Theme session J

Assessing and promoting the survival of released catches and the implications of modified survival rates on aquatic systems

Conveners: Mike Breen (Norway) Tom Catchpole (UK)

Introduction

The importance of catch welfare in promoting both responsible and sustainable fishing is gaining international recognition. This has been highlighted by the new EU Landing Obligation where there is an exemption to release catches demonstrating high survival. Motivated by fisheries management policies around the world, there has been an increased investment in research on discard survival and catch welfare. In theme session J, speakers were invited to share their experiences of overcoming the challenges of promoting the survival of released catch and obtaining reliable estimates of survivability, including studies on the following topics:

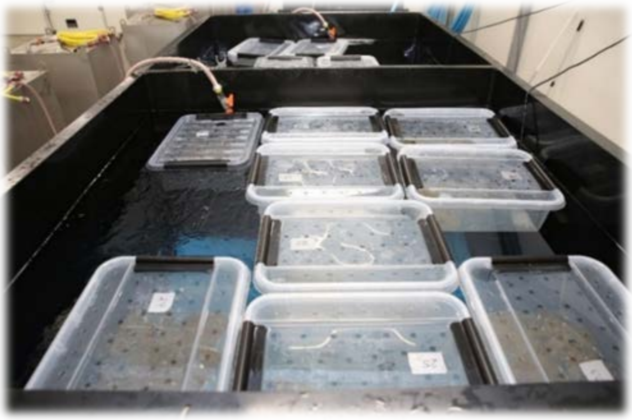
- Methods for assessing survival of released catch
- Best practice for promoting the survival of released catch
- Catch welfare in commercial and recreational fisheries
- Applying discard survival estimates in fisheries assessments and ecosystem models
- Discard survival in the context of the European landing obligation exemptions
- Survival estimates of marine and freshwater species to inform ecosystem effects of fisheries

ICES Guidance on Discard Survival Methods (WKMEDS)

Research aimed at determining whether aquatic organisms survive, after being caught and returned to the water, has been conducted over decades. There have been reviews of the outputs from this work, but until recently, there has been no assessment of all the scientific methods and approaches that can be employed in meeting this aim. The ICES Workshop on Methods for Estimating Discard Survival (WKMEDS) was established to describe and provide guidance on best practice for methods to quantify the survival of aquatic organisms caught and returned to the water. The catalyst to initiate WKMEDS was the recent change in European Union (EU) fisheries policy, which has meant there is a need for guidance on how to investigate levels of discard survival. The EU Common Fisheries Policy (CFP) introduced a phased discard ban; although the policy includes several exemptions including that for "species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, of the fishing practices and of the ecosystem".

To support a proposed exemption, defensible, scientific evidence for discard survival rates are required. Consequently, there was a need for the provision of guidelines, and identification of best practice, for undertaking discard-survival assessments. The first presentation of the session by Tom Catchpole (J:653) was an introduction to 'Guidance on Methods for Estimating Discard Survival', produced by WKMEDS and to be published as an ICES Cooperative Research Report. The guidance is designed to be used by practitioners and have global applicability to survival assessments in commercial and recreational fisheries. It includes advice on steps to initiate and design experiments, guidance on applying the different practical methods, how these methods can be used in combination to achieve different objectives, and also advice on data analysis. The session included numerous examples of studies that have benefited from the application of the ICES guidance.

Application of the guidance

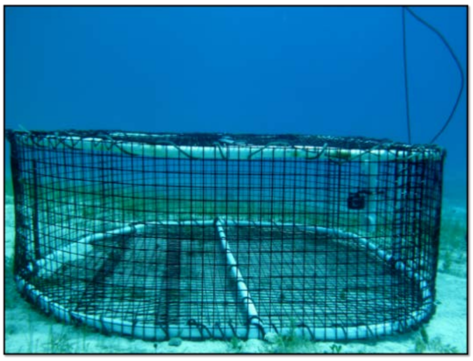


Unwanted catches of plaice and holding facilitates used in captive observation experiment

Several discard survival assessments were presented in the session, many of these were on flatfish species, which are a group of fishes receiving interest because, in general, they are characterised as being resilient to the stressors of the fishing process and exhibit some of the highest levels of discard survival. For example, Thomas Noack and colleagues (J:206) assessed the survival of discarded plaice (*Pleuronectes platessa*) and lemon sole (*Microstomus kitt*) caught in a demersal otter trawl fishery in Skagerrak. Captive observation and vitality methods were combined and showed survival rate was higher for plaice (55-64%) than for lemon sole (14-46%) and were effected by haul duration and handling time There was also a demonstrable relationship between vitality (health status) and mortality, enabling vitality to serve as a proxy for survival. The relationship between vitality and mortality, specifically reflexes, were also explored for flatfish species in the Baltic Sea trawl fishery by Sarah Kraak et al. (J:220). In this case, the RAMP approach was applied, and while the selected reflexes, when combined, were found not to be useful as predictors of mortality, alternate analysis was suggested that may yield a predictive relationship between reflex impairment and survival.

