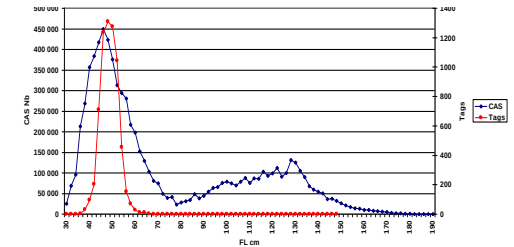
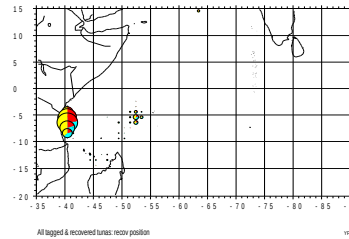
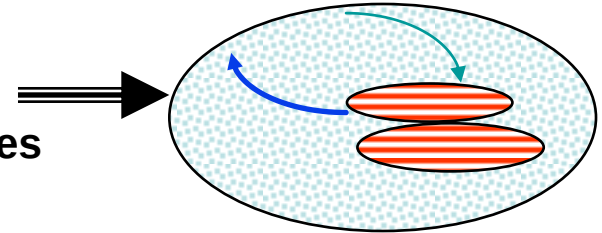


Tagging & movement: the ultimate goal is to estimate at least ½ quantitatively, the movement flow of tunas in the entire Indian Ocean, and during the entire lives of tunas

Tagging done in a very limited area and only on small tunas,

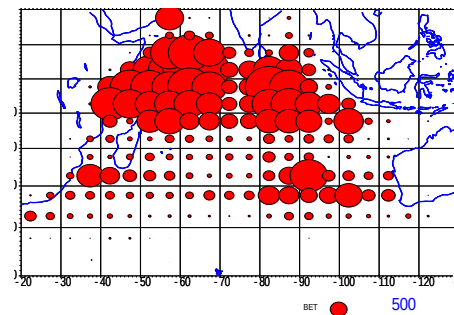


**Typical movement patterns
Expected for BET and YFT:
Between equatorial nurseries
and temperate feeding
grounds**



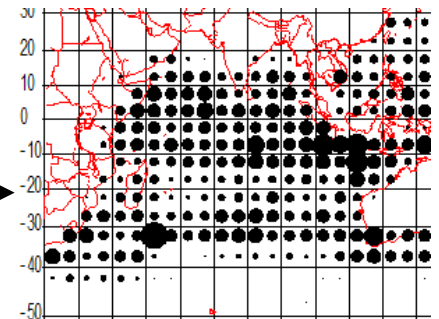
***But movement patterns
must be estimated during
the entire fish lives (>10
years for bigeye?) and in
their entire habitat***

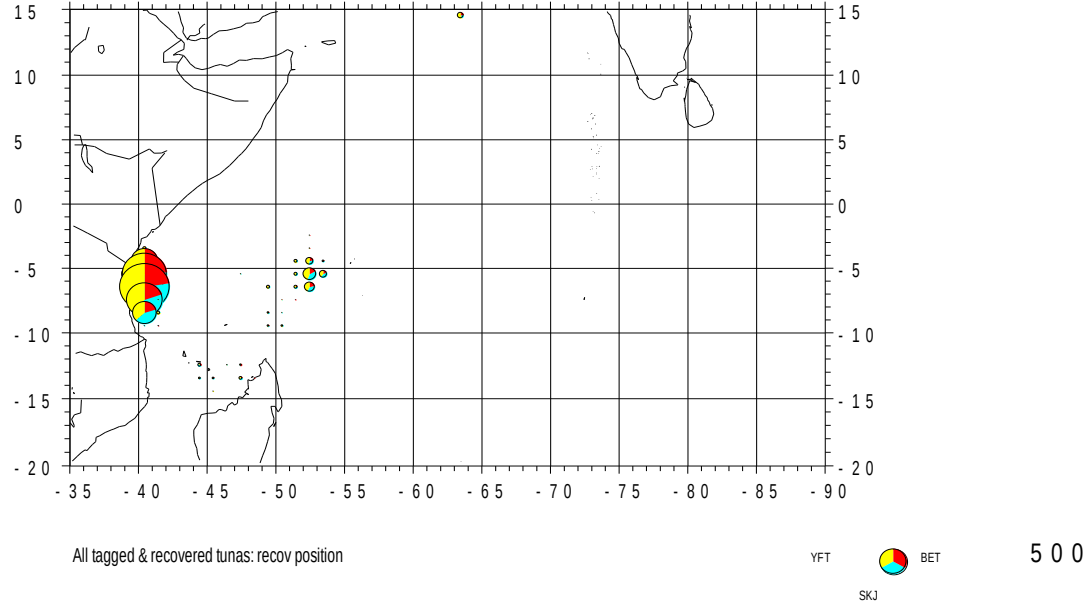
**Bigeye IO
distribution
of adults shown
by BET catches
or CPUE /
longliners**



