will be the first step towards the integration of the future research on fish condition in Europe. Clearly, the workshop has led to a new European, multidisciplinary group for marine scientists to define key questions in the field of fish condition. With the help of this group, it is here proposed to monitor fish condition effectively.

Other future activities planned by the group are the analysis of specific topics that were discussed during the workshop, such as the spatial and temporal variability of condition of species (taking as example the European hake, *Merluccius merluccius* across its entire Atlantic and Mediterranean range), the question about comparing GSI and condition to look in more details to check the capital/income theory and the plasticity of both strategies, and the link between natural mortality and condition of the populations through cohort analyses. It is also planned to draft a short summary of the main, innovative ideas resulting from the workshop in ICES Food for Thought initiative. Finally, the participants addressed the far-reaching importance of fish condition studies other than stock and habitat status, particularly regarding the human health aspects (energy reserves in form of lipids and particularly omega 3 fatty acids can be beneficial for the health of consumers). The new ICES Working Group WGFICON will consider these broad aspects related to fish condition that are of interest to the management and preservation of fish stocks and marine habitats, as well as health of consumers.



Some participants of WKFICON

6 References

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Annex 1: List of participants

PARTICIPANT	ORGANIZATION	E-MAIL	COUNTRY
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Annex 2: Agenda

FINAL Workshop Programme:

Day 1 (17 November 2016)

Morning (09:00-13:00 h): Open session (open to all participants and university community, no registration needed).

Room "AULA MAGNA" Faculty of Sciences. University of Girona

09:00-09:15. Presentation of the workshop (J. Lloret, Claire Saraux, Pierluigi Carbonara)

09:15-10:15 Presentations of the different groups/participants (5 minutes ppt per group/participant)

10:15-13:00 Theme sessions (15-20 minutes ppt each session):

1. Condition indices in freshwater fish: lessons for marine ecosystems. Emili García-Berthou (University of Girona) and Lluís Benejam (University of Vic).
2. Use of simple morphometric condition indices in North Atlantic fisheries: the example of anchovy, mackerel, white and black anglerfish. Carmen Hernández, Begoña Villamor and Jorge Landa (IEO, Centro Oceanográfico de Santander).
3. Ecological implications of fish condition (relation with population and community dynamics). Manuel Hidalgo and Lucía Rueda (IEO, Centro Oceanográfico de Baleares).
4. Links between habitat quality and fish condition. Alfredo García de Vinuesa and Montserrat Demestre (Institut de Ciències del Mar, CSIC) and Josep Lloret (University of Girona)
5. Effects of fish condition on life-history traits of fish: the example of small pelagics in the Mediterranean. Pablo Brosset and Claire Saraux (Ifremer)
6. Seasonal and ontogenetic changes of the European hake stock condition in the South Adriatic Sea: comparison and validation through different indices. Marilena Donnaloia and Pierluigi Carbonara (Coispa).
7. Effects of fish condition on their reproduction: what and when analyses should be carried out? Marta Muñoz, Alba Serrat and Josep Lloret (University of Girona)

Afternoon (14:30-18:30 h). Discussions on Topic 1 and Topic 2. Elaboration of the main conclusions regarding these topics. Session only for registered participants.

Room PB25

Day 2 (18 November 2016)

Morning (9:00-13:00 h): Discussions on Topic 3 and Topic 4. Elaboration of the main conclusions regarding these topics. Session only for registered participants.

Room PB25

Afternoon (14:30-17:00 h): Elaboration of the report (conclusions must be agreed by all participants). Possibility to carry out a joint publication. Session only for registered participants. Room "Aula Magna"

Annex 3: Summaries of presentations

Condition indices in freshwater fish: lessons for marine ecosystems?

By *Emili García-Berthou (University of Girona) and Lluís Benejam (University of Vic)*

We reviewed the study of fish condition in freshwater environments, using our work as examples. In our studies, we use analysis of covariance (ANCOVA) to evaluate fish condition (weight-length relationship) taking into account fish size (covariate). ANCOVA has several advantages over condition factors (e.g. weight length⁻³) and similar indices (see reviews in García-Berthou and Moreno-Amich, 1993; García-Berthou, 2001). The adjusted or predicted means in ANCOVA are the means of values of the response variable adjusted for effects of covariates, typically length (García-Berthou and Moreno-Amich, 1993); these adjusted means thus allow comparing groups or treatments for the response variable, after accounting for the effects of fish size.

