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# PROTOCOL FOR THE USE OF SORTING GRIDS TO ALLOW SMALL TUNAS TO ESCAPE FROM PURSE-SEINE NETS

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## BACKGROUND

Sorting grids have been proposed as a way to improve size-selectivity in purse-seine fisheries. The objective of the grid is to allow the escape of fish of all species of sizes below a certain threshold, fixed by the space between the bars of the grid. The idea was introduced in the eastern Pacific in the early 2000s, thanks to the initiative of the industry from Ecuador. Early attempts with rigid grids proved unacceptable for the crews, and so flexible designs have been developed and are in use in the region. Sorting grids are obligatory for all vessels operating from Ecuadorian ports, and several designs have evolved with their utilization.

A major obstacle to deriving scientific results from these tests is that the use of the grids is not standardized and, as the vessels can control how much of the grid is submerged, the captains' choices have confounded the data.

A recent random sample of 40 sets from a database that has not yet been digitized showed that, in over 50% of the sets, the grid was not submerged at all, and in only 10% of the sets was 80% or more of the grid submerged.

The Undersecretariat of Fisheries Resources of Ecuador developed and carried out a program, directed by Mr. Fabricio Rios, of placing an additional observer on a sample of vessels to monitor the performance of the grids. Data from this program show a much higher level of utilization of the grids in the trips with these observers on board. A comparison of these data with data from sets in which the grid was not used can produce some useful insights about the functioning of the grids. The program has also tracked the performance of the different designs in a sample of trips with an additional observer.

The first stage of the program should focus on establishing which sizes of which species escape through the grid. Earlier tests showed encouraging results for several species; of special interest is the release of juvenile bigeye tuna from sets on fish-aggregating devices (FADs). However, as individuals of this species are the same size or larger than other tunas, allowing them to escape through grids without losing the catches of other species is not possible unless the different species separate vertically in the net, or show other behavioral differences that allow for a selectivity based on criteria other than size. On the other hand, sorting grids could play a major role in reducing the impacts of the fishery by allowing the escape of many undersized tunas, and of other species associated with the FAD.

In order to proceed further, experiments are necessary that will require a commitment by a number of vessels to follow the specifications of the program, as set out in the following protocol. The protocol has been enriched by the contributions of Fabricio Rios, Javier Ariz (IEO, Spain), and Jacques Sacchi (formerly with IFREMER, France).

# ELEMENTS OF A PROTOCOL FOR EXPERIMENTS WITH SORTING GRIDS

## OBJECTIVES OF THE DEVELOPMENT OF THE GRIDS

We can identify a variety of objectives to be reached. Each one of these is of itself of value, and the use of grids could be adopted in order to achieve one or more of these.

a) Reduce the fishing mortality of juvenile bigeye and yellowfin, as necessary.

b) Reduce the fishing mortality of tunas of all species that will not be utilised, including skipjack and the lesser species (black skipjack, frigate and bullet tunas, etc.).

c) Reduce the catches of species associated with FADs that are not to be retained.

These objectives take into account that the catches to be retained can change dynamically, so the fishermen can begin to retain species or sizes that were previously discarded. The goal is to eliminate discards of individuals of all species that are dead or have a low chance of survival, and also to allow, as far as possible, the release of bigeye and yellowfin tuna alive and able to survive in the long term, as may be required by the management of these species.

## GRID MODELS

Based on the results of the Ecuadorian program, the most interesting alternatives appear to be the net twine grid (Model 2) and the Dyneema grid (Model 4), which differ basically only in their materials. Among the models not yet tested but suggested by experts, there are three interesting designs: 1) PVC grids in folding segments (Model 7); 2) transparent half-inch PVC panels (flexible Model 8); and 3) semirigid rings built into the net mesh (Model 9). For the sake of simplicity, the next tests could be limited to two of these models (e.g. Models 4 and 7), but bearing in mind that there are other options available.

## DIMENSIONS AND POSITION OF THE GRIDS

The optimum size or number of grids, and their position in the net, have not yet been tested, but adding such variables would complicate the analysis, so it is advisable to use initially a single grid in a position selected by the fishermen based on their experiences. However, there are other options to be explored, and a better understanding of the behaviour of the species in the net may suggest other alternatives.

Regarding the dimensions of the grid, as a first step, we can accept the suggestion of the Ecuadorian researchers and build grids four meters wide by six meters deep.

## MATERIALS FOR CONSTRUCTING THE GRID

The experiments with sorting grids began with rigid materials that were not acceptable due to the risks and difficulties of operating them aboard the vessel. The fishermen developed models with more flexible materials, and currently there are various types of materials that are being tested in the Ecuadorian program. Of these, some that have proved not to be durable, and others that damage the fish that pass through the grid, have had to be eliminated. Among the rest, and some that have not yet been tested, we have (Nelson 2004):

a) Net twine or Dyneema

b) Articulated PVC tubing

c) Transparent PVC sheet, one half-inch thick

d) Individual rigid or semi-rigid rings

The experiment using net twine or Dyneema has started, but it would be desirable to explore the feasibility of other options that can produce openings with a more stable form. We propose comparing designs a) and b) in the main experiment, constructing articulated PVC grids that can be added to the existing ones. After five or six trips it will be decided whether to continue with the second design. If the results are negative, b) will be replaced by c), and so on. Testing all the design simultaneously would complicate the experiment and would require very numerous samples.

As a parallel project, it is recommended that grids be constructed with the concepts of c) and d), and tests of their functioning be started on one vessel for each one.

