MINOUW

Case study results

1.7 Bottom trawl in Aegean Sea

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Summary

Deep Vision testing

Case study results

Type of intervention

To explore whether the Deep Vision system can be an effective monitoring method for fisheries independent surveys in the Mediterranean, providing near real-time and non-destructive monitoring of potential catch composition at high spatial resolution; to adapt Deep Vision system on the multispecies Mediterranean bottom trawl fisheries.

Main activities carried out

A set of trials with the Deep Vision system were conducted in Saronikos Gulf on the Greek research vessel "Philia", from 10 to 15 October 2017. Owing to difficulties with shipping and handling the full-sized Deep Vision frame during trials in Spain in April 2016, a lighter deployment frame was designed and constructed in-port on the vessel. The goal was to construct a frame which would be lighter and less prone to collecting sediment and lose buoyancy during trawling. It was constructed from four 110 cm-long, 10 mm thick white sheets of high density polyethylene (HDPE) and placed inside a 150-cm long section of 40 mm square mesh netting.

A total of 10 demersal trawl hauls were performed at depths ranging from 60 to 400 m, duration from 32 to 97 minutes at a trawling speed of ~2.3 knots. The Deep Vision camera was run at a rate of 5 image pairs per second for hauls 1-9 and 10 pairs per second on haul 10. It was hoped that the higher frame rate would improve the ability to track individuals, but this proved not to be the case and the doubled quantity of images made data handling and analysis much more difficult.

All trawls were conducted with a closed codend and the catch was separated by species with individual lengths and total sample weight measured for each species. This was done in order to ground-truth Deep Vision results for species counts and length distributions and to ensure that catch data would be collected even in the event of a failure of the Deep Vision system. Measurement of the physical sample (catch) was performed using standard HCMR protocols. All catch was separated by species and for each species total sample weight and individual lengths were measured. In cases of very abundant species of fish, a randomly selected sub-sample of smaller size was measured and its weight recorded along with the total catch weight for that species.

Due to the amount of time necessary to perform physical measurements of the catch and service the Deep Vision system (downloading and verifying data, ensuring batteries were charged), Deep Vision data were archived and processed following completion of the cruise. A common protocol was used for all DV data analyzed. In order to test for the effect of different people analyzing the Deep Vision data, two hauls were analyzed independently by two different software users.

After completing all measurements, a parallel analysis of the DV results and corresponding catch data was performed. Since the Deep Vision images are time-referenced, the results can be used to reconstruct the temporal pattern at which individuals and species/groups were captured. Histograms of the measurement time (relative to the haul start) were produced for each species/group. Using average weight per species, a running measure of catch rate throughout the haul was also calculated.

Main results

- The Aegean Sea trial was highly successful with no significant technical difficulties
- Comparisons of Deep Vision results with physical measurements of the catch were in

general agreement regarding mean length by species / species group.
- Independent analyses of two hauls by two different operators indicated little difference in results due to operator, and that the inclusion of less than ideal images for estimating length did not affect the overall results suggesting the image analysis software and procedure is robust to variations in image quality.
- DV was useful in providing information on the spatial distribution, overlap and catch rates of species/sizes along the trawl path.

Discussion of the results

The legitimacy of regulations and enforcement could be improved by transferring more responsibility to user groups by including them in the decision making process resulting in co-management, which involves agreements between participants in the fishery and government regulatory agencies. The fundamental issue is what institutional arrangements are required for the sustainable utilization and management of common pool resources which are removable and suffer the effects of environmental variability and uncertainty. A common tool used is limiting access by issuing licenses and permits (i.e. rights to fish) to try to regulate fisheries (Mollett 1986), albeit the social aspects of fisheries and fisher behavior should be considered in the design of management systems (Wilen 1979, Healey 1985, Pringle 1985). The essence of co-management is that the government and the user groups share responsibility for managing the resource. In our case, the establishment and implementation of joint decision making has been tutored by the EU regulation. The main actors are represented, including society (ONG), scientists (research Institute), fishermen (Fishermen guilds), commercialization (Fishing Warf) and managers (DGPMM). The approach chosen is adaptative management, with changes in the regulation depending on the fishing results. As stated by McCay (1995) the specific models in each country reflect the broader institutional patterns and practices that prevail because fisheries management institutions do not originate in an institutional vacuum and must generally relate to their external political environment. In our case the EU policies determine the approach to the current management.

The survival study introduces an approach to assessing relative post-release mortality of the target species (*A. minuta* and *P. ferreri*) in the transparent goby fishery, and the environmental dependencies of fishing post-release mortality. To date, these species use to be returned to the sea when the maximum daily quota is exceeded by a boat or when the discarded fraction is high what technically hinders the fish sorting and promotes slipping. In these cases, survival of released fish remains unknown affecting the proper management of the fishery. In fact, the co-management committee revises periodically the daily catches and the fishing effort (Morales-Nin et al., 2017); however, they does not take into account the total mortality caused by fishing. The immediate mortality estimated in this study at the averaged environmental conditions was low (survival average value of 99.9%, CI 97.9-100%) but the asymptotic delayed mortality was considerably high (survival average value of 47.2%) and presented a high variability (CI between 33.8% and 65.8%). The wide range observed in the delayed mortality is caused by the high variability of environmental conditions. In fact, water temperature seems to have a major effect on survival. Conversely, the effect of depth was lower than the effect of temperature due, probably, to the fact that transparent goby fishery is carried out in relatively shallow waters (less 30 m depth). On the other hand, other factor that could be affecting the survival of the target species is their small body size. The fact of the size-specific mortality of discards, with smaller fish showing greater mortality, has been demonstrated in many studies (Suuronen et al 1996; Uhlmann et al 2016). Therefore, *A. minuta* and *P. ferreri*, given their small body size which had an average value of 2.34 ± 0.5 cm, could be considered as fragile species with a high sensitivity to fishing effect.

The most common by-catch species (*Pagellus acarne*, *Diplodus annularis* and *Pagellus erythinus*) are affected by the landing obligations because all of them were captured under their minimum legal size. However, these species showed a short-term survival higher than 60%. Therefore, it is recommended that further research should be conducted that may support a potential exemption from the Landing Obligation of this species with respect to article 15, paragraph 4b, of the Common Fisheries Policy (EU Regulation 1380/2013). Returning these individuals to the sea could provide substantial benefits to these stock, as these species are exploited by other small-scale fisheries in this area (for example, trammel net fisheries).

How practical is it for fisherman to implement this improvement, technically and financially?

Deep Vision is not currently developed to be used in commercial fisheries, but its future value cannot be excluded upon significant technological advancements. As it stands, it could help scientists to inform fishermen by providing them with improved information on the spatial distribution of unwanted catches. The modified frame, rendered DV deployment possible on relatively small vessels (research and commercial trawlers), as the ones available in the Mediterranean Sea.

Is there sufficient evidence to support wider adoption of the method/technology?

For scientific use, the method introduces an additional (temporal) dimension to the haul measurement, implicitly increases the spatial resolution and allows documentation of species overlap within a trawl haul, and is therefore very useful.

The application of DV in commercial bottom trawl fisheries aiming at discards reduction might be possible upon significant technological advancements.

CONCLUSION

The trials carried out in the Saronikos gulf were highly successful. Handling of the simplified frame went without major issues and image quality was generally sufficient to identify and measure the passing organisms, although quality was less than in pelagic trawl applications where the system has been used most. The Deep Vision results generally matched well with measurements from the catch. The proportion of the total catch measured from Deep Vision images was very similar to the proportion measured manually on deck, with similar results for lengths measured directly and estimated from images.

The time to analyze the Deep Vision data was, however, much greater than anticipated. This can be attributed less to the learning curve for using the software (which should lead speed improve with practice) and the species richness and more to the number of visually similar species present (which will likely remain constant). in such cases, the goal of using Deep Vision as a tool to map fish distributions in "near real time" seems to require further steps on developing the analysis automation, in order to speed-up the data scrutiny process. Requirements of a good computer monitor and low ambient lighting for analysis of the Deep Vision images also makes it unlikely that analysis could be carried out at sea effectively. Standard manual sorting and identification of the catch on deck actually proved to be much faster, with catch quantities by species available later in the same day. Deep Vision results, in contrast, were not available until a number of months after the cruise.

Result time-constraints notwithstanding, the analysis of DeepVision data produces the additional information of (frame) entry time for each detected specimen, which cannot be obtained with manual deck measurements.

In addition, when/if DeepVision measurements are considered adequate and no physical sample (or other work) is required, the need for on-board scientists/technicians is also heavily reduced.

Additional resources and links

- https://www.deepvision.no/
- Rosen, S., Jörgensen, T., Hammersland-White, D., & Holst, J. C. (2013). DeepVision: a stereo camera system provides highly accurate counts and lengths of fish passing inside a trawl. Canadian Journal of Fisheries and Aquatic Sciences, 70(10), 1456-1467.

The MINOUW Consortium

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