Although freshwater ecosystems generally lack the large datasets available for sea fish (for long time-series and wide study areas), some studies have been developed with significant results. For instance, we have detected significant small-scale effects of habitat on fish condition of an endangered cyprinodontid fish (*Aphanius iberus*) in saltmarsh lagoons. In similar habitats, invasive mosquitofish (*Gambusia holbrooki*; an exotic species from the USA) increased reproductive investment in saline waters, at the cost of somatic condition. Assessing the effect of latitudinal gradients on life history of mosquitofish, we detected that mosquitofish inhabiting northern latitudes had less gonadal weight but better condition than southern populations. On reservoirs, we also found some significant results showing that fish condition can be a good metric of the well-being of fish, even at short temporal scales (days or weeks). The condition of roach (*Rutilus rutilus*) and bleak (*Alburnus alburnus*) varied significantly during the drawdown on Sau reservoir (Ter basin) following the reduction of oxygen availability in the water column. In Flix reservoir (a highly polluted reservoir in Ebro River), a significant negative impact on condition (eviscerated and liver weights adjusted for fish size) was detected for several fish species. Finally, we also studied the effects of water diversion of small hydropower plants on fish condition in the upper Ter river basin. We detected better fish condition in less impacted reaches, although the results were species-specific and *Salmo trutta* was the most sensitive species. Overall, our results suggest that somatic condition is an invaluable, cost-effective ecological indicator at the individual level of organization.

Use of simple morphometric condition indices in North Atlantic fisheries: the example of anchovy, white and black anglerfish.

By *Carmen Hernández, Begoña Villamor and Jorge Landa (IEO, CO Santander)*.

For European anchovy (*Engraulis encrasicolus*) changes of the condition status of individual year classes during 1990–2011 was analysed through exploration of two condition factors, Fulton's and Le Cren's. Fulton's CF by size class showed an increasing trend with size and Le Cren's CF was not affected by size, which determined its suitability for the purposes of the present study. There were several features that took place in the biology of the anchovy cohorts born during the last period of collapse and recovery of the population and one was the increasing of the condition factor in 2010–2011, where a higher Le Cren's CF was found. The evolution of the condition factors of white and black anglerfish (*Lophius piscatorius* and *Lophius budegassa*), in

northern Iberian Atlantic waters (ICES Divisions 8c-9a) and in Celtic Sea, southwestern Ireland and Porcupine Bank (ICES Divisions 7b,c,h,j,k) from a decade (2006 to 2015) was analysed. Le Cren's relative condition factor was quarterly estimated. Four comparisons of the condition factor (CF) were made among: Stocks, sexes, immature-mature and quarters. The evolution of the condition factor shows some seasonal variation. In both stocks, these seasonal differences could be due to transference of energetic reserves to the gonadal development in mature individuals, while that energy in immature individuals would be reflected in a better condition.

Links between habitat quality and fish condition

By García de Vinuesa, A., Demestre, M. (Institut de Ciències del Mar-CSIC) and Lloret, J (University of Girona).

Different demersal and benthic fisheries such as trawling, trammelnet, longline fishing or the use of dredges can disturb the quality of habitats. Particularly trawling is the activity that contributes most to the modification of marine ecosystems, producing loss of abundance, decrease of diversity, changes in the structures of the communities and physical modification of the habitat. These changes modify the abundance, quality or diversity of potential prey of fish and can produce changes in their condition. We have carried out several studies on the quality of habitat (de Juan *et al.*, 2009; Demestre *et al.*, 2008 or Figuerola *et al.*, 2001, among others) in some of which we have been able to verify the loss of habitat diversity or loss of abundance of some groups of organisms and increases in abundance of groups that benefit from the effect of trawling. Studies have also been carried out relating the habitat protection (Lloret *et al.*, 2003) habitat type (Lloret *et al.*, 2005) or bathymetry with the fish condition (Lloret *et al.*, 2002). For this purpose, condition indices such as Fulton, gonadosomatic and hepatosomatic indices or total lipid content in muscle and in liver have been studied on commercial demersal species such as *Diplodus sargus*, *Pagellus erythrinus*, *Pagellus acarne* *Mullus barbatus* or *Mullus surmuletus*. Nowadays we are conducting study on how habitats affected by trawling as muddy or especially productive habitats such as maërl or crinoids beds, affect the condition of fish to improve their management.