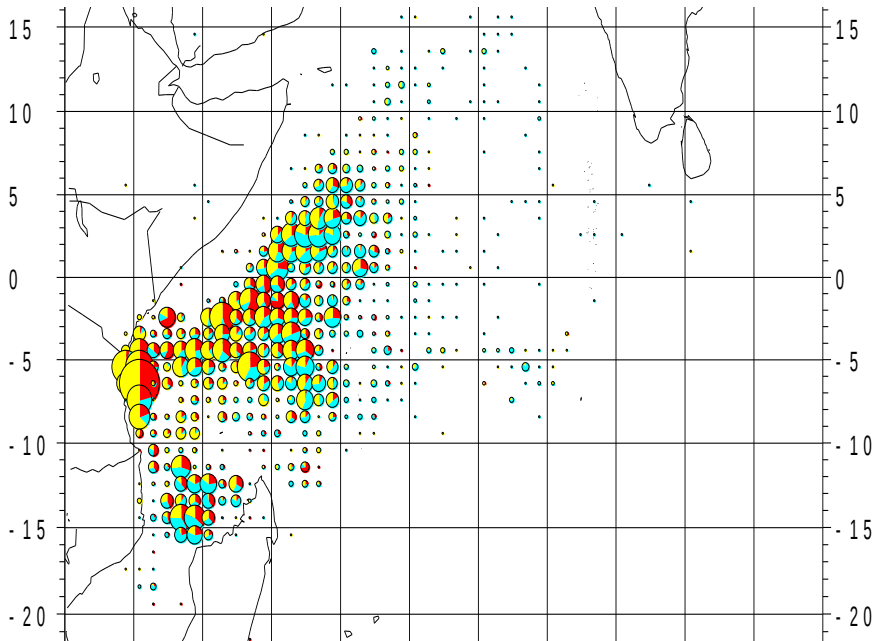
Catches

Max CPUE

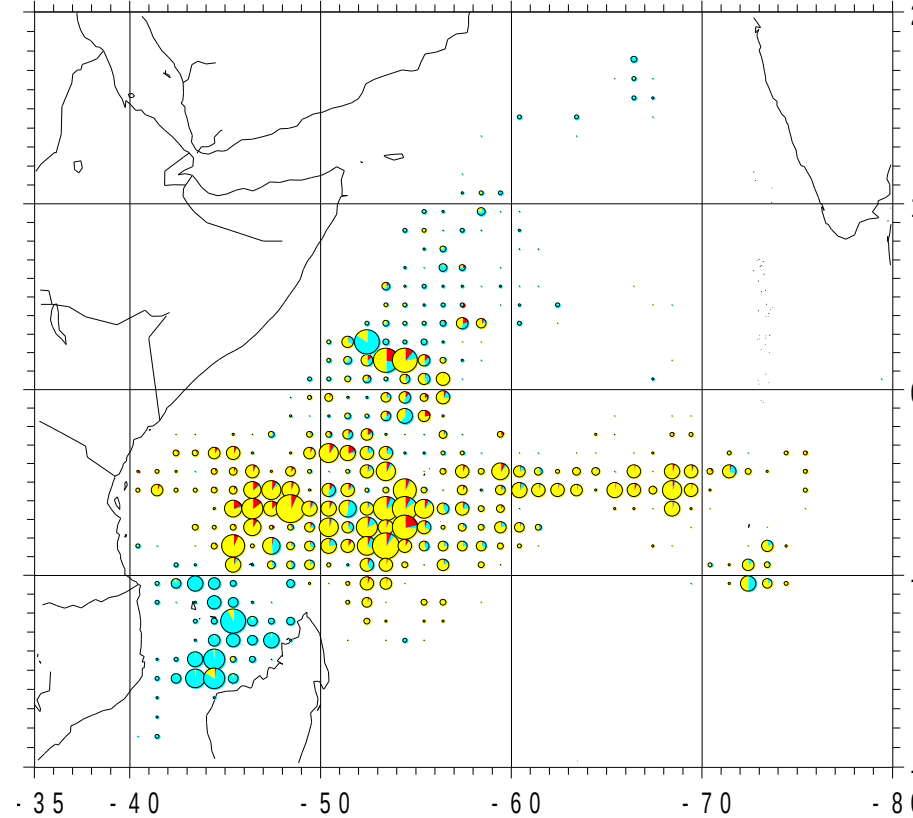
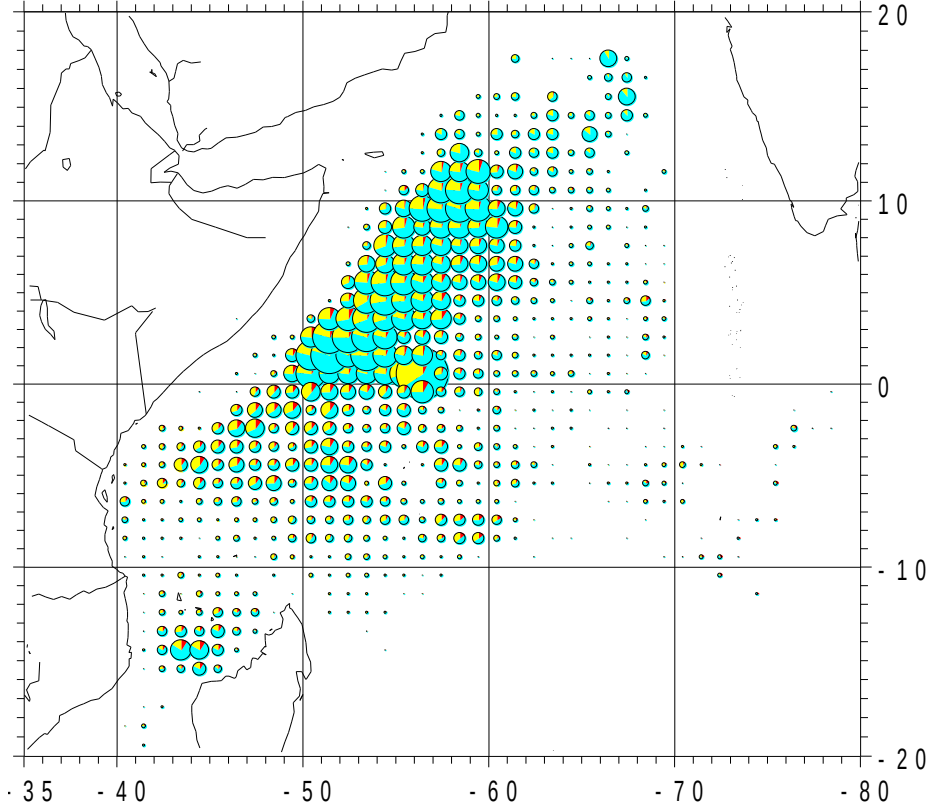




tagging location of tunas by species, tagged during the IOTTP, and later recovered (a map probably simipar to the map of released tags?)



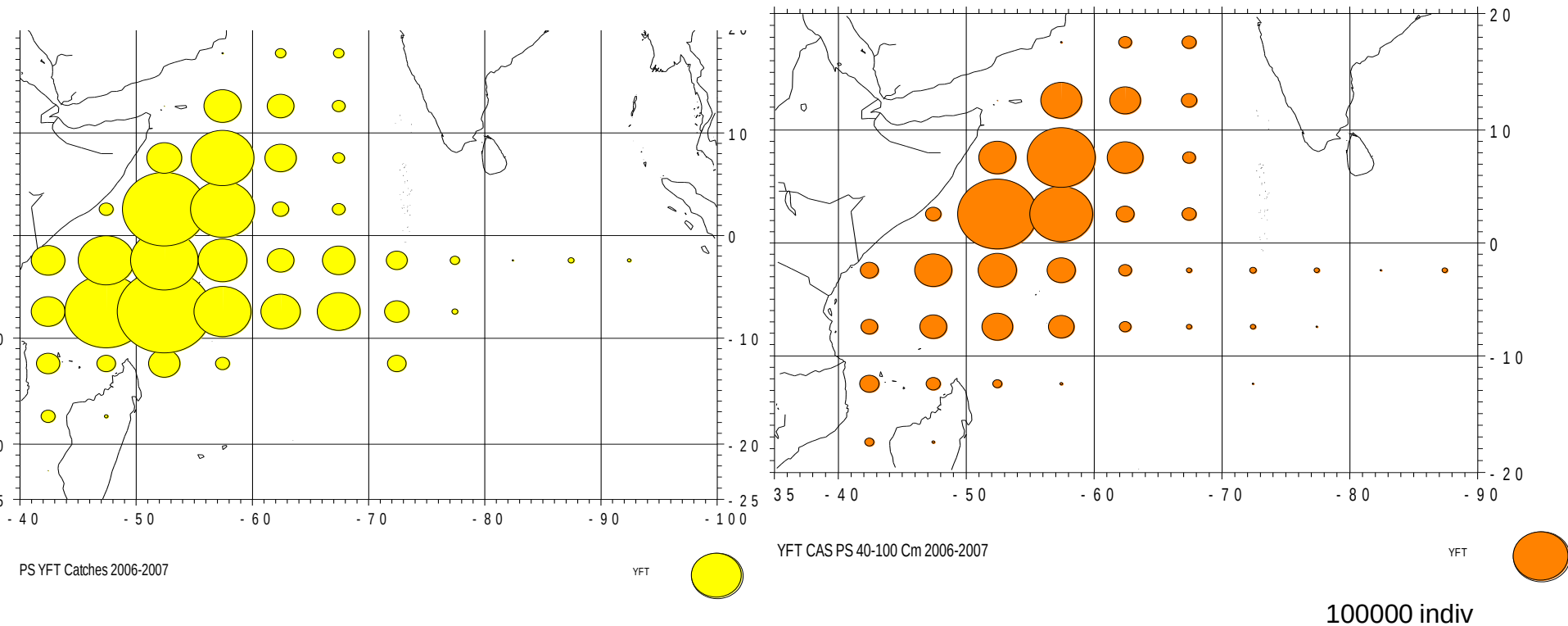
reporting locations of tunas by species, tagged during the IOTTP



