

## **DRAFT Theme session K on Discarding: quantities, causes and consequences**

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Discarding is an important feature of fishing practices in worldwide fisheries. Discards have long been seen as a source of waste and of information bias in single stocks management. Moving towards an ecosystem approach to fisheries management increases the concern, as discarding may affect non-target species, habitats, and the food-web as a whole. Therefore, an improved understanding of the social and environmental factors that determine discarding behaviours is needed. Furthermore, consequences of discarding such as the effects of this unaccounted mortality on populations and communities, and the fate of discarded animals (both in terms of individual survival and recycling in ecosystem processes) are major issues. New insights will have important implications in what should be monitored (ex. indicators of potentially harmful fishing practices, discards quantities) and which management measures are likely to be effective answers to this problem.

The Commission of the European Union has instigated the estimation of the amount of waste and the development of regulations to limit bad fishing practices. Since 2002 the EU requires member states to collect discard data (Commission Regulation No 1639/2001). The objective of the regulation was to gather and improve availability of data on discarding. Consequently, several countries initiated or expanded discard sampling programmes. There is a need to discuss approaches in sampling strategies, estimation methods and raising procedures; but also in the integration of discard data in stock assessment and management advice. The increase in discard data available also provides an opportunity to analyse patterns, causes and consequences of discards across many fisheries.

A wide diversity of papers were presented, addressing several topics: a) factors determining discard quantities and composition such as economic incentives, environmental factors, fishing practices and management measures; b) biological studies of impact of discards on species and communities, fate of discarded materials, integration of discards data into stock assessment; and also c) sampling designs, raising variables and procedures, variability. The session was structured into three sub-sessions.

### **1. Sub-session about causes of discarding**

A diversity of potential factors causing discarding and determining discards composition and amount were presented, from a variety of fisheries, mainly based on onboard sampling of total catch. Factors including community composition, length-composition or year-class strength, fishing area and season, behavioural interactions between animals and fishermen, mesh size and gear design, quotas and market prices were found to have significant influences. A microeconomic model of sorting behaviour, taking account of the cost of discarding and the time constraints on sorting onboard was developed, suggesting that a given amount of discarding might be optimal, depending on these constraints. In the discussion it was agreed that more economic studies are needed, to improve our understanding of incentives to discard. Fishermen interviews would be very useful as well. For example, in the groundfish fishery in Alaska, major changes in regulation caused different responses from the fleet, whose investigation allowed a better monitoring and enforcement. The need for more studies about the efficiency of selective gears, once implemented in fleets, was also outlined.

The participants then discussed the question of how to use knowledge of discarding factors to limit discards. Some suggested the creation of incentives to use more selective gears and to better utilise the catch to avoid discarding, *e.g.* by educating the general public about these practices and their negative consequences. Compensation for reduced catch and income when

new, more selective gears become mandatory are needed to make these acceptable. More flexibility in the quota system could also reduce the incentives to discard, *e.g.* by allowing some bycatch to be ascribed to next year quota. Knowledge of areas and seasons where discards are high can be used for partial fishery closures. Information systems allowing knowing in real time where unwanted bycatch is high can now be developed to permit fast movement of the fleet towards other areas. It was generally agreed that comprehensive approaches should be used to limit discards, although some participants were in favour of a discard ban. The pros and cons of a discard ban were discussed, namely that a ban provides a strong discouragement to discard, although probably it will only be effective with a considerable increase in fishing inspection/observation at sea, and requires the adaptation of fishers and their fishing practices which might bring low profits in the short term. However, unless enforcement is complete, such an extreme regulation would prevent scientists from further investigating discards, and the recent increase in knowledge about discarding would cease.

## **2. Sub-session about consequences of discarding**

This theme sub-session identified several consequences for discarding: from the reduction of reproductive potential of a stock, to introduction of bias in stock assessments, but also its potential for byproducts for human consumption and as a food source for several species (commercial and non-commercial, including seabirds); and its impact on benthos communities. Several talks showed the utility of discard data in different studies, *e.g.* discard data was used to identify area and season patterns and also size selectivity of associated species, with the objective to identify measures to reduce bycatch fishing mortality. However, in mixed-fisheries the issue remains very difficult, and mitigation measures beneficial to one species are often detrimental to others. The use of discard data in stock assessment was also suggested in other formats than as part of the catch data: it may be used as an additional tuning series or as an indicator of unaccounted mortality.