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Effects of fish condition on their reproduction: what and when analyses should be carried out

By *Marta Muñoz, Alba Serrat and Josep Lloret. (University of Girona).*

It is well known that fish condition can have a significant impact on their reproduction, being an essential factor for the productivity of exploited populations. This impact depends largely on whether the species is capital or income breeder. When reproduction is fuelled by food intake, the condition of the fish does not substantially affect its reproductive potential, since the individual does not need to use stored energy. The relationship will then be more indirect, since fish in better health will have more capacity to obtain resources and, therefore, more energy available to destine to reproduction, although they do not need to mobilize their lipid stocks. There are, however, mixed strategies between these two extremes. The zygotarous *Helicolenus dactylopterus* shows a mixture of capital and income breeding strategies depending on the maturation stage of the ovaries. Recruitment of oocytes is dependent on female reserves, while final oocyte development, which is a rapid process, is more dependent on concurrently gained energy. Therefore, only final potential fecundity fixed prior to spawning depends on the K_n of the female at that specific moment, mainly on weight as an expression of female capacity to capture current energy. The Mediterranean hake *Merluccius merluccius* also show a mixed strategy, but in this case it implies seasonal variability of the effects of the condition over reproduction. So the importance of knowing the stored lipid reserves to be able to estimate the health or condition of the individuals is variable within the same species. In this case it does not depend on the stage of gonadal development but of the existing food resources and, therefore, of the season of the year in which the fish are caught.

Finally, parasitism has also been identified as a factor affecting the condition and reproduction of several fish species, although its effect is still more variable and specific.

Overall, these studies show that the links between condition and reproduction are complex and very variable depending on the reproductive strategy of the species, the stage of development gonadal or the availability of resources offered by the medium. We therefore consider that the management of stocks should take into account different parameters relating to the condition of the specimens depending on the species in question.

Effects of fish condition on life-history traits of fish: the example of small pelagics in the Mediterranean.

By *Pablo Brosset and Claire Saraux (Ifremer-Marbec)*

Multiple changes have been described since 2008 in the Gulf of Lions ecosystem and particularly in small pelagic fish dynamic. Anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) are exploited, but are now smaller and in poor condition while a third species, the sprat (*Sprattus sprattus*) strongly increased in biomass and abundance. This study investigated these changes by analysing small pelagic fish body condition (i.e. individual energy stores) variations and its causes and consequences. Anchovy and sardine body condition was optimal in 2005 and 2006 and decreased after 2008 to stay steady at low level since 2010. These body condition changes were mainly associated with changes in zooplankton concentration, but also with both sea surface temperature and diatoms for sardine and Rhône outflow for anchovy. Older sardine are also currently in very poor condition. Thus, as bottom-up

control was highlighted and may explain the poorer body condition by a reduced food supply. In a large-scale study, we pointed out the fish body condition decrease in other Mediterranean areas as the Adriatic Sea, the Catalan Sea or the Strait of Sicily. Furthermore, anchovy displays a better body condition in high energetic areas (fronts areas, local upwellings) when sardine prefers areas with high primary productivity. Those differences could be linked to the different reproductive cycles and trophic behaviours. Body condition variations are not synchronous in the Mediterranean Sea, pointing out the importance of local factors in this quasi-enclosed basin. This study completes the previous work made on top-down processes and strengthens the bottom-up importance to determine forage fish body condition both in the Gulf of Lions and the Mediterranean.