In the southern North Sea, Junita Karlsen and colleagues (J:579) demonstrated that reflex tests already established for plaice and sole (*Solea solea*) to determine health status, were also suitable for lemon sole. In this study overall vitality scores were the best predictor of mortality. Work led by Sebastian Uhlmann and presented by Klaas Sys (J:429), explored the potential for bias between scientists when conducting visual vitality assessments, and demonstrated the importance of taking steps to ensure assessments of fish are performed consistently. It was recommended that scoring criteria and responses clearly defined and unambiguous, and for all those conducting the assessments to have equal and abundant training.

Another group of fishes receiving attention were the elasmobranchs. Brendan Talwar (J:252) presented survival assessments for deep sea sharks caught in commercial long line fishery, and Dorothee Kopp introduced a study on rays caught in the trawl fishery in the Bay of Biscay (J:229). For the deep Sea sharks, the work produced indicative survival estimates of 50% were reported for Cuban dogfish (*Squalus cubensis*) and 27% for Gulper sharks (*Centrophorus* sp.), although in both cases this was considered an overestimate, owing to the restricted monitoring time and the exclusion of predation effects on discarded catches, which was observed. For trawl caught rays, an acoustic tagging and array method is being applied, at the time of the conference, fish had been tagged but data had not yet been collected and analysed.



Monitoring cage for captive observation of discarded deep-sea sharks and Gulper shark

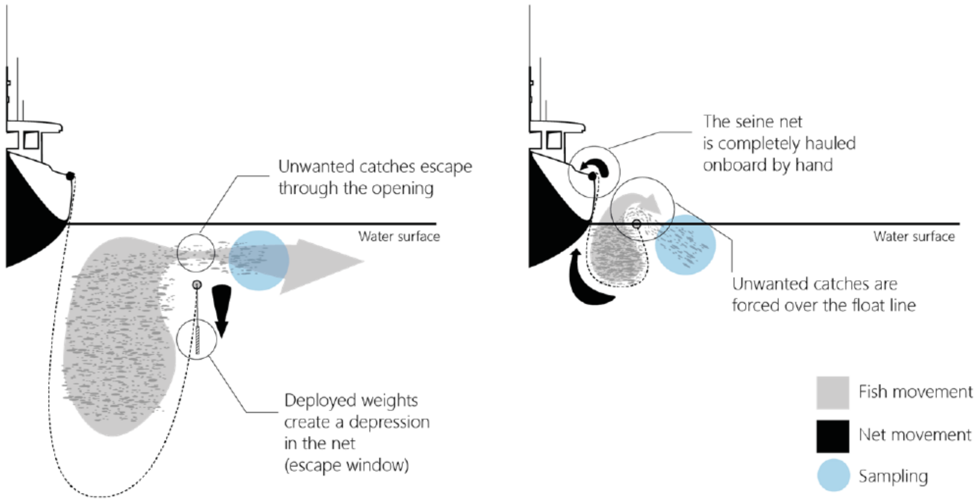
Additional to assessments in commercial fisheries, there were also several assessments from recreational fisheries. Atlantic halibut, was investigated by Keno Ferter et al. (J:172), to assess the stress endured during a catch and release event. It was shown that while the specimens showed signs of stress, and increase in lactate following capture, baseline levels returned within 24 hours after release. Also in a recreational fishery, the release survival of hook and line caught cod, haddock and Tusk in the Gulf of Maine hook and line fishery was presented by Conner Capizzano et al (J:648). In this study acoustic tags and an array or receivers were applied to quantify release survival estimates. The study showed that injury level, size and season are important factors that affect survival probability.

