TUNA RESPONSE TO PURSE SEINE SORTING GRIDS

The behavioral response of captive yellowfin tuna (*Thunnus albacares*) to bycatch reduction devices for commercial purse seine fisheries

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comparing 'color'* & orientation

Fish swam through one of a contrasting pair of grids (3 schools of 6, Fig 1). Escape events were recorded for each position/device. The variables, using PVC pipe grids, were *horizontal*, *vertical*, *black*, and *white*. A Pearson's X^2 (w sim p-value, 2000 reps) was used to compare schools, and exact binomial tests (Ho: p=0.823) with a Bonferroni adjustment for paired comparisons with summed data.

* We could not control for contrast or brightness (much less hue), but hope to focus on these attributes in future experiments.

significant position bias **(no-grid control; Fig 2*a*)**

more fish passed through vertically oriented grids **(see Fig 2*b* & *c*)**

white apparently more effective **(see Fig 2*b* & *c*)**

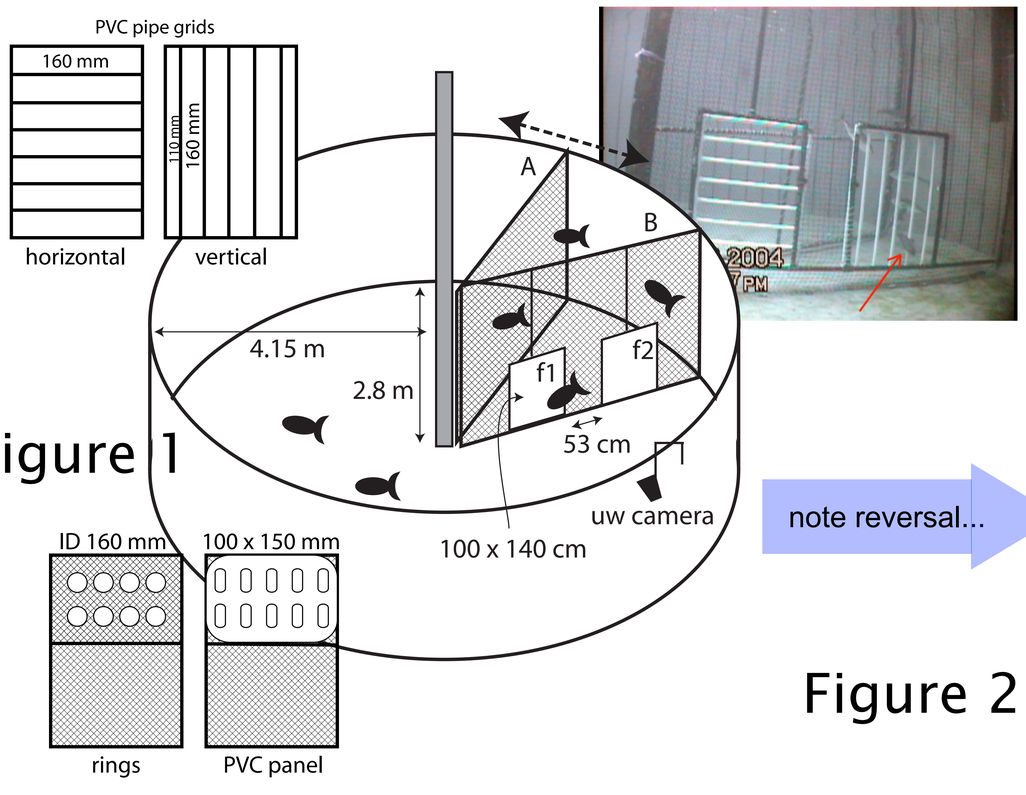

Figure 1

note reversal...

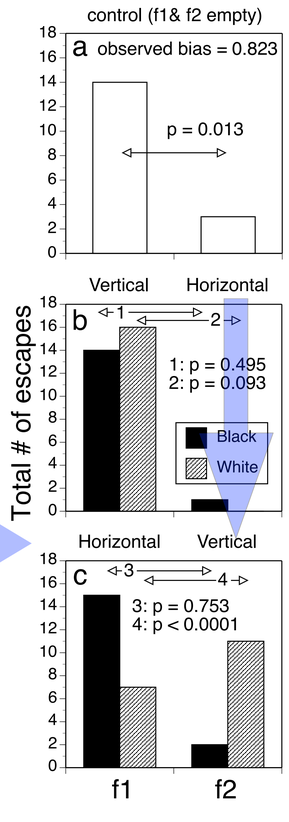

Figure 2

synopsis

More than 50% of world tuna catches come from purse seine sets on floating objects. These sets result in high rates of juvenile mortality and threaten Pacific stocks of bigeye (*Thunnus obesus*) & yellowfin (*T. albacares*) tuna. Sorting grids, designed to release small fish and retain larger ones, may offer a means of reducing this source of mortality. Our experiments are an initial attempt to identify critical design characteristics and compare existing grid designs.

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comparing rings & a clear panel

Fish (school of 4, 2 trials) swam through either of a pair of grid designs, an array of rigid rings and a clear, semi-flexible PVC panel w oval holes (Fig 1). Escape events were recorded for each position / device. Exact binomial test (summed data, Ho: p=0.823) of hypothesis (Fig 3).

more fish passed through the PVC panel **(Fig 3)**

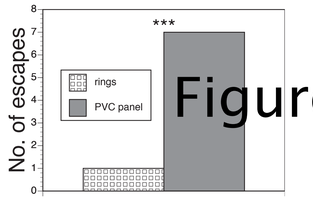
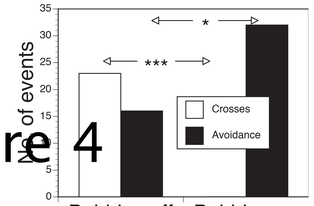


Figure 3

Figure 4



testing a bubble curtain

Bubble barriers offer a potential means of controlling fish movements within a seine. We observed a school of 9 yellowfin for two 10 minute periods, the first without and the second with a bubble curtain in operation along the radius of the tank*. We counted the number of times fish crossed that radius and the number of avoidance reactions† while bubbles were on and off. We used exact binomial tests (Ho: p=0.5) of hypotheses (Fig 4).

* A sand-filled porous canvas hose (D 17 mm) was placed on the tank bottom, from the edge to its center; pressurized with air, the hose emitted a wall of bubbles through which the fish would not pass. † e.g. when a fish approached within 1 m of the hose, on or off, and altered its heading abruptly (> 30 degrees)

no fish passed through the active bubble curtain

avoidance reactions more frequent with bubbles on **(Fig 4)**

conclusions

Orientation and visual aspects are important characteristics in the design of sorting grids for yellowfin tuna. We attribute the strong effect of position to the crowding associated with maneuvers in the narrow portion of the cage, near f1. The clear PVC panels warrant field trials and the potential utility of a bubble curtain as a means of controlling fish movement within a purse seine deserves further investigation.

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