Seasonal and ontogenetic changes of the fish condition in the European hake stock of the South Adriatic Sea: comparison and validation through different indices

M. Donnalioia, M.T. Spedicato, W. Zupa, A. Trani, P. Gaudio, P. Carbonara (Coispa, Italy)

First observation on seasonal variation of hake condition (*Merluccius merluccius*) are provided in the South Adriatic Sea using different condition indices. Some biological aspects as growth, sex and reproduction are analysed to understand their relationships with fish condition. Moreover, proximate composition and fatty acid amounts are determined and quantified in muscle and liver of juvenile, recovering and spawner females to investigate the dynamics involved in the mobilization of energetic reserves. Among the common condition indices, the hepatosomatic index (HIS) is particularly sensitive as indirect indicator of nutritional status for demersal species, as hake, in which lipids are accumulated in the liver (HIS correlates significantly and positively with lipid and protein amounts). Anyway, the use combined of somatic condition (Kn) and physiological indices provide useful information on global condition and its variation in according to the ontogenetic factors (sex, size and maturity stages). Generally, the hake stock reaches best condition during summer and autumn probably associated to the seasonal variations in availability and quality of preys (in juvenile females and adult males their relative values of Kn and HIS present similar patterns among all seasons). Adult females mobilize the hepatic lipids for supplying the energetic demands on reproduction too (the gonadosomatic index is positively correlated to the HIS only for this portion and both indices show opposite trend among the maturity stages that precede and follow the spawning). However, significant amounts of hepatic lipids and their constituent fatty acids are lower in spawner females than juvenile and recovering ones.

Ecological implications of fish conditions: from populations, through communities to ecosystems

By M. Hidalgo and L. Rueda (IEO, Balearic Islands, Spain)

Spatio-temporal variation of fish condition can trigger a variety of implications on key ecological processes. These implications can be summarized at different hierarchical levels in: demographic and population dynamics, species distribution, community interactions and ecosystem properties. The trade-off between fish condition and somatic growth is known to be highly species-specific and can affect fish survival, particularly in recruits and juveniles. During the juveniles and pre-reproductive process, there are species that comparatively invest much energy in weight growth while others invest much energy in somatic growth (i.e. growth in length). As it has

been suggested for European hake in the Mediterranean Sea, cohorts with recruits in good morphometric condition can compensate with a decrease in somatic growth during the juveniles stage affecting the survival rate from the recruit and the juvenile stage. In this case, it has been hypothesized that a condition-mediated survival of populations mediated by a growth compensation process. This can be highly relevant to the population dynamics when density-dependence regulation has low influence in populations' persistence as it has been suggested for some species in the Mediterranean Sea. In a fisheries assessment context, this can help to understand the stock-recruitment relationships both in the recruits and the spawner component. In addition, recent studies also show how fish condition can be used to make natural mortality variant at ontogenetic and temporal scale. These condition-correlated natural mortality rates can trigger a decrease in the influence of fishing mortality on fisheries assessment frameworks.

The interaction of fish condition and species distribution is also of high relevance as it can also affect key ecological processes. Since species distribution of fish can temporally change, the mean spatial pattern of key life-history traits or fish condition can also change with them. This can be of special relevance for those ecological processes that, for a given species, are spatially localized such as density-dependence, reproductive rate or juvenile survival. This can be also relevant to understand how trophic ecology affects fish condition dynamics. Although much effort has been invested in finding species-specific general patterns that relate the quality and quantity of food intake with fish condition, these patterns have revealed to be highly context dependent. This has been observed in the Mediterranean Sea where the environmental drivers and, the population and communities structures are spatially structured, even at short spatial scales. The synthesis of ecological processes above-described may be taken into account in the ecosystem approaches to management from qualitative but also from a quantitative point of view. This is the case of Integrated Ecosystem Assessments (IEAs) that are '*quantitative evaluations and synthesis of information on physical, chemical, ecological, and human processes that provide the scientific understanding to deliver advice on trade-offs between different policy options*' for which fish condition can be an important element to be considered.