Recreational caught Atlantic halibut; haddock released with acoustic tag attached

The provision of viable and meaningful controls, particularly in captivity based survival assessments, was an important topic for discussion in this session. Several methods for obtaining controls were discussed, including "benign" capture methods, quarantining and pseudo-controls, and the session was referred to the ICES Guidance on Methods for Estimating Discard Survival (by WKMEDS) for further information. It was recognised that while obtaining representative and unbiased controls continues to be a challenge in this field, the effort required to obtain good controls often yields valuable information on appropriate handling practices and holding conditions for the subject species; which can in turn be used to promote good welfare practices in the relevant fishery.

Promoting catch welfare and survival of released fish.

While the provision of reliable estimates of post-release survival is important for the management of fisheries with substantial proportions of unwanted catches, the optimal solution for addressing any unwanted fishing mortality is to minimise the risk of mortality of released fish, by promoting good catch welfare practices. Evidence of substantial improvement in the survival of discarded Norway lobster (*Nephrops norvegicus*) through modified sorting practices was presented by Dorothée Kopp et al (J:128). By introducing a discard chute, discarded animals were returned to sea after only 10 mins, as opposed to after ~60 minutes with standard practices (i.e. at the end of the sorting process). This substantial reduction in emersion stress increased survival potential, particularly in summer, i.e. from 36.4% [95% confidence interval: 30.3, 42.5] in standard practices to 56.5% [49.2, 63.7] with the discard chute. Keno Ferter et al [J:185] presented results from trials in recreational fishing for European eel (*Anguilla Anguilla*) which showed that by using large J or circle hooks, the catch rate and/or deep-hooking of undersized eels was significantly reduced. Use of these hooks, as well as improved handling practices, would therefore substantially lower the mortality of released eels, compared to standard small J hooks. Improved handling practices, i.e. immersing the catch in water, prior to sorting, as well as reduced sorting times, significantly improved the survival of plaice (*Pleuronectes platessa*) in a Dutch electro-pulse trawl fishery (Pieke Molenaar et al, J:551). However, even for fish which were held in water and sampled at the start of the sorting process, survival remained relatively low at 24% [17, 32]. It was concluded that conditions within the electro-pulse trawl were therefore the primary source of the observed mortality, and future mitigation measures would need to focus on that.



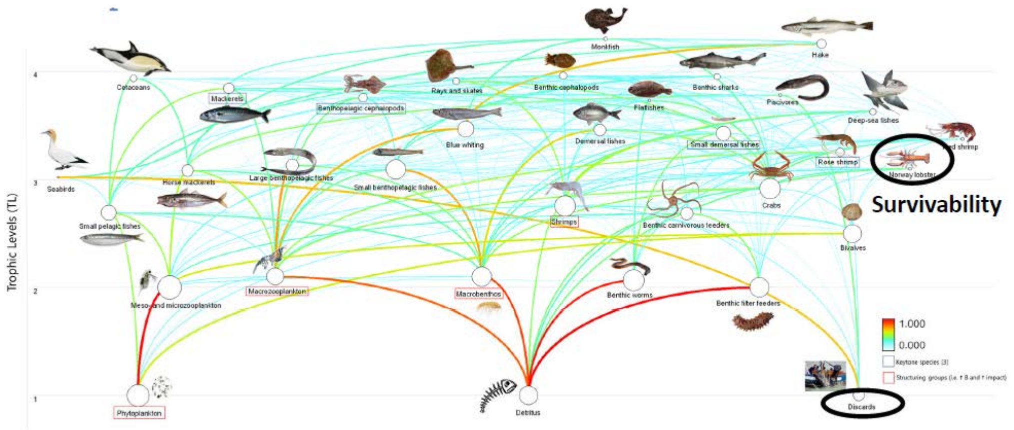
A comparison of standard (right) versus modified (left) slipping practices (from Marçalo et al, J:112)