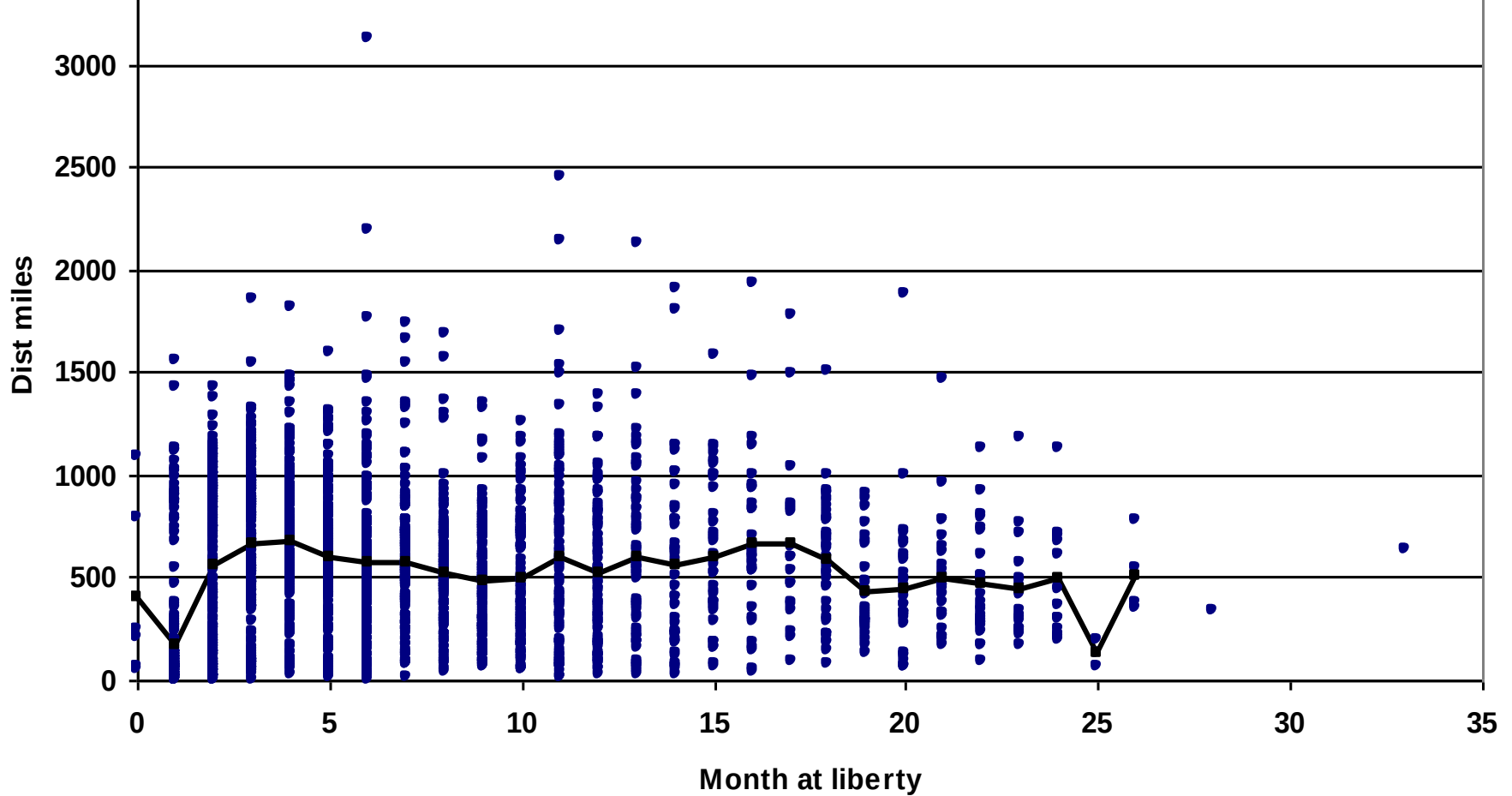
YFT BET
SKJ

The legend indicates the color coding for the fish species: yellow for Yellowfin (YFT), cyan for Skipjack (SKJ), and red for Bigeye (BET). The circles in the maps are colored according to the species caught, with some circles being multi-colored to represent mixed catches.

average catches of yellowfin, skipjack and bigeye taken by purse seiners during the average period 2006-2007, on FAD (left) and on free schools (right)

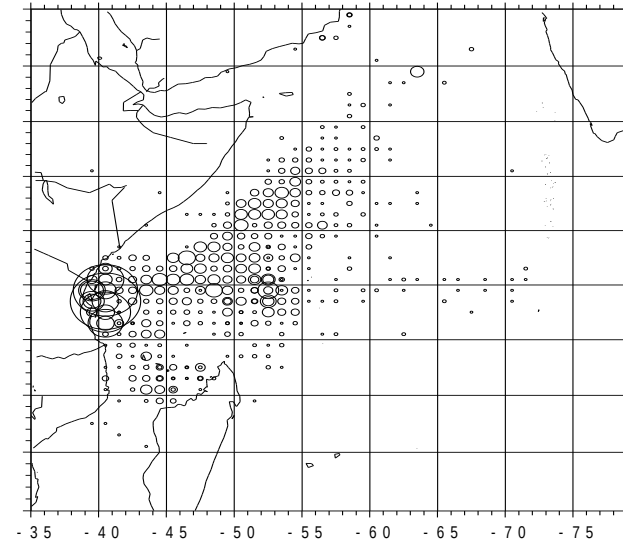
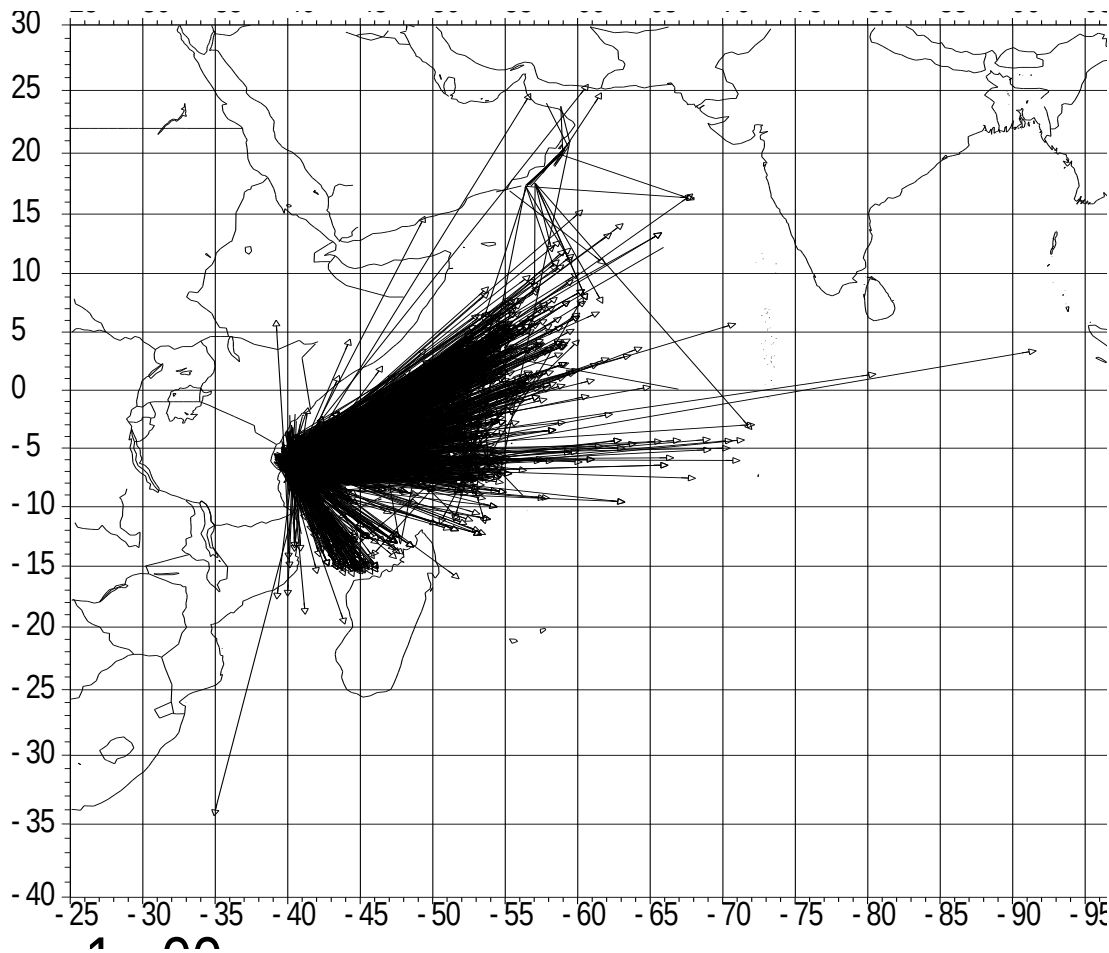


average catches of yellowfin by purse seiners during the average period 2006-2007: figure 4a left, total catches, and figure 4 b, right, catch in numbers of juvenile yellowfin smaller than 1 meter (widely dominant in the recovered yellowfin).



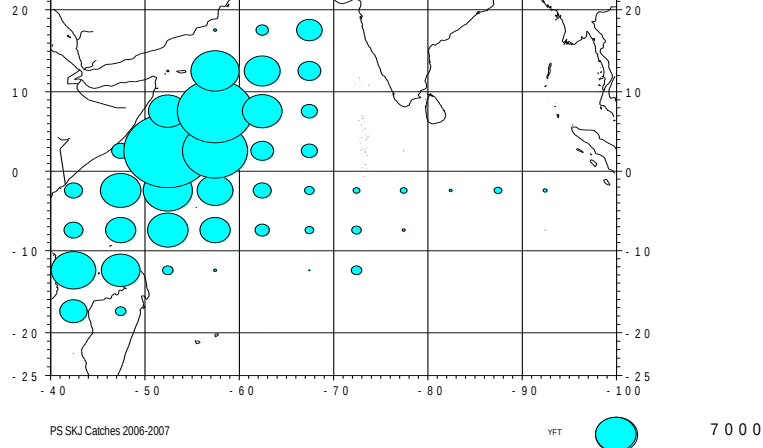
Linear distances estimated between tagging and recovery positions for all yellowfin recovered at a know position (average 526 miles)

