Methods for model

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Using the observed catch (Kg) data for Guanacaste between 1990 and 2013, and the observed CPUE (Kg/trip) data for Coyote and Bejuco between 2007 and 2013, we used a logistic model to predict biomass (B) of the whole stock for each year (1990 - 2013). Taking initial biomass as

and having biomass defined as

where K is the carrying capacity of the population, r is the intrinsic rate of our population (Coyote/Bejuco fishery), B is the total biomass of the region, and C is the total catch of the region. From here on, the analysis was done having two groups: certified communities (Coyote and Bejuco) and uncertified communities.

Based on the predicted biomass, we predicted catch, taking into consideration the interaction of the two groups, defined by ,

Total catch of both groups (Ct) was calculated as,

where q is the catchability coefficient, the fraction of the population fished per unit of effort, and Et is the effot (kg/trip) of the certified and uncertified communities. is the biological mixing parameter, which reflects the velocity at which returns to effort take effect. When = 1, there is perfect mixing between uncertified and certified communities, thus the decrease in effort in one community will be compensated by the increase in effort in others. Once we included the interaction of groups, catches are divided into, certified catches (Cc) and uncertified catches (Cu)

In order to assess the fit of our model, we will compare observed CPUE with model predicted CPUE between 2007 and 2013 through

where -lnN is the Negative Log Likelihood (NLL).

When we minimize NLL, we can also omit the constant term

and since our uncertainty is fixed we can also omit the term

therefore,

## Profits

profits where calculated separately for the certified communities (c) and profits of the uncertified communities (u)

where p is the ex-vessel price. This dataset of ex-vessel snapper prices, was recorded by INCOPESCA from 1990 until 2013. We used it to see changes through time, and we corrected for inflation using the consumer price index (CPI) reported by the World Bank.

Costs (c) were calculated as

When

then,

Effort of certified communities (Ec) will be fixed into the future due to restrictions caused by the certification. Effort of uncertified communities (Eu) will respond to catches and profits. The fishery is an open access fishery, therefore, the effort of uncertified communities will only respondo to profits.