Fish released, or “slipped”, from purse seines have been shown to have high mortalities, if they are crowded excessively. Ana Marçalo (J:112) presented results from a study in the Algarve, Portugal, where sardine slipped from purse seines were shown to have a survival rate of 11.7% [8.9, 15.2] when released using standard slipping practices – i.e. crowding and then slipping over the floatline. However, when crowding was avoided, by draping weights over the floatline to create an opening in the net, the survival was increased to 44.7% [39.3, 50.1], equivalent to the experimental control survival 43.5% [38.0, 49.3]. Several presentations described research in Norway investigating the potential for using changes in schooling behaviour to make inferences about catch welfare (as a practical alternative to reflex based vitality assessments). Nils Olav Handegard et al (J:113) investigated the effects of crowding and hypoxia on mackerel schooling behaviour, and demonstrated that changes in schooling function (specifically "predator" avoidance) were detectable at sub-lethal crowding densities. This implies that monitoring schooling behaviour has potential to provide indicators of compromised catch welfare, before stressors reach fatal levels. Related work by Maija Tenningen et al (J:260) showed how a fishing sonar (SIMRAD SN90) could be used to monitor schooling behaviour, as well as describe purse seine geometry (and volume), to enable approximation of crowding density early in the capture process. Changes in the behaviour of mackerel and herring during "slipping" from regulated discharge openings in purse seines were described by Neil Anders et al (J:310). An initial reluctance to escape was followed by "orderly massed escapes", which in later stages of the slipping event could degrade into "disorderly massed escape", suggesting that the catch may be becoming excessively crowded. Work continues in this area to use these behavioural metrics to help develop best practice to promote the welfare of fish during slipping operations.

There was discussion in the session about the practical and social challenges to promoting discard survival by introducing good welfare practices to both recreational and commercial fisheries. It was recognised that there were lessons to be learned from aquaculture in this approach, and that economics were an important motivator, particularly in commercial fisheries. For example, fishermen in Algarve purse seine fisheries actively avoid crowding fish in the catch because excessive scale loss in sardine catches can detrimentally effect market prices. Kai Lorenzen et al (J:622) demonstrated how, using social science methods, the key motivators for promoting good welfare practices can be identified. For example, recreational fisheries in the Gulf of Mexico have been trying to introduce new mitigation measures for relieving the effects of barotrauma in reef fishes. Analysis of stakeholder surveys revealed that the most persuasive motivator for uptake of these measures was the perception of subjective norms (i.e. social pressure) and that this could be promoted through opinion leaders, fisheries forums and regulations.

Assessing the implications of post-release mortality

The ecological impacts of changes in fisheries management measures, for example the EU Landing Obligation, on the marine ecosystems remain poorly understood. Conducting model based simulations to investigate different management scenarios is one approach to address this. Robert Boenish et al (J:246) presented evidence that cod bycatch in the American lobster fishery was a major source of fishing mortality unaccounted for in the current Gulf of Maine stock assessment. Increases in discard mortality estimates coincided with apparent increases in natural mortality from 2006, and their inclusion in stock assessments models improved retrospective patterns with respect to spawning stock biomass and stock numbers. Marie Angeles Torres et al (J:421) presented a poster on an ecosystem modelling approach, using Ecopath with Ecosim, to investigate the ecological consequences of adopting selective techniques to reduce discards, while assuring their survivability, in a Portuguese fishery targeting the Norway lobster (*Nephrops norvegicus*).



Ecosystem modelling of the effects of discard mortality in the Portuguese Nephrops fishery (Torres et al, J:421).

In the closing discussion, it was cautioned against presenting discard survival estimates with a false impression of accuracy and precision, because of the potential for inherent experimental biases and imprecision. The session was referred to the ICES WKMEDS Guidance, where the reader is advised that there should be a clear statement concerning any potential biases associated with the chosen method (i.e. captivity effects and unaccounted predation mortality), as well as presenting treatment and control survival estimates with appropriate confidence intervals. In particular, the magnitude of any observed control mortality will reflect directly upon the robustness of estimates of treatment mortality. These potential frailties in survival estimates emphasise that simple point estimates should not be the sole endpoint of a survival assessment. There is also great utility in using these assessments to identify fatal mechanisms and appropriate mitigation. It follows that reducing the risk of discard mortality by avoiding unwanted catches and promoting good catch welfare should be the ultimate aim.

Conclusions

In summary, the session on assessing the survival of released catches, provided a rich source of information on the latest developments on this research area. There were studies presented from a wide variety of species and fisheries from many ICES member countries, and clear synergies in the approaches being taken in the USA and in Europe. It was recognised that this has been assisted by the development of guidance by ICES WKMEDS group which has been widely taken up. The considerable progress in this area has been assisted by a heightened interest from managers, although there still remain practical and analytical aspects of the methods that can be improved, such as applying controls and accounting for control mortalities. These developments are set to continue, alongside wider application of survival estimates to enhance stock assessment and ecosystem models and to improve understanding of fatal mechanisms so catch welfare can be improved. This work is expected to be continued by a new WGMEDS group (set to continue the work of WKMEDS) in which there remains a high level of interest from many active scientists.