100

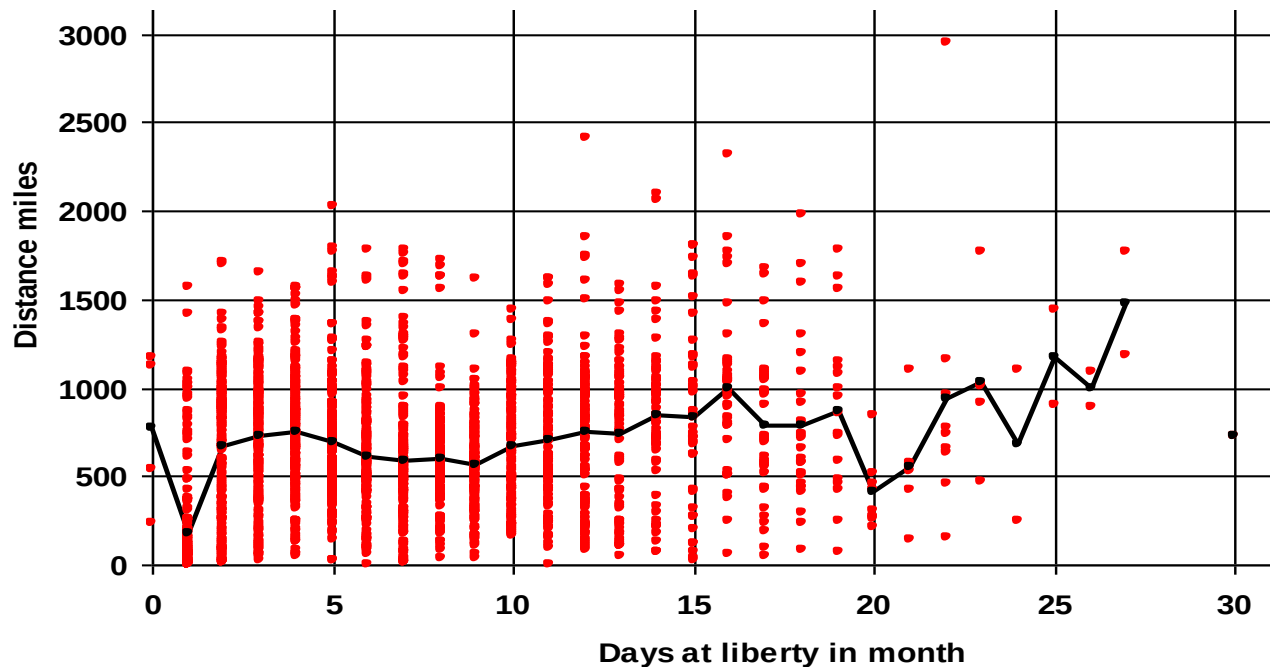


All YFT tagged & recovered tunas: recov position

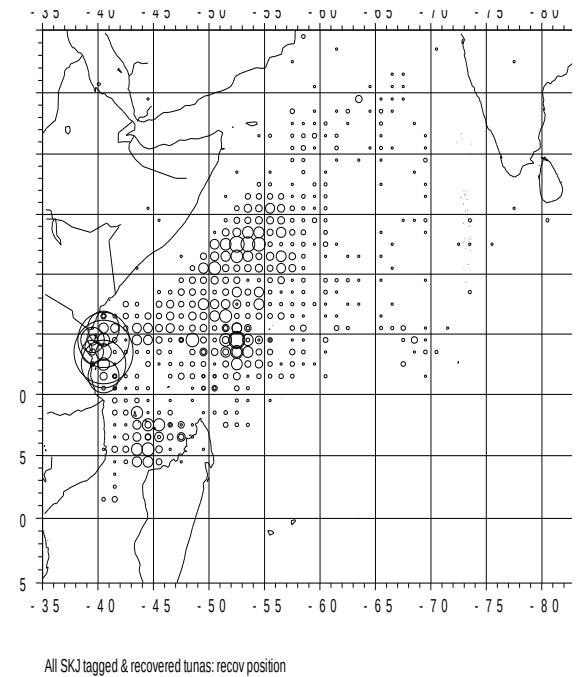
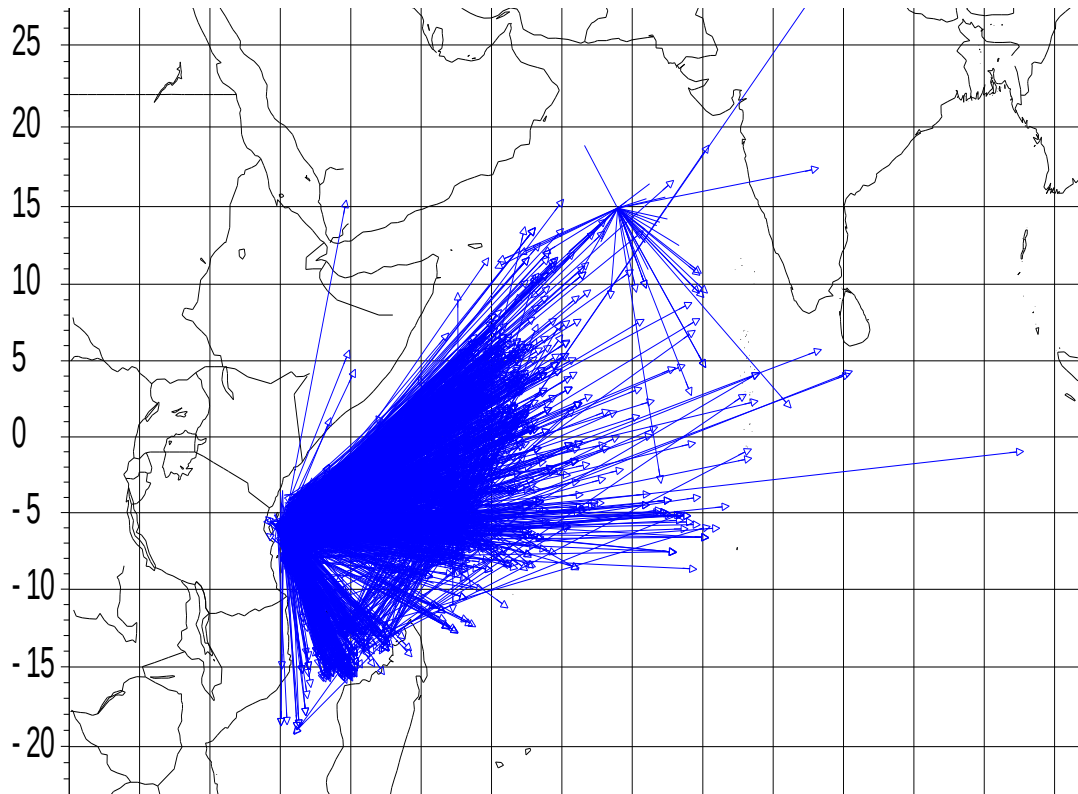
yellowfin recoveries the linear trajectories between tagging and recovery positions and map of the yellowfin recovery locations..



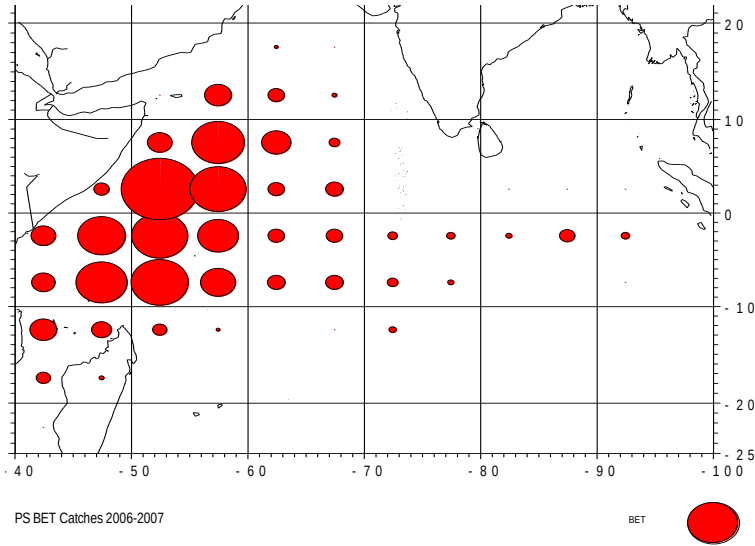
Average catches of skipjack by purse seiners during the average period 2006-2007



