Post-capture shrinkage of fish

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The occurrence of — and how to deal with — shrinkage of fish that were legal sized when caught, but then measured as undersize some time later, has been known to fisheries agencies for some time. Possession of undersized fish is one of the most common offences seen in the fisheries compliance field, resulting in large numbers of Penalty Infringement Notices for minor offences and court appearances, convictions, boat/vehicle seizures and major penalties for more serious offences.

Fisheries agencies have tended to keep the shrinkage issue quiet, largely because it's just so hard to know how to deal with it. It flares up occasionally, mainly in interactions between Fisheries Officers and those commercial fishermen whose catches include numbers of fish that are millimetres undersized when inspected. On rare occasions, such instances become public knowledge, arousing interest among anglers and local media. For example, in 2000, Fisheries Victoria decided against prosecuting a Gippsland Lakes' commercial fisherman alleged to be in possession of undersized black bream on the basis of the department's own research on post-capture shrinkage of bream. While some local anglers pondered how prevalent this might be among commercial fish catches, the implications for their own fishing did not produce a ripple of concern.

It is probably safe to conclude that, in most states, some potential cases of possession of undersized fish have not proceeded to court based on consideration of the shrinkage factor. If so, it's fair to contemplate how many anglers may have paid Penalty Infringement Notices for lesser offences of the same sort when their fish were all of legal size when first caught.

Careful examination of fish that are close to Minimum Legal Lengths (MLLs) is front and centre when Fisheries Officers conduct field inspections of anglers' catches. MLLs are crucial to the regulatory framework needed to ensure that recreational and commercial fishing is conducted sustainably. In some instances, such as stocking-based recreational fisheries, MLLs are important in strategies aimed at ensuring that fishing conforms to broad community views on what constitutes a fair or acceptable size for retaining fish. Wherever MLLs are specified, they are widely publicised and are a key focus of both the fisher information and field enforcement sides of compliance programs, supported, where necessary, by the courts.

So, when recreational and commercial fishers take (catch and keep) fish that just meet a MLL while alive, the possibility that the fish may shrink after death presents a risk to the fisher and a challenge to Fisheries Officers in how they interpret and apply the regulations. There are several possible explanations for a fisher to be in possession of undersized fish. These range from post-capture shrinkage of fish that met the MLL when taken, to carelessness, calculated risk-taking or out-and-out flouting of the size limit regulations. Among the factors that a Fisheries Officer may take into account are the fraction of the total catch that are undersize and the degree to which fish measure under the MLL when inspected. How the officers respond might be left to their discretion or agency directions might guide them — who knows?

To inform fisheries agencies on this point, there has been some good work conducted — independently of each other — by marine fisheries researchers in Queensland, Victoria and South Australia on the shrinkage of 5 popular saltwater species that are taken by recreational and commercial fishers along the East Coast.

REDTHROAT EMPEROR

In a 1991 study of coral reef fishes, 45 red emperor were hooked, measured, tagged and iced in insulated containers. They ranged in length from 235-495mm fork length. At the time the MLL was 350mm total length, equivalent to 324mm fork length. When measured around 2 hours later, the average reduction in length was 5.0 and 4.2mm as measured by 2 observers. Modelling showed that “there was almost a 1 in 5 chance that a legal-sized fish would shrink by as much as 10mm within 2.25 hour post mortem, but the probability of observing a 15mm reduction was very low”.

SUMMER WHITING

Thirteen summer whiting taken in a beach seine in 1996 measured from 134-329mm fork length; the MLL was 300mm, equivalent to 281mm fork length. They were divided into 2 groups held separately in insulated containers: one group was placed on a tray over crushed ice and the other fish were buried in crushed ice. They were re-measured after 2, 4, 6 and 24 hours.

All fish shrank over 24 hours with virtually all shrinkage occurring in the first 6 hours after death. The chilled fish shrank by 1.1-3.7mm (average 2.5mm) while the iced fish shrank by 0.7-3.7mm (average 1.9mm) over 24 hours. Shrinkage was faster among the chilled fish compared to the iced fish.

SNAPPER

Carried out in the early 2000s, the Victorian study of post mortem shrinkage in snapper was a more sophisticated investigation. Using snapper measuring 179-262mm fork length (about 19-29cm total length), the study was designed to account for any impact that rigor mortis may have on shrinkage. The possible effect of rigor mortis was examined by comparing shrinkage of intact snapper and snapper that had been carefully filleted to eliminate any compression of the vertebral column during rigor. After being euthanized, measured and tagged, both filleted and control snapper were covered with ice and held in a chill room at 4°C. They were then measured 1, 2, 4, 6, 12, 24, 48, 72 and 168 hours after death. Fish from both groups showed similar amounts of shrinkage, so the results were pooled for all fish. They showed that
shrinkage was faster over the first 6 hours and was virtually complete after 24 hours, although some showed slight shrinkage up to 168 hours after death. The amount of shrinkage averaged 5.5mm and ranged from 2-9mm.

While they eventually shrank by the same amounts, the intact fish shrank faster than the filleted fish.

