

Transversal workshop on the monitoring recreational
fisheries in the GFCM area
Mallorca 2010



INSTITUT MEDITERRANÍ D'ESTUDIS AVANÇATS

A new approach to estimate fishing mortality based in the angler behaviour and catchability



J. Alós, M. Cabanellas-Reboredo & M. Palmer

Mediterranean Institute for Advanced Studies (CSIC-UIB)
C/ Miquel Marqués 21, 07190, Esporles, Illes Balears, Spain

imedea.uib-csic.es

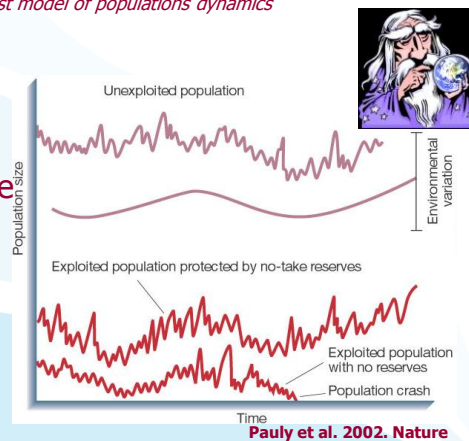
Populations dynamics (PD) in Fisheries

$$S_{i+1} = S_i + (A + G) - (F + M)$$

*S = Stock Biomass
A = Recruitment
G = Growth
F = Fishing mortality
M = Natural mortality
I = Time

Perhaps the simplest model of populations dynamics

- PD ↔ Important to determine the impact of the recreational fishery and to do simulations and predictions of different management scenarios (e.g. MPAs or MLS)
- **F** is key term



Fishing mortality (F)

- The term "fishing mortality" (usually shortened to F) is a technical fishery science term that is often misunderstood. It refers to the rate at which animals are removed from the stock by fishing.
- In the **Commercial fishery**, the F refers primarily to biomass that are landed



Fishing mortality (F)

- In the **recreational fisheries** there are not any data base (in general, i.e., in USA the National Marine Fisheries Service online dataset_ analysed in Coleman et al. 2004_Science)
- Estimations of fishing mortality are conducted trough creel survey, interviews, log books and tournaments (introducing different kind of bias sources)
- Thus, other new approaches to estimate F In recreational fisheries are welcome!!!



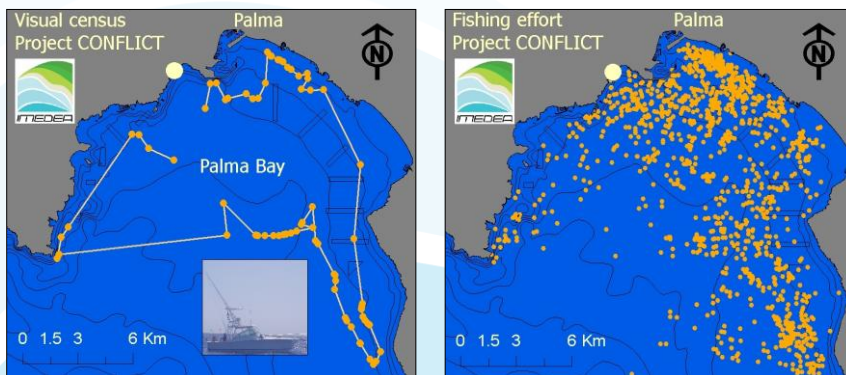
New model-based approach to estimate F

- A new approach based in a probabilistic modelling and focused in the events that occur at individual level, both for angler and fish
- 2-fold based in 1) estimate fishing effort including an accurate spatial effort modelling and a characterisation of the angler behaviour and fish movement, and 2) a model of catchability (cpue) based in the size-selectivity properties of the fishery and the typology of the angler
- The case: A model developed to our recreational fishery
- A key tool in a population dynamic model to simulate management scenarios



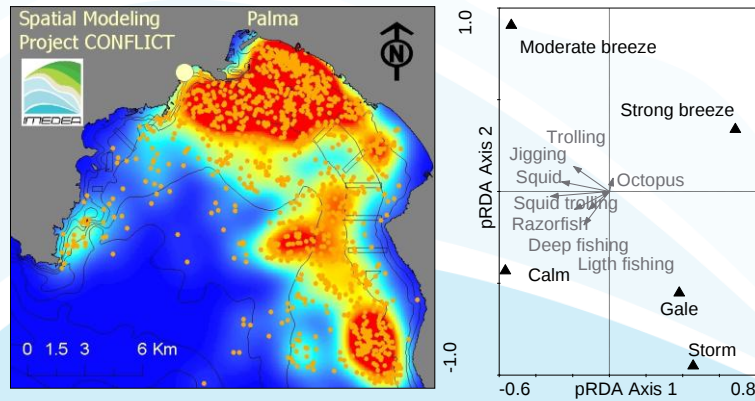
Fishing effort

- Estimate fishing effort through field work and objective data (visual census done by own boats). Hierarchical design
- Data sampled (accurate information): 1) regarding anglers: **XY** Position (so Spatial- explicit), Number of anglers/gears, boat type, boat length and fishing method and 2) regarding environmental variables (whether condition, season, depth, fish abundance etc...)