The potential use of models to predict discards was discussed. The Gulf of St. Lawrence snow crab fishery is a good example, where to minimise mortality of future recruitment, an occurrence or abundance model may be used to close fishing areas when the discard percentage of soft shell crab is predicted to be high. However, in the present state of knowledge, in most fisheries the factors determining the variability of discards are so poorly understood that models cannot be used for predictive purposes. It was also discussed that discard mitigation measures might be more acceptable by fishermen in a system of effort control management instead of a TAC control, particularly when other management measures such as selectivity improvements cannot be achieved without a high profit loss. Nevertheless, in a medium term the impact of such measures may be reversed, with profits increasing.

## **3. Sub-session about sampling and estimating discards**

Onboard sampling programs from different countries were presented. In the US the developing national report relies on a variety of data collection methods, from logbooks and market reports to onboard catch sampling and vessel monitoring system. The report will be updated as more detailed data about specific fisheries become available. In the European Union the difficulty to meet the precision required by the Data Collection Regulation in discards estimates was outlined in several presentations. The common difficulty in analysing onboard collected data is that it originates from a multi-stage sampling, where hauls are sampled within trips, that are a sample of total trips. An array of methods to estimate discards were presented, from simple and ratio-estimators to Bayesian and/or model-based estimators. More sophisticated methods generally require more knowledge of the factors causing variability in discards. The appropriate estimator in a given situation depends primarily on the use to be made of the estimate, either to include in the catch estimates for stock assessment

purposes, to understand the causes of discarding, or to implement an ecosystem approach to fisheries management.

On the other hand, sampling has to address multiple objectives and the optimal design will necessarily be a compromise between these. The difficulty of obtaining representative samples was outlined, and its consequences in terms of bias might be important. The usefulness of onboard observer programs was discussed. These can be very efficient when coverage is high, but high costs might limit coverage. Alternative methods include self-sampling, already in use *e.g.* in the *Nephrops* fishery in the Irish Sea, with a high coverage perhaps compensating for the less reliable standardisation of sampling. Video monitoring of total catch is another alternative, which reduces the problem of multi-stage sampling, as sampling from the haul population becomes possible. Both approaches could be used in a complementary way. Some participants suggested that onboard observer programs could be used to estimate total catch including both discards and landings, making market sampling less useful. Thus the cost of onboard sampling could be balanced by decreasing market sampling. The data collected would probably be more comprehensive, including fishing area and method, and allowing quality control. However, currently the representativeness of onboard sampling is limited by the voluntary nature of the sampling programmes, and a legal basis is necessary to improve this. It is envisaged that discard programmes will become mandatory in the EU, *i.e.* the fishers will be obliged to take observers onboard. A much higher level of coverage is achievable when resource property rights give the notion of individual accountability, industry thus bearing the problem like *e.g.* in Canada.

The need of annual sampling programs was also discussed, as it seems too costly to maintain on the long term. It might not be necessary to sample all species and/or fisheries every year. Generally, it was agreed that a flexible approach should be adopted, adapting sampling methods and design to particular fisheries.

### **Conclusions/Recommendations**

Discard sampling programs should have clear and prioritised objectives. The methodologies associated to the collection of discard data, such as sampling methods and design and raising procedures, will depend on the original program objectives. Alternative sampling methods like fishers surveys, self-sampling or video-monitoring could be used as a complement to onboard observer programs.

Further research is needed, especially on incentives to discard, the efficiency of selective gears, and the ecological consequences of discards on ecosystem dynamics.

Mitigation measures to be further investigated and developed include the education of the general public about discarding practices, selective gears, and partial fishery closures, possibly in real-time. Comprehensive approaches co-ordinating several mitigation measures should be adapted to specific fisheries.