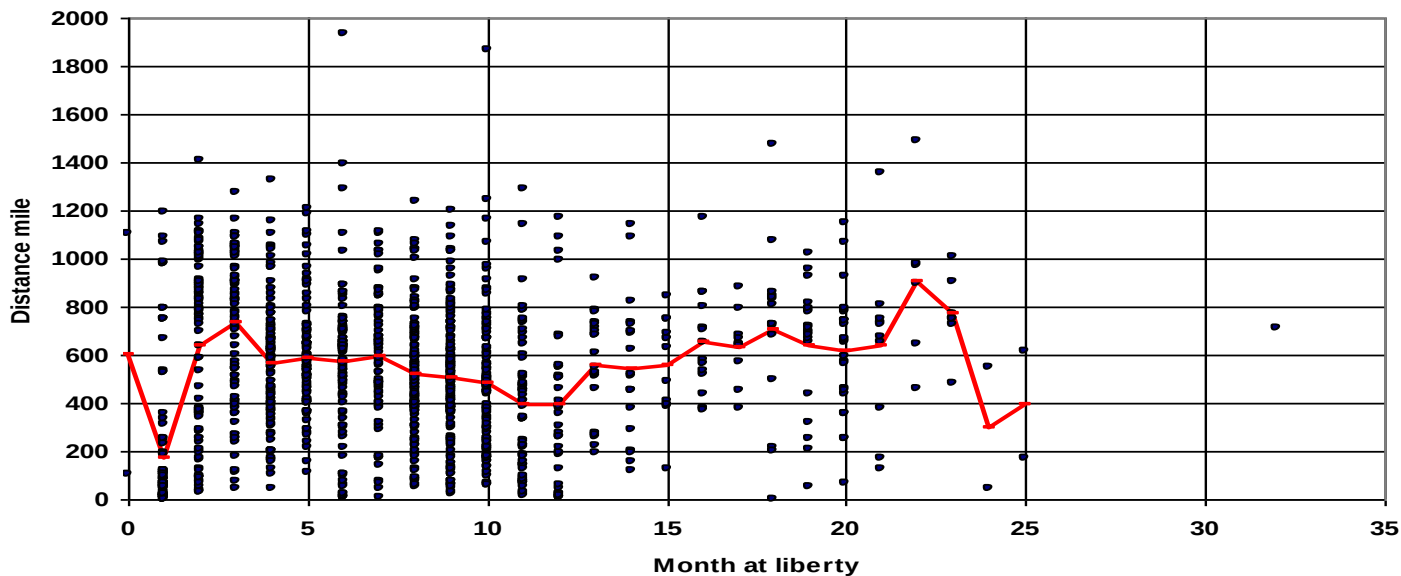
Linear distances estimated between tagging and recovery positions for all skipjack recovered at a known position (average 642 miles)



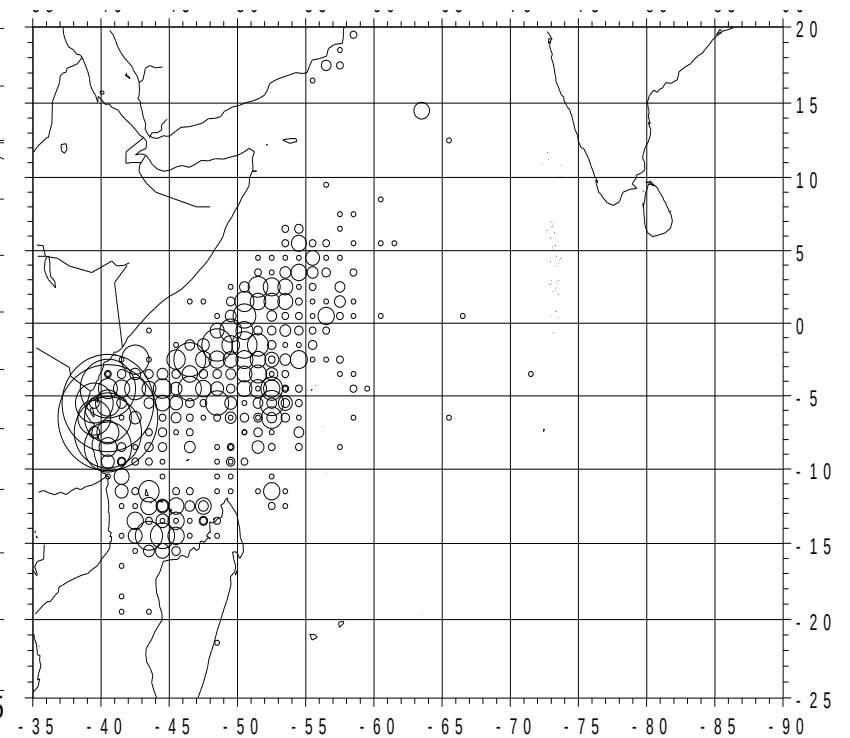
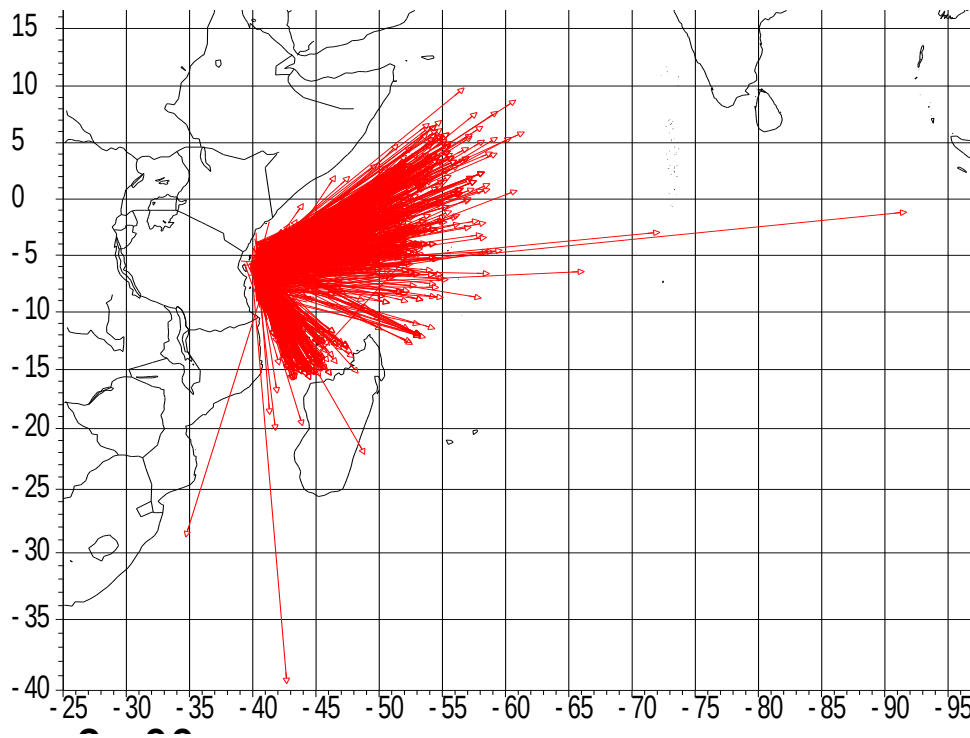
Spikjack recovers the linear trajectories between tagging and recovery positions.



Average catches of bigeye by purse seiners during the average period 2006-2007



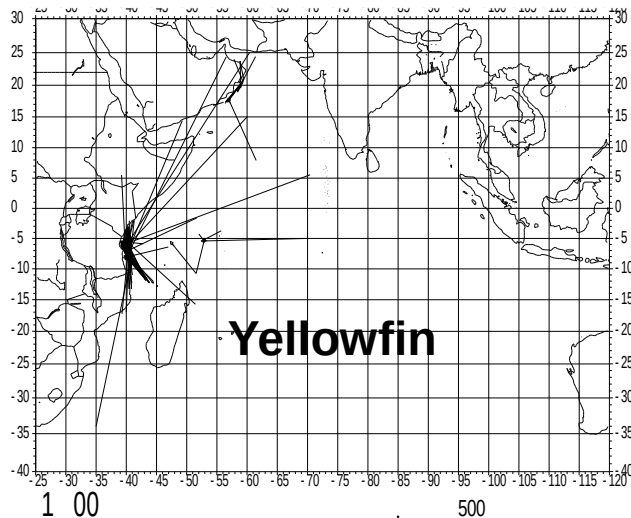
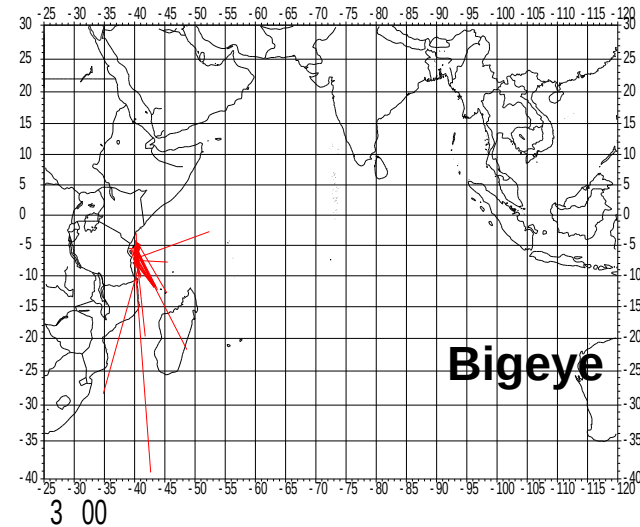
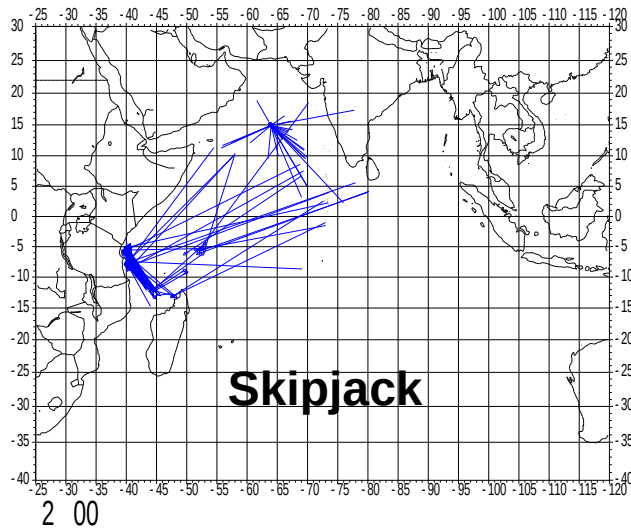
Linear distances estimated between tagging and recovery positions for all bigeye recovered at a known position (average 525 miles)



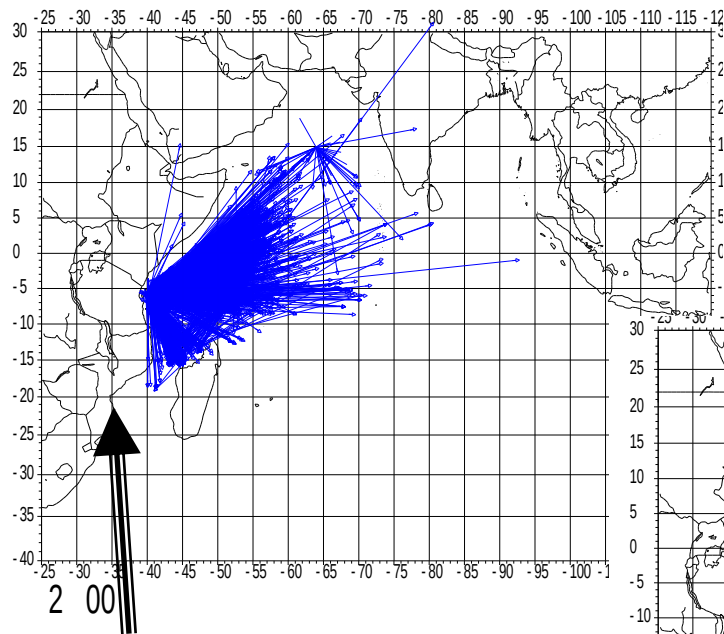
All BET tagged & recovered tunas: recov position

Bigeye recovers the linear trajectories between tagging and recovery positions and map of the bigeye recovery locations.

Recoveries by other gears: longline, P&L, hand line, gillnet...

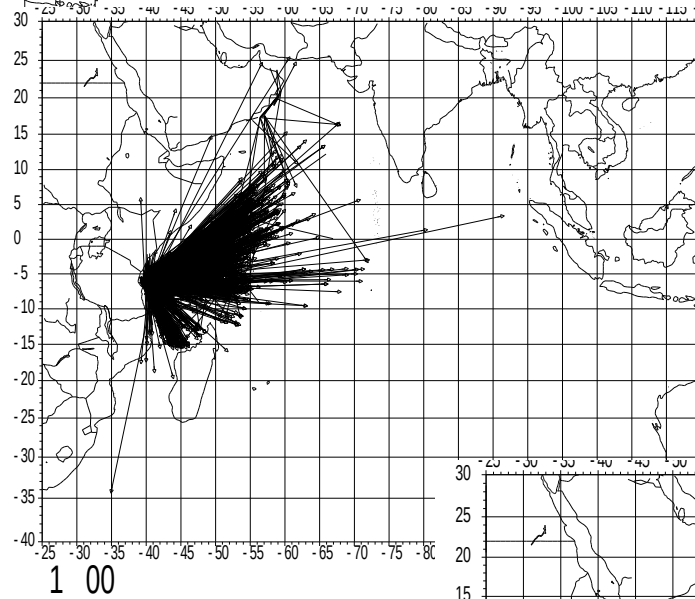


A wider scope of movements,
especially for yellowfin and skipack

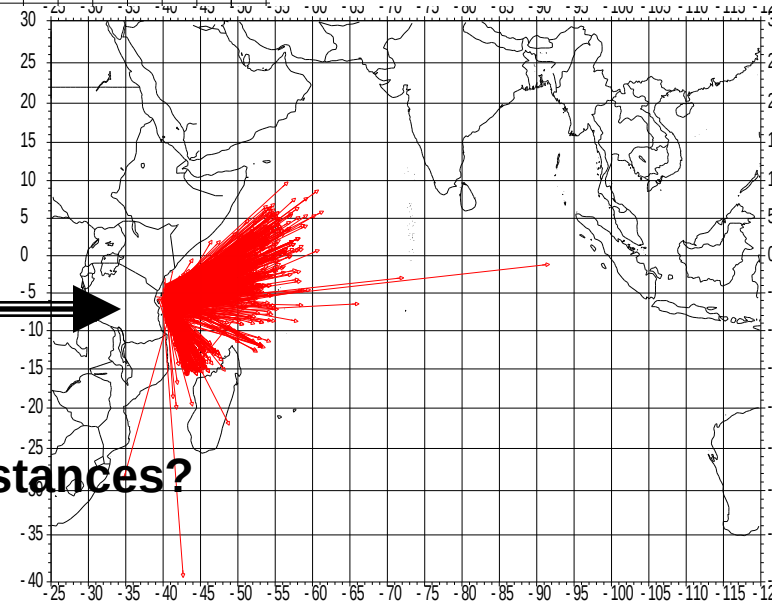


Skipjack

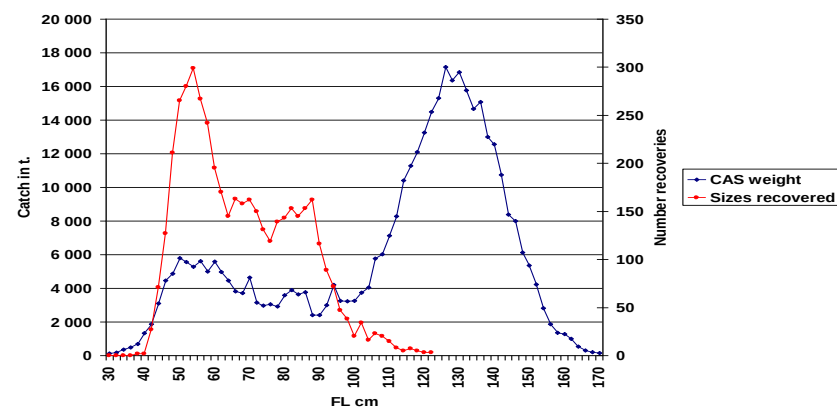
Yellowfin



Bigeye



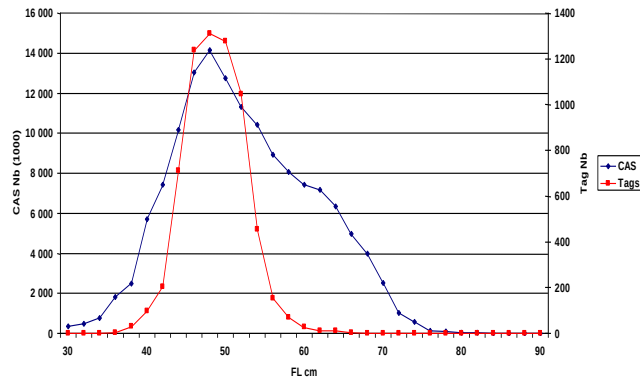
A between species gradient of declining distances?



Yellowfin

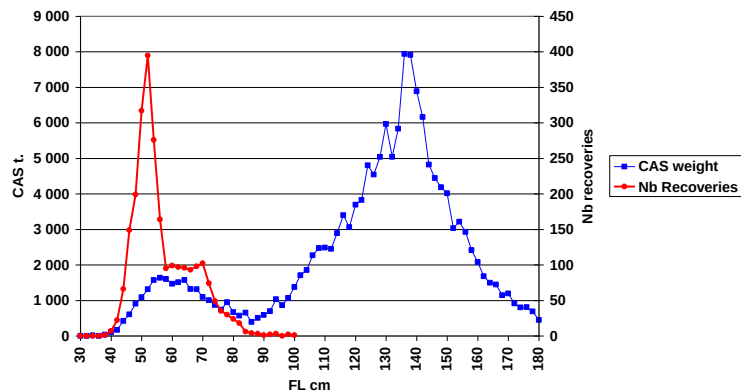
= Blue curve show the average recent catch at size i.e. the importance of each size in each fishery.

= The red curve shows the tagged/recovered sizes that are presently used in the analysis



Skipjack

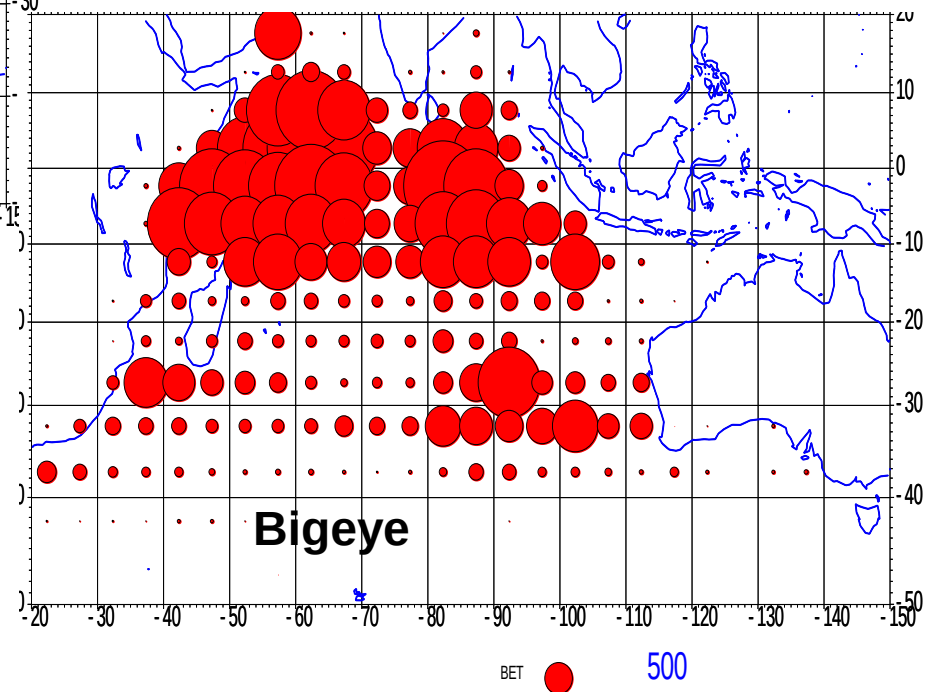
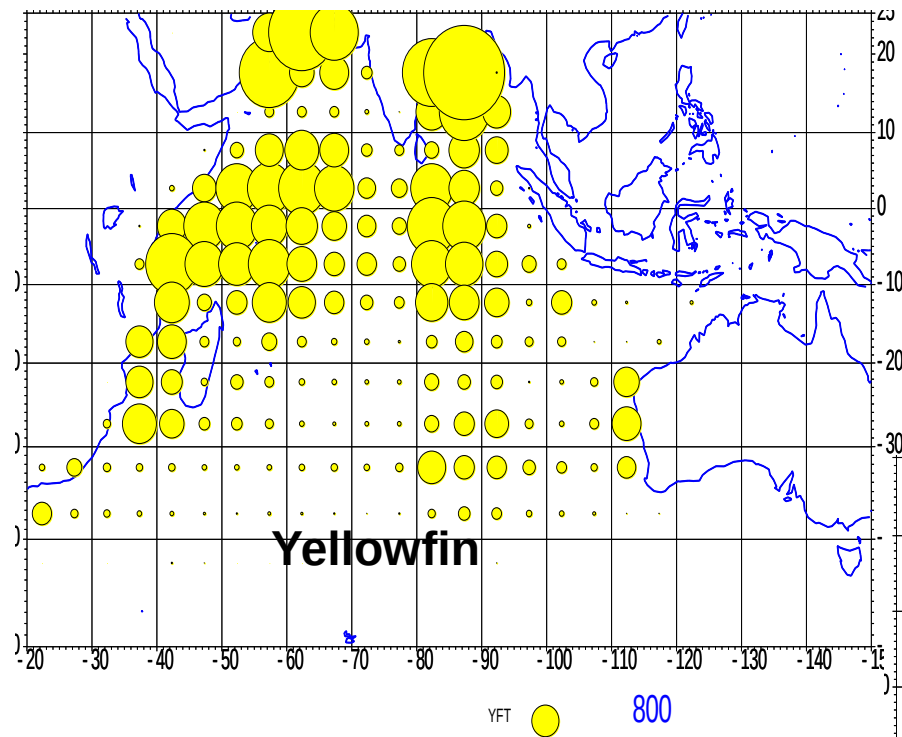
= the present recoveries of adult YFT and BET, the dominant groups in these 2 fisheries, are still too weak to be very informative



Bigeye

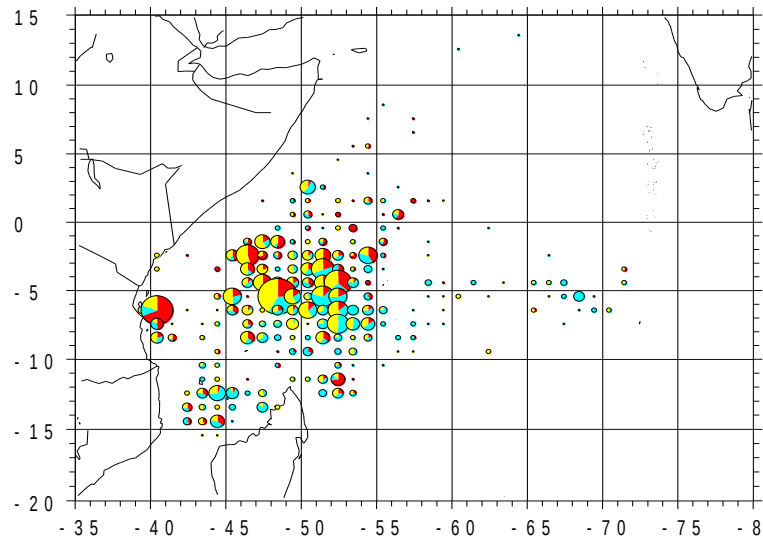
= If recovery rates by longliners is improved and OK, this information should soon be obtained by the logical recovery of adults

Average catch at size (in numbers of fishes) of yellowfin, skipjack and bigeye and numbers at sizes of the recovered tags for each species (average sizes tagging/recov)

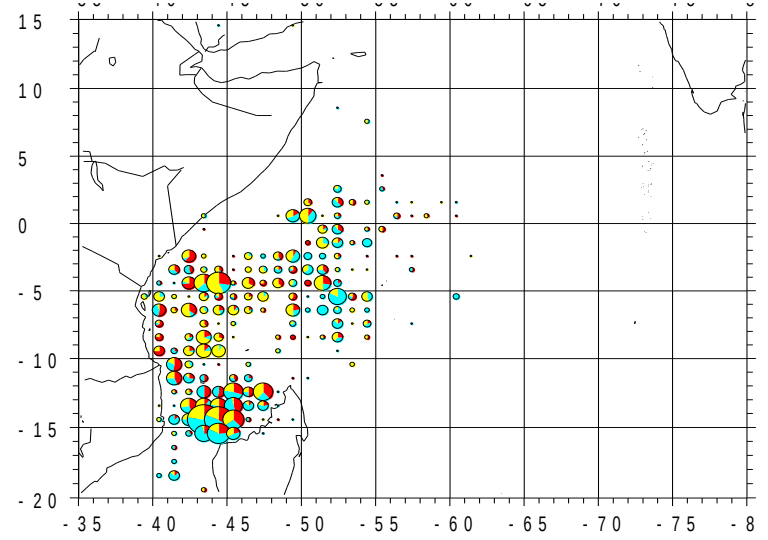


Average catches of yellowfin and of bigeye taken by longliners during the 2001-2005 period (note that these 2 fishing zones of adult tunas are much wider than the area with recoveries)

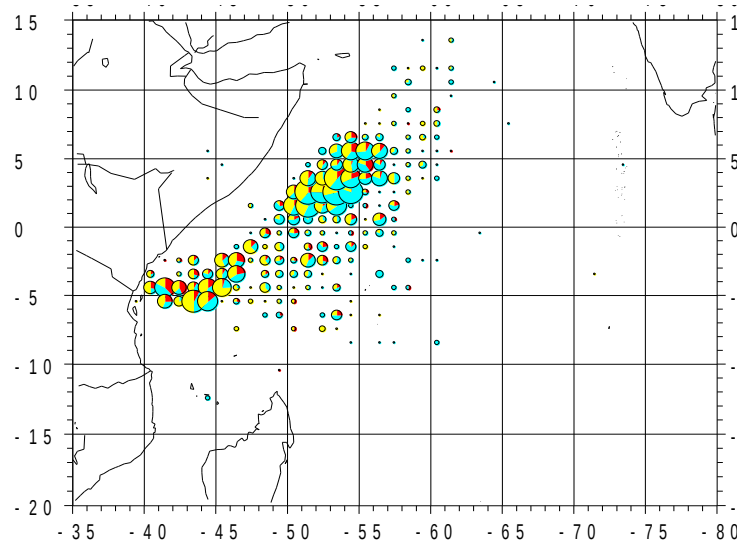
UNless we can get a good reporting rate by longliners, the relationship between tagged fishes in the Western IO and the IO population will remain questionable?



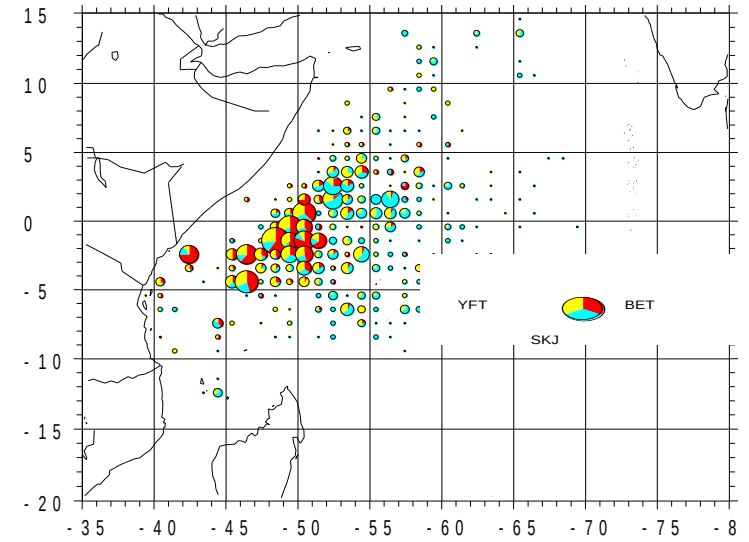
1st quarter



2nd quarter

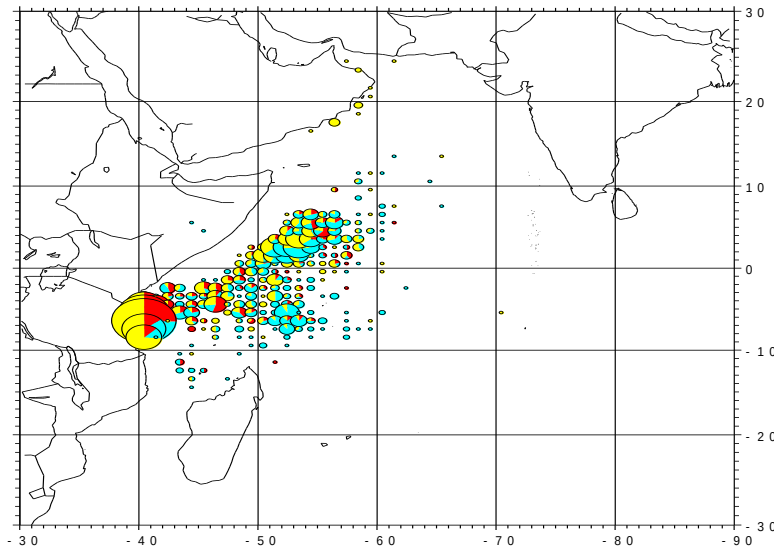


3rd quarter



4th quarter

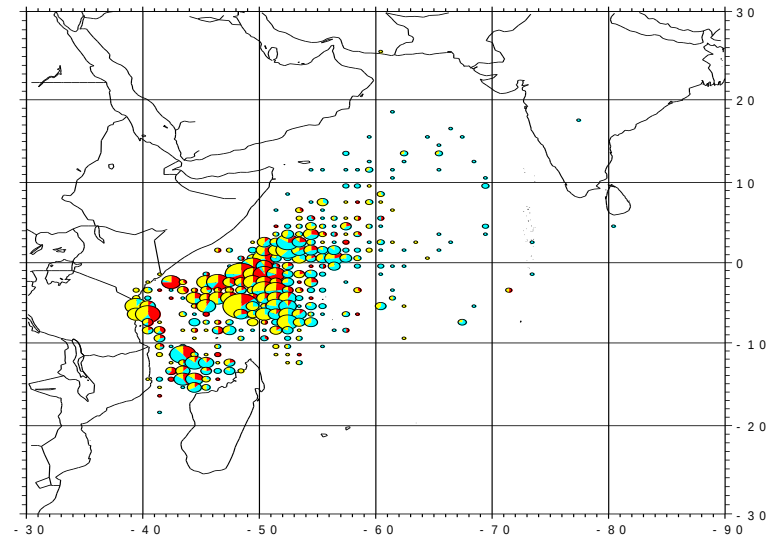
Quarterly geographical distribution of the observed recoveries, by species, during the period 4th quarter 2005-1st quarter 2008.



Nb Recov <3 months

<3 month

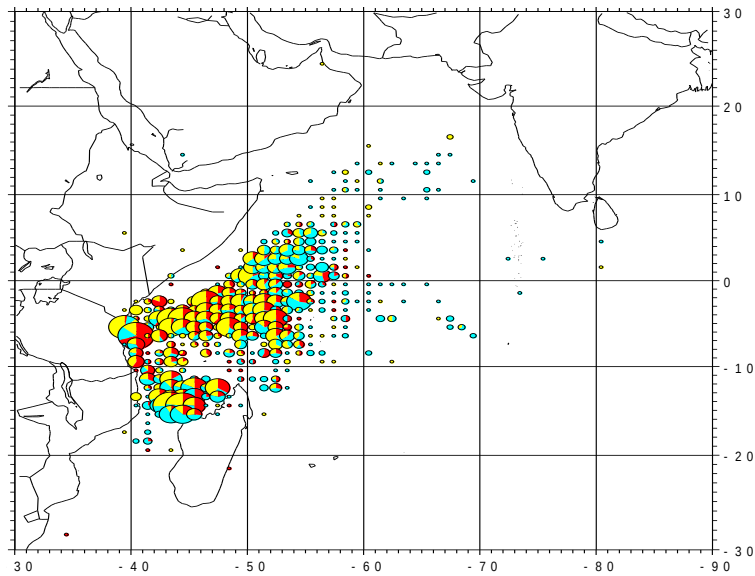
YFT BET SKJ



Nb Recov 3-6 months

3-6 months

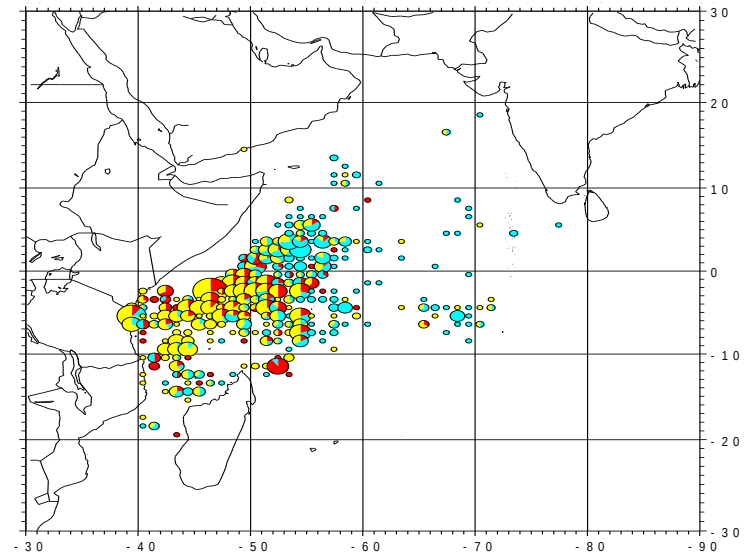
YFT BET SKJ



Nb Recov 6-12 months

6-12 months

YFT BET SKJ