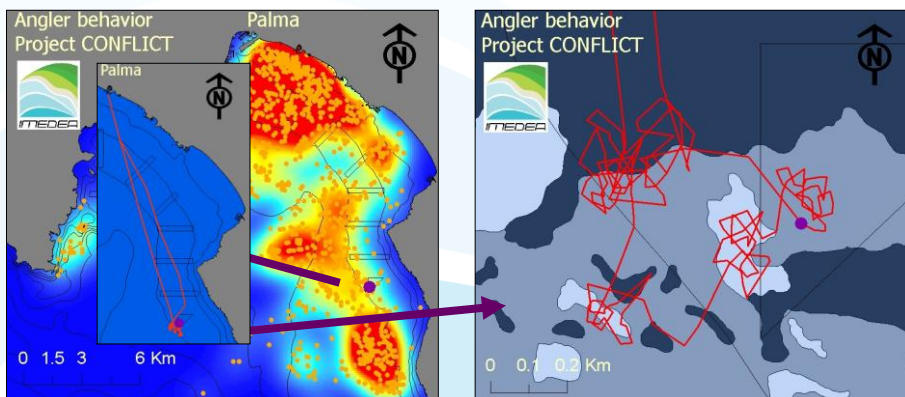
Spatial Fishing effort modeling

- We can model the effort (regarding environmental variables) and then we can simulate what was the effort during an specific year
- We are able to do spatial-specific predictive maps that allow us to know hoe many anglers are fishing in an specific year
- Modelling used the information obtained from the visual census and modelled through spatial-specific models accounting with spatial and temporal autocorrelation



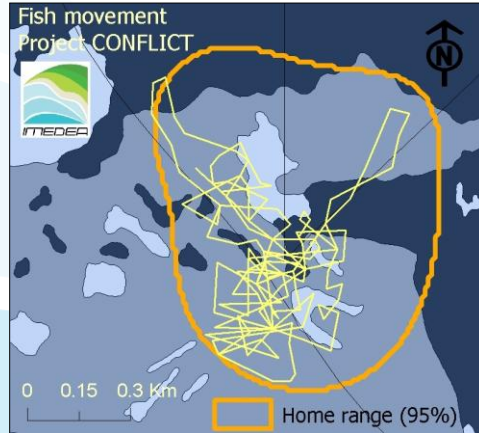
Angler behavior

- **The data obtained from the Predictive effort maps is "static"**
- **Angler individual movement and Behavior**
- **Data from tracking-anglers program (GPS and video cameras)**
- **Simulation of movement through State-space models (probabilistic models)**



Fish movement and behavior

- At the same way, fish movement and behavior can also modeled through probabilistic simulation in State spatial model
- Data from conventional mark and recapture studies and acoustic tagging

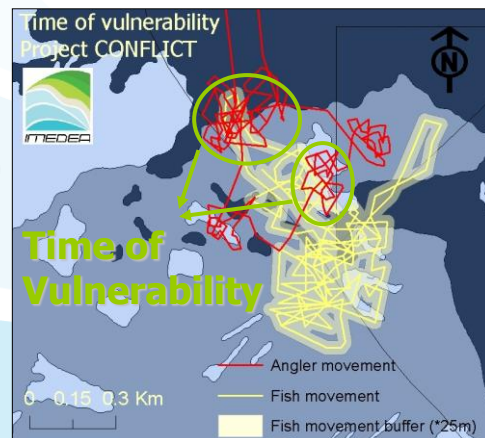


Time of vulnerability

- Angler individual movement and Behaviour
- Data from conventional mark and recapture studies and acoustic tagging

Time of vulnerability

...is related to the probability of encounter of the fishing gear and fish...



Catchability

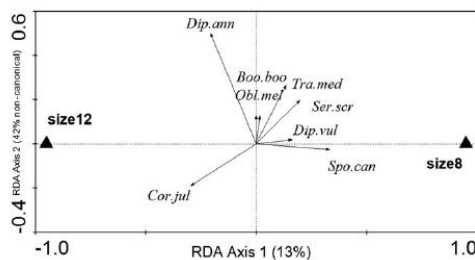
...if fish is available, catchability (cpue) will depend on fishing gear and angler efficiency and the selection probability...