**SIZE OF THE OPENINGS**

Deciding the size of the openings in the grid, equivalent to a mesh size, is complex due to the mixture of species and objectives involved. In this first part of the experimental procedure we can continue to use apertures 8.5 cm wide by 10 cm in materials that can give, and 8.5 centimetres wide by 12 cm high in more rigid materials, so as to commence by developing a viable system, and optimise its specifications later. The suggested measurements are fairly similar to those proposed previously by IATTC researchers (10 cm x 15 cm, in Nelson (2004)).

**SAMPLING**

**PHASE 1**: Study of the feasibility of escaping from the net

A minimum sampling unit will be used that can be increased if the necessary means are available. Given the individual characteristics of the vessel and gear combinations, it is recommended that at least three vessels be used for each treatment. Adding more vessels would help to accelerate obtaining results, and it would be desirable provided the quality of the information obtained is not compromised.

In order to compare Models 6 and 7 and a control, the procedure would be as follows:

Select nine vessels, a similar as possible (especially as regards the dimensions of the net), and allocate them at random to Treatment 6 or 7, or the control, or if this is not possible, the selection of the vessels should be based on their carrying capacity, in order to achieve a balanced distribution among the treatments; thus we would have for example three vessels of 500-600 t capacity, three vessels of 900-1000 t, three vessels of 1400-1500 t, with similar nets at least within each group. One vessel of each capacity group would then be allocated to each treatment or to the control, thus forming three groups of vessels with approximately equivalent characteristics.

The vessels in the control group would remove the sorting grid, while the others would install grids with the same surface area as models 6 and 7 in the same place in the net. It will be ensured that the designs of FADs used by all the vessels are basically the same (for example, whether they have netting hanging below the FAD of a similar length). They will be deployed along the equatorial zone before the experiment, in an area bounded by the 95°W and 120°W meridians, and the 2°S and 2°N parallels, in order to have a sufficient quantity for all the vessels. In general no attempt will be made to change the fishing modes of the vessels, except for ensuring that there are no differences among the FADs that would confound the results.

To monitor the experiment the best-trained and most experienced observers available will be used, who will be given a refresher course in species identification, with emphasis on differentiating between yellowfin and bigeye.

**During the experiment, 100% of the grid shall be submerged in all sets regardless of the catch encircled.** No se fijara un número de lances al comenzar el experimento, sino que se trabajará de manera cumulativa, agregando lances a medida que se producen. Al alcanzar al menos un par de centenares de cada tipo, que cumplan estrictamente la condición especificada en este párrafo, se comenzarán a analizar los resultados, y se tomarán decisiones en cuanto a continuidad basado en los resultados parciales. Todos los lances en los que no se cumpla la condición serán eliminados del estudio.

Recapture codends (in nets with a grid included) of the greatest capacity possible will be used, based on the tests carried out by Ecuador. We are aware of the deficiencies of the recapture codend method for verifying the results of the experiment (*e.g.* individuals returning to the net, or retention in the net due to blockage of the codend). We therefore suggest that the possibility of modifying the construction of the codend be studied with the assistance of technicians from the fleet.

In each set the following will be estimated:

a) Catch retained in the recapture codend (RC) by species and by length, or at least length groups (> or < 2.5 kg), in number of individuals if possible, otherwise in estimated weight.
b) Catch retained on the purse-seiner by species and by length, or at least length groups (> or < 2.5 kg), in number of individuals if possible, otherwise in estimated weight.
c) A simple assessment of the condition of the individuals in the RC, which will give an idea of the possibilities of survival of those individuals.

**REPORTS**

The results will be reported set by set by e-mail, including information on the position and time of this set, environmental data, and other variables that will allow the results to be standardised if necessary.

**ANALYSIS**

The data will be analysed periodically, using randomisation or other nonparametric tests, to evaluate the statistical significance of the differences observed. No specific number for the total reduction of fishing mortality will be used as a target, rather we will attempt to assess how much it can be reduced with each design. The process of mitigating incidental mortality can be carried out gradually, adding innovations as they are developed. The target of this first phase is met if a couple of systems are identified that will allow a "significant" proportion of individuals to escape. In this case the word "significant" has a double meaning: (a) statistically significant, and (b) of such magnitude as to explain the massive change in the fleet. This latter magnitude has to be evaluated subjectively, but a reduction of only 10% would be insufficient to justify continuing tests of a grid.

**PHASE 2:** Studies of survival after escape

The first phase will allow one or two grids to be identified that show promising results; the second phase will verify the survival of the individuals that escape. This phase will begin when the first one ends so specific details are not necessary.

To illustrate the options available for estimating survival in this phase, we can list some of them:

a) Detailed assessment of the condition of the escapes.
b) Tagging of the various types of individuals that escape.
c) Short-term retention of the escapes in floating corrals and
d) Retention of escapes in floating corrals for 1 to 2 weeks to estimate post-escape mortality.

Floating corrals will be built similar to those used for fattening tunas (rings of cylindrical PVC, with netting hanging underneath, and weights on the lower part to maintain its shape). These corrals will be carried on at least one of the vessels of each treatment, and will be set up before the set to receive the escapes. Long-term observations require towing and maintaining the escapes, including feeding, so they will be left for a later stage.

**PHASE 3**: Monitoring of performance

In order to verify the consistency of the results, and study any problems caused by prolonged use of the grids, a monitoring program will be continued with a somewhat lower level of coverage by observers.

A program of interviews with captains of tuna vessels will be initiated in order to obtain their comments and suggestions regarding the use of the equipment.