Estimation and monitoring of catch discarding in Icelandic waters

Arni Magnusson

Marine Research Institute
Skúlagötu 4, P.O. Box 1390, 121 Reykjavík, Iceland
E-mail address: arnima@fish.washington.edu

Abstract

- The individual transferable quota system (ITQ) has been in effect in Iceland since 1984, and like most other fisheries management regimes, it can generate an incentive for discarding catch. This poster describes two different approaches to the problem of identifying catch discarding and estimating its magnitude.

- Firstly, the length distribution of landed catches is compared to the length distribution of a control catch, caught by monitored ships. Secondly, the species composition of landed catch is viewed in relation to quota status and other factors. Some of the possible statistical analyses of these data are presented and monitoring methods are discussed.

How much fish is discarded?

- In Icelandic waters, discarding of cod is of primary economic importance. Other gadoids and flatfishes are also discarded.

- The estimated discard rate of Icelandic cod is 2–10% by weight, 5–25 thousand t annually. This is 6–30% of the total number in catch, and varies between years, areas, and fishing gears.

What difference does it make?

- Discarding usually leaves the fish dead. This increases the total mortality rate of the stock, and thereby the probability of its collapse.

- Economically, discarding is a wasteful harvesting strategy. It can produce short-term profit for individual firms, but inflicts long-term loss for the society.

- Finally, discarding skews the picture that fisheries scientists have of the stock, since landed catch does not reflect all the fisheries mortality.

Why do fishermen discard fish?

- High-grading (discarding of marketable species) involves discarding smaller fish of the target species, and non-target species of any size. On the market, cod price increases with size and a large difference in price induces discarding.

- In the individual transferable quota system (ITQ), fishing vessel owners can buy and sell quota. Ideally, they should optimise their quota composition according to the vessel's effort.

- In reality, however, many fishermen complain about a lack of quota, for cod in particular. Essentially, the fleet's potential effort is much greater than necessary.

- There are also special circumstances when a large quantity of marketable fish is discarded. This can be related to the freshness of the fish. For instance, a very large tow can contain more fish than the on-board process can handle.

- Also, when a vessel is far away from the next port, fishermen may choose to discard their processed catch (a few days old) and continue fishing, instead of returning to port.

Integrating discards into stock assessments

- Biologists, law enforcement agents and economists research discards from different viewpoints. The biological side focuses on how discards affect their stock assessment models.

- Usually, these models assume that landed catch equals the fisheries mortalities. Nevertheless, ICES correctly defines fisheries mortalities as a sum of factors, including landed catch, misreported and illegal landings, and discards.

- When discards are integrated in stock assessment, the main effects are:

  ⇒ Our estimate of the recruitment will increase, as well as the overall stock size.

  ⇒ However, the scientific advice for optimal harvesting strategy does not change very much, given that the discard rate is not steadily increasing or decreasing. This does of course not diminish what has already been said about the destructive effects of discarding.

Comparing length distributions to estimate discards

- There are mainly four different sources of length distributions that can be used:

  (1) Catch from research vessels. Each year, surveys are carried out all around Iceland with various fishing gears.

  (2) Catch from monitored fishing vessels. Their fishing method differs substantially from the research vessels.

  (3) Catch from non-monitored fishing vessels. These catches have often been subject to discarding.

  (4) Discards from monitored fishing vessels. An agreement has to be made with the crew to discard as they would normally do, without being penalised by the authorities.

- For statistical analysis, the sampling from these sources should be random. This is not always the case when choosing vessels to monitor.

- A comparison of length distributions from sources 2 and 3, sampled in the same year, gives an estimate of the magnitude of discards (Fig. 1).

- If source 4 is available, it gives another estimate of the magnitude of discards, independent of the one inferred from sources 2 and 3.

- Source 1 is currently not used to estimate discards, although it might be transformed to approximate source 2. This should only be necessary if those data are not available, as the quality of the approximation is questionable due to different fishing practices.
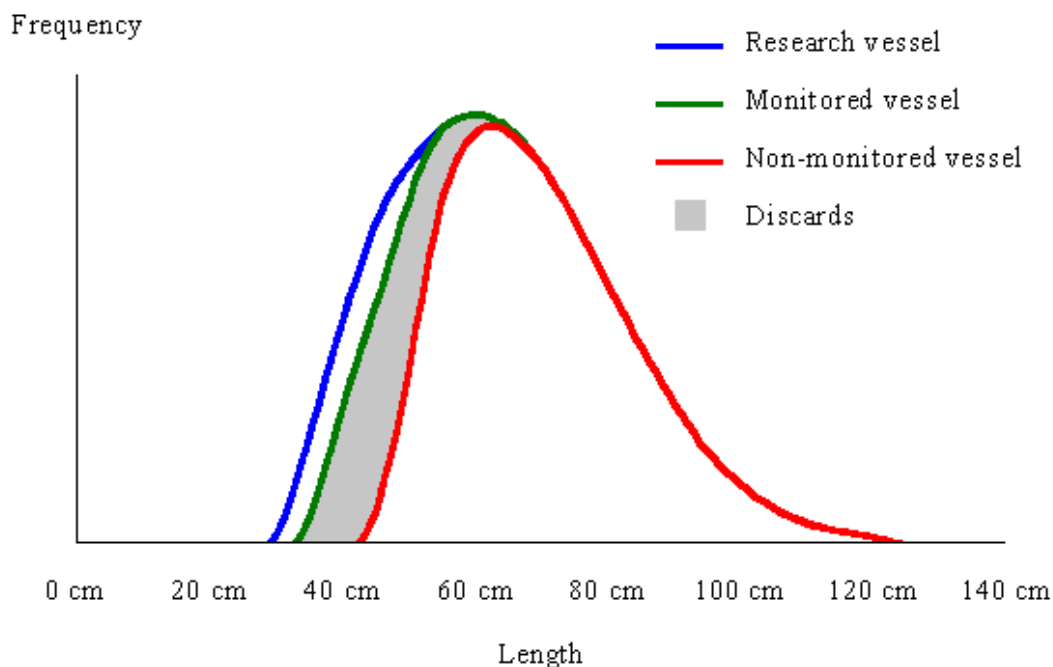