BLACK BREAM

In a December 1999 study in Victoria — when the MLL was 26cm — 70 black bream were caught in a commercial haul seine and were initially treated as if part of a commercial catch, being stored in unrefrigerated insulated boxes. They were individually tagged and measured about one hour later, then divided among 3 separate treatments involving differing levels of ambient temperature and cold storage. When first measured, the bream were 246-353mm in total length. When measured 24 hours after death, the mean shrinkage was 5.0mm. There was no difference among the groups subject to differing forms of storage, and the degree of shrinkage bore no relation to the original length of the fish. Bream that were held at 22°C for 12 hours before being iced tended to shrink faster than those immediately iced or refrigerated at the start of the experiment. The researchers estimated the probability that 50 per cent of bream measuring 260-264mm when caught would shrink to below the 26cm MLL after 24 hours. They estimated that the probability of a bream measuring more than 270mm shrinking by 12mm is extremely low.

The researchers noted that the rapid initial shrinkage observed may have been even greater if the bream had been measured immediately upon capture and not the 75 minutes or so later. They calculated that between 60 and 145 minutes after capture, bream shrink by an average of 2.5mm per hour.

KING GEORGE WHITING

The 1995 whiting study was conducted in SA, where the aim was to measure length changes between capture by commercial fishermen and onshore inspection up to 8 hours later. Mesh-netted whiting were measured immediately on capture, individually tagged and placed in an ice-seawater slurry in insulated bins. At the end of normal fishing operations, the fish were measured again at the processing plant up to 12 hours after capture. When re-measured, 72 of the 76 whiting showed shrinkage of up to 8mm.

This study was carried out at 2 locations — Coffin Bay and Port Lincoln. What was particularly interesting — and important if results are extrapolated elsewhere — was the significant difference in the amount of shrinkage between whiting of the same sizes at the 2 sites. Coffin Bay fish shrank by an average of 3mm, while Port Lincoln fish shrank by an average of 5mm. The researchers calculated the probability of whiting measuring up to 5mm above the MLL when caught shrinking to below the MLL was 4 per cent at Coffin Bay and 30 per cent at Port Lincoln.

OVERSEAS OBSERVATIONS

These Australian studies have shown post mortem shrinkage to be common in all 5 species examined. Similar results have been observed for many species in the northern hemisphere. These range from tropical reef and pelagic fish to coldwater groundfish and trout, and are linked to a variety of post-capture storage treatments. Adding to the intrigue attached to this phenomenon, a Florida study found that, while most bluefish (tailor), Spanish mackerel and pompano shrink over 6 hours after death, 7 out of 8 common snook increased by an average of more than 1 per cent of their length over the same period.

WHAT ARE THE IMPLICATIONS?

Post mortem shrinkage of fish can pose serious risks to fishers, and complex challenges for those in compliance and judicial positions. For those species in which it has been observed, shrinkage happens fastest in the first hours after death and happens faster in fish held in ambient/warm conditions than those chilled or iced.

The findings for these 5 popular species pose a number of interesting questions. It is all very well to advise anglers to measure their retained fish carefully and to immediately place them on ice or in chilled brine for food quality purposes. However, the reality continues to be that this is not how many (most?) anglers operate. So, either way if their catch is going to die and quickly begin to shrink, should they be advised to act conservatively by routinely allowing a margin of error for fish that barely meet their respective MLLs when caught?

What margin of error do — or should — Fisheries Officers allow for legitimate shrinkage? Whether their judgements are based on set departmental protocols or their own discretion, are these the subject of discussions and review with angler groups and industry? In the complex business that constitutes fisheries management, compliance is “where the rubber hits the road” and has 2 equally vital components — education and enforcement. So, what messages do recreational and commercial fishers need to hear to maximise compliance with MLLs and are these messages being clearly delivered? In every state, MLLs are well publicised, as are messages about holding and dispatching fish humanely and chilling them as quickly as possible, but shrinkage is not mentioned in information products.

A special consideration is worth mentioning here. Scientific programs and high level fishing tournaments that depend on accurate measurement of fish lengths should emphasise the critical importance of carefully measuring fish immediately they are caught. This is particularly important for tag-recapture programs that are intended to determine growth rates in fish and for age-length studies where fishers supply otoliths along with length, other capture data and fish frames.

Maybe it’s time for an open conversation about post mortem shrinkage for the sake of fishers and effective fisheries compliance?

Footnote

Fact Box
For redthroat emperor there is about a 1 in 5 chance that a legal-sized fish will shrink by as much as 10mm within 2.25 hours after death.

Shrinkage of up to 3.7mm in summer whiting occurs mainly in the first 6 hours after death.

More than 70 per cent of legal-sized black bream up to 10mm above the MLL may shrink to less than the MLL within a few hours of capture.

Legal-sized King George whiting measuring up to 5mm above the MLL may shrink by up to 8mm within a few hours of capture.

Shrinkage of snapper occurs faster over the first 6 hours after death and is virtually complete after 24 hours. For those measuring close to the MLL, the reported shrinkage averaged 5.5mm and ranged from 2-9mm.

Where tag-recapture programs are aimed at measuring growth rates in fish, it is critical that recaptured fish are measured carefully while alive, immediately upon capture.

Fishers should be wary of keeping just-legal sized fish in ambient conditions for hours before landing.

Fact Box
In most states, fisheries legislation specifies 2 distinct offences in relation to undersize fish — taking fish that are less than the minimum size, and — possessing fish that are less than the minimum size. In relation to the possession offence, the relevant size of the fish is the length of the fish at the time it is examined by a Fisheries Officer.

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