Annex 4: Working Group on Fish Condition proposal

The participants of the workshop aim to propose the creation of a **Working Group on Fish Condition** (WGFICON). A proposal of the creation of WGFICON group will be presented to SICOM and ACOM, who should review the interest of the creation of this new group by supporting the current ICES Strategic Plan. The first meeting of this group would be chaired by Karl-Michael Werner, Germany, Manuel Hidalgo, Spain, and Josep Lloret, Spain and would be held at the Thünen Institute in Hamburg/Bremerhaven, Germany in the first half of 2018, to:

- a) Review and consider recent research into how to incorporate fish condition in stock assessments through natural mortality, reproductive potential and growth, and adapt reference points (e.g. F_{MSY}) to changes in fish condition
- b) Review ongoing work for analysing spatial and temporal changes in fish condition
- c) Discuss a specific plan to monitor regularly fish condition (e.g. individual length-weights and liver and gonad weights) in the new national Data Collection Programme (landings, discards and surveys).
- d) Discuss a specific plan on how to implement fish condition in the implementation of spatial management measures including the effect of habitat protection (Marine Protected Areas, spatio-temporal closures) and in the Integrated Ecosystem Assessment (IEA).

WGFICON would report by September 2018 to the attention of the ACOM Committee.

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the use of fish condition indices in the evaluation of the status of the stocks and the quality of the marine habitats, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Scientific justification	This group will provide the opportunity to regroup the ICES/GFCM community working on the field of fish condition. As such metrics could serve to measure habitat quality, the health of stocks and it is a promising biological parameter for a ecosystem based approach of fisheries assessment. Broadly speaking, condition of fish is also important to human health.
Resource requirements	The research programmes which provide the main input to this group are underway, but resources required to undertake the meetings of this group are not underway because not all members of this group are within the ICES or the DCF umbrella. Therefore, the participants ask ICES and other institutions to provide sufficient resources that make possible all participants to meet.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	None.
Financial	Financial support is needed to continue the activities of the group
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGBIOP, RCM, WGEKO, WGCAMEDA, WGIPS, WKIDEA

Linkages to other organizations EU Data Collection Framework, STECF, GFCM

Annex 5: Recommendations

RECOMMENDATION	ADDRESSED TO
<p>1. Because condition is proved to be a good indicator of stock and ecosystem health, WKFICON participants recommend to monitor regularly fish condition (e.g. individual length-weights and liver and gonad weights) in the new national Data Collection Programme (landings, discards and surveys). In order to progress in this issue, the new WGFICON working group will invite to the first meeting the responsible scientists of the different organisms to which this recommendation is addressed (right column)</p>	<p>WGBIOP WGIPS Regional Coordination Meeting (RCM) Data Collection Reference Framework (DCRF) of the General Fisheries Council of the Mediterranean (GFCM) Experimental fisheries surveys: MEDITS, MEDIAS, IBTS, BITS, etc.</p>
<p>2. According to the results presented during the WKFICON workshop and the discussions carried out, participants recommend that body condition indicators must be included in stock assessments. In order to progress in this issue, the new WGFICON working group will invite to the first meeting the responsible scientists of the different organisms to which this recommendation is addressed (right column)</p>	<p>ICES assessment working groups Scientific, Technical and Economic Committee for Fisheries (STECF) GFCM WGSA</p>
<p>3. Based on the evidences that body condition is a good indicator of habitat quality, we recommend using fish condition in the implementation of spatial management measures including the effect of habitat protection (Marine Protected Areas, spatio-temporal closures). Condition should be also considered in the Integrated Ecosystem Assessment (IEA). In order to progress in this issue, the new WGFICON working group will invite to the first meeting the responsible scientists of the different organisms to which this recommendation is addressed (right column)</p>	<p>WKIDEA WGCOMEDA EC Directorate-General for Maritime Affairs and Fisheries, focal point of multi-annual plans EC Directorate-General for Environment Secretariat of the Network of marine protected area managers in the mediterranean (MedPAN) Regional Activity Centre for Specially Protected Areas (RAC/SPA) secretariat</p>
<p>4. The activity of the WKFICON group needs to be continued in order to answer the open questions regarding the methodological aspects and the integration of the FC into the stock assessment models. Taking into account that only 60% of participants of this group are involved in the Data Collection Framework, it is essential that a specific financial support is provided to continue in future its activities.</p>	<p>ICES Secretariat ACOM General Fisheries Council of the Mediterranean (GFCM) Secretariat</p>