- Catchability is a concept in fishery science which reflects the **efficiency** of a particular fishery
- Its quantitative magnitude is expressed by the **catchability coefficient**, which relates the biomass abundance to the capture or fishing mortality
- Experimental angling sessions to test fishing gear and angler efficiency

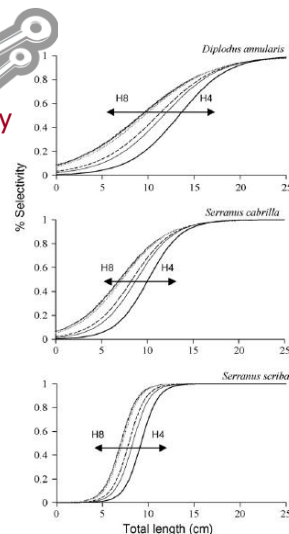


Hook-size selectivity and catchability

- Many selectivity studies on recreational fisheries report better catch rates for small hooks than for large hooks
- And, Size selectivity by larger hooks was clearly demonstrated for some fisheries
- .. Clearly demonstrated in our fishery through experimental angling sessions (Cerdà et al 2010, Alós et al 2008_ICES JMS, 2009_Fisheries Research)



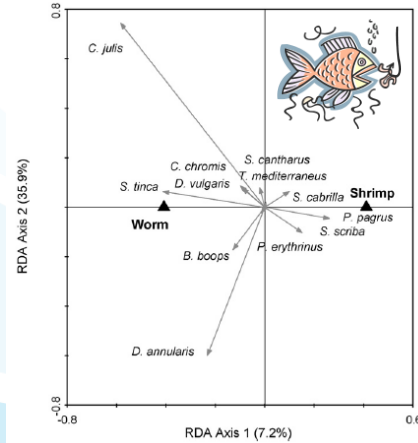
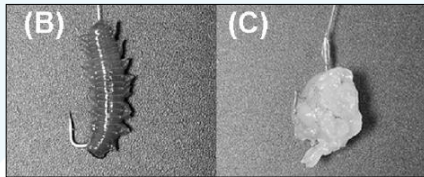
Alós et al. 2008_ICES JMS



Cerdà et al. 2010_Fisheries Research

Bait and catchability

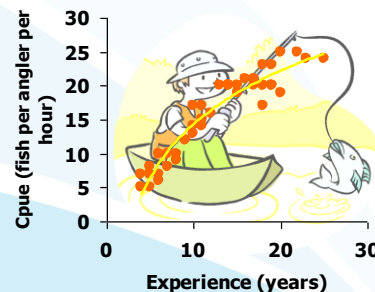
- The type of bait is also an other variable important that affects the probability to be caught
- We found that type of natural bait influenced catch rates, size of fish captured, the fish species composition of the catch as well as hooking location in our marine recreational fishery (Alós et al 2009)



Alós et al. 2009_Fisheries Research

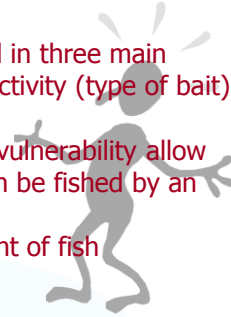
Type of angler and catchability

- The type of angler (regarding social and economics aspects) is a key topic in a model of catch ability in recreational fisheries (e.g. experience is important to catch more or less fish)
- This is our actual research line and methods include 1) multivariate analysis to characterize different kind of anglers (social and economics surveys Project CONFLICT) and 2) experimental angling to estimate cpue of each group



Model of catchability

- We are able to estimate a probabilistic CPUE based in three main characteristics size-selectivity (hook size), bait selectivity (type of bait) and angler type
- This probabilistic CPUE combined with the time of vulnerability allow us to estimate the probability of an specific fish can be fished by an specific angler
- Of course, the model of cpue is indirectly dependent of fish abundance



An examples: Time of vulnerability of an specific fish fish during one fishing trip is **30 min.**

1. An experienced angler using efficient gear (small hooks) has a mean cpue of **4 fish per angler per hour**
2. An inexperienced angler using inefficient gear (large hooks) has a mean cpue of **1 fish per angler per hour**

The experienced angler has a 200% of probability to catch the specific fish and the inexperienced 50% of probability

Thank you

Pep.alos@uib.es



CSIC



IMEDEA
Miquel Marqués, 21
07190 Esporles, Mallorca
Illes Balears, ESPANYA
Tel.: +34 971 61 17 16
Fax.: +34 971 61 17 61

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imedeaiuib-csic.es