Figure 1. Length distributions of landed catch from sources 1–3, demonstrating how an estimate of discards is inferred from the comparison.

Species composition as a discarding indicator

- When fishermen are especially likely to discard one species, as is the case with Icelandic cod, it can be informative to look at the species composition. The method proposed here uses landed catch data which is publicly available (on the internet), as opposed to expensive catch monitoring or sampling methods.

Y-axis: Yield_{cod} / Yield_{total}

When discarding of cod has occurred, the boat will land less cod compared to other species, than a similar boat that has not discarded cod. $\textbf{Yield}_{total}$ can be based on a selected group of species that share habitat with the cod, making this method of identifying discards more powerful.

X-axis: Quota_{cod} / Quota_{total}

Fishermen that are low on cod quota will try to direct their efforts from the cod, and thereby lowering its proportion in the catch. This can be seen on the resulting plot (Fig. 2), which has constant year, month, fishing gear and area.

- The interesting data points are the lower outliers, as they represent boats that may have landed less cod due to discarding. This method can thus be appropriate to identify discarding boats, but is less helpful in estimating the magnitude of discards.
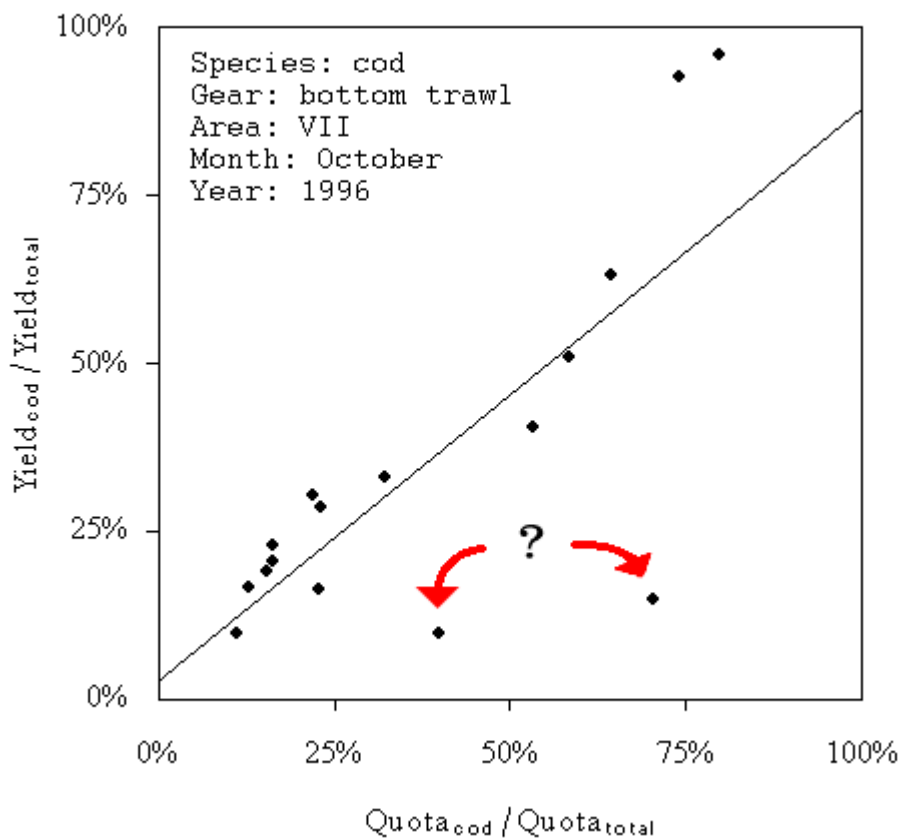

Figure 2. Relative cod yield of 16 boats in October '98, compared to their quota status in the beginning of the month. Discarding is a possible explanation for the two low outliers.

- It is still possible that the fishermen with low cod ratio in their catch had simply managed to avoid cod, without discarding at all. On the other hand, it would still need an explanation how the other boats, facing the same situation, did not manage to avoid cod. This ability to single out species is highly dependent on the fishing gear used.

Conclusions

- It is apparent that the two methods discussed here serve different purposes. Comparing length distributions is an effective, albeit expensive way to estimate the magnitude of discards, and has been practised for decades.

- Looking at species composition with constant year, month, fishing gear and area is a promising viewpoint to identify which boats are likely to be discarding.

- When a "suspicious" boat has been designated, it is important to observe the boat's co-ordinates in other months, to evaluate other possible reasons for the pattern.

- The method of designating the "suspicious" boats can be developed further. The straightforward way, shown in Fig. 2, is to look at the ones with largest negative deviation from the least-squares line. Other regression approaches certainly deserve being looked at.