

SERAWG-03-INFO-06

3rd Meeting of the Stock and Ecological Risks Assessment (SERAWG3)

08-11 March 2021

(online)

**CONSIDERATIONS IN THE USE OF SURVEYS (ACOUSTIC AND TRAWL)
FOR MANAGEMENT OF ALFONSINO FISHERIES**

Relates to agenda item: 3.6 Alfonsino future work plans

Info paper

Delegation of [SIODFA]

Abstract

-
- **Costs:** in the small SIO benthic-pelagic fishery (3 vessels) the cost of dedicated research vessels to collect fishery independent data from a fishery spanning 2500 nm will be unjustifiable.
 - **Acoustic Surveys:** Two of the three main requirements for successful acoustic assessment of alfonsino stocks exist or can be obtained. However, the nature of the distribution of alfonsino will prevent implementation of a survey whose design satisfies the requirements of providing reasonably unbiased and precise abundance estimates. SIODFA concludes that acoustic methods cannot be used satisfactorily to estimate alfonsino abundance.
 - **Trawls Surveys:** Benthic-pelagic trawling is fundamentally different to that of conventional demersal trawling. Conventional, fishery-independent trawl surveys are based on demersal trawling. Consideration of the characteristics the benthic-pelagic alfonsino fishery trawling show that conventional trawl surveys will not be possible as a means of estimating alfonsino abundance or trends in abundance..



CONSIDERATIONS IN THE USE OF SURVEYS (ACOUSTIC AND TRAWL) FOR MANAGEMENT OF ALFONSINO FISHERIES

February 2021

Summary Points

Costs: in the small SIO benthic-pelagic fishery (3 vessels) the cost of dedicated research vessels to collect fishery independent data from a fishery spanning 2500 nm will be unjustifiable.

Acoustic Surveys: Two of the three main requirements for successful acoustic assessment of alfonsino stocks exist or can be obtained. However, the nature of the distribution of alfonsino will prevent implementation of a survey whose design satisfies the requirements of providing reasonably unbiased and precise abundance estimates. SIODFA concludes that acoustic methods cannot be used satisfactorily to estimate alfonsino abundance.

Trawls Surveys: Benthic-pelagic trawling is fundamentally different to that of conventional demersal trawling. Conventional, fishery-independent trawl surveys are based on demersal trawling. Consideration of the characteristics the benthic-pelagic alfonsino fishery trawling show that conventional trawl surveys will not be possible as a means of estimating alfonsino abundance or trends in abundance.

1. INTRODUCTION

Fishery independent surveys are a common and valuable activity contributing to effective fisheries management. Their value arises because their results are not biased by the need to continue fishing while collecting data. However, because they require the use of an expensive dedicated vessel, even if only a chartered commercial fishing vessel. For large scale fisheries involving dozens or scores of vessels the expense may be justified. However, only three vessels prosecute the Southern Indian Ocean benthic-pelagic trawl fishery. Their individual operating costs are of the order of \$60,000 - \$70,000/day: thus, their use for fishery independent scientific activities is difficult/impossible to justify, even assuming that useful results are obtained.

2. ARE ALFONSINO A POSSIBLE CANDIDATE FOR ACOUSTIC SURVEY STOCK ASSESSMENT

There are several requirements for successful acoustic assessment of alfonsino stock/population abundance:

- i. Existence of the technical capability to undertake acoustics surveys. This includes (a) installation of calibrated acoustic systems on the vessels and (b) bridge officer capable to operate the acoustic equipment. Bridge officers inevitably have extensive experience in operating complex acoustic systems. SIODFA factory trawlers are equipped with the necessary (SIMRAD) acoustic systems. Calibrations can be done but this requires bringing a team of technicians from Cape Town to Port Louis and at least a day of calm weather
- ii. Knowledge of the relation between echo intensity and sonified alfonsino biomass, i.e., the means to convert the measured integrated echo intensity to biomass estimates using a known backscattering cross section area (aka Target Strength) - biomass relation. This relationship is as yet undetermined

- iii. for alfonsino, though approximations could be used. The results would, no matter, provide annual trend information if surveys were done over a period of years. While the required analysis is not trivial, given the necessary resources and commitment, which will be considerable, it should be possible to evaluate the required parameters of an echo intensity – biomass relation.
- iv. The ability to survey the stock(s) of interest in a manner that enables accurate and acceptably precise estimates of alfonsino abundance. Alas, this requirement is not satisfied and is not expected to be feasible in the future.

Alfonsino are fished in association with the sea floor features that are spread across the Southern Indian Ocean. In any one year a single vessel may fish up to 50 of the thousands of bottom features across the SIO, and over a period of 5 years, perhaps at least 75 such features. Fishing is only possible when the nature of the bottom is conducive to fishing, e.g., even with the 'mid-water' benthic-pelagic trawl designed to fish alfonsino, irregular and bottom topography and/or gradients may prevent fishing without unacceptable gear damage. Thus, alfonsino may occur on sea floor features where fishing is impossible, and hence are not prospected by the factory trawlers. Further, alfonsino are not consistently present on the sea floor features where fishing is possible and characteristically fished. Alfonsino are highly mobile and once detected may remain only for a day/day in association with the features where they have been located once fishing starts. Some skippers have concluded that alfonsino will flee an area once detected no doubt because of engine/vessel noise and possibly even as a consequence of a learning reaction to being targeted by trawls.

Where alfonsino go to when they 'disappear' is unknown, possibly to another feature, or if not, to the open ocean and in this case undetectable. Thus, when alfonsino are encountered on a sea floor feature that is subsequently searched there is no way of knowing if these are fish just encountered on the last feature that was searched.

An absolute requirement to estimate a total population biomass is:

- i. Knowledge of the fraction of the population represented by the samples that have been sampled. For example, it might be assumed that each sea floor feature surveyed represented a single observation
- ii. Knowledge of the number of samples, i.e., seafloor features, in the total population so that the sampling fraction can be determined and the population total estimated by raising by the sample estimate – basic sampling theory.

But a highly mobile population, a large number of seafloor features to be surveyed and relatively low sampling capacity (three vessels) implies that:

- i. the same fish are not sampled more than once
- ii. fish not available to survey will not contribute to the sample estimate and thus the estimate of the population total will be negatively biased
- iii. there is knowledge of the number of population units – seafloor features providing habitat for alfonsino (N). While the number of features sampled (n) may be certain, the population total, N, will be unknown. But to obtain a population estimate, the sum of the sample estimates must be raised by the inverse of the sampling fraction – n/N . Around 350 features have been named in the SIOFA area that have been associated with benthic-pelagic trawling, though an unknown number of these may refer to duplicate names for the same feature, and
- iv. fish fleeing a sea floor feature while it is being surveyed will negatively bias the sample biomass estimate (i.e., integrated echo intensity) that is obtained.

These multiple sources of bias will render the results in error to an unknown extent. The only result possible will be a minimum biomass estimate – that from fish aggregations that were accurately surveyed, but the relation of this minimum estimate to the population total will render the result of little value.

Alfonsino form schools during the day that are highly mobile and are extremely difficult to catch to the extent that fishing is usually not attempted during the day. As such the fish in the aggregation will have a different average acoustic backscattering cross sea area during the day, if that is when they are sampled, to that which they have at night because of their different distribution of aspect relative to the vessel transducer and thus a different relation between echo intensity and fish size. This will provide a further impediment to obtaining a satisfactory acoustically-derived stock size estimate.

2. TRAWL SURVEYS

Trawl surveys are a widely used to obtain fishery-independent information. Stations, whose locations are commonly determined according to a stratified random model, are trawled following a standard protocol, e.g., for 30 or 60 minutes using a trawl whose design is kept standard year after year. If possible, the same trawler is used to undertake the fishing over a series of years and during the same season(s) as fish behaviour is known to be affected by vessel noise. If bottom conditions prevent trawling at one of the locations the vessel may move to the closest suitable site or omit the station.

A standard and implicit assumption in using the results from trawl surveys is that the relation between catch and abundance is constant depending on the estimate of the catchability coefficient. Complications in interpreting data may arise from deciding how to handle catch outliers, especially if they have a major impact on the result of the survey, and in deciding upon a suitable transformation of catch data to estimate precision.

With benthic-pelagic alfonsino fishing, fish concentrations must be first located where a benthic-pelagic trawling is possible without undue risk of gear damage. These locations are well determined and if no fish are present on the tow lane the vessel will proceed to different sea floor feature. Some features may have only one tow lane on which fishing is possible. If a vessel arrives at a feature and another vessel is fishing that lane, it will continue to another feature. One feature has been described in which the fish swim around the seamount and the vessel must wait for the fish to arrive at the site of the sole fishable lane. It is rare that a skipper will tow along a transect where he hasn't fished before. There are locations with flat sea floors where traditional demersal trawling is possible but these are few.

Alfonsino may or may not be present on the known tow lane when the vessel arrives. If yes, the skipper/alternate bridge officer will set the trawl at a commonly used depth, at which time the tow is deemed to begin (i.e., start time and depth). He will then attempt to catch the aggregation in the trawl, which may be one to two kilometres behind the vessel with the aid of acoustic systems. Many tows are completely unsuccessful and presumably other tows catch some unknown fraction of the alfonsino aggregation on which the gear was set. When pursued by the vessel the alfonsino will school and usually flee down the seafloor feature, possibly to considerable depths. This depth is determined by the tactics used by the skipper in attempting to catch the alfonsino and may have no meaning in terms of the prior fish distribution.

If the alfonsino encounters a thermocline, this may arrest the flight of the fish school and they are captured. In this case the time between when the tow is deemed to start, i.e., the trawl is at the depth where the pursuit will begin, and when it is completed, i.e., trawl haul back, is best considered as a proxy measure of the depth of the thermocline rather than a measure of fishing effort. The incidence of zero catches experienced by a bridge officer is dependent on their skill, and the fraction of zero tows declines with accumulating experience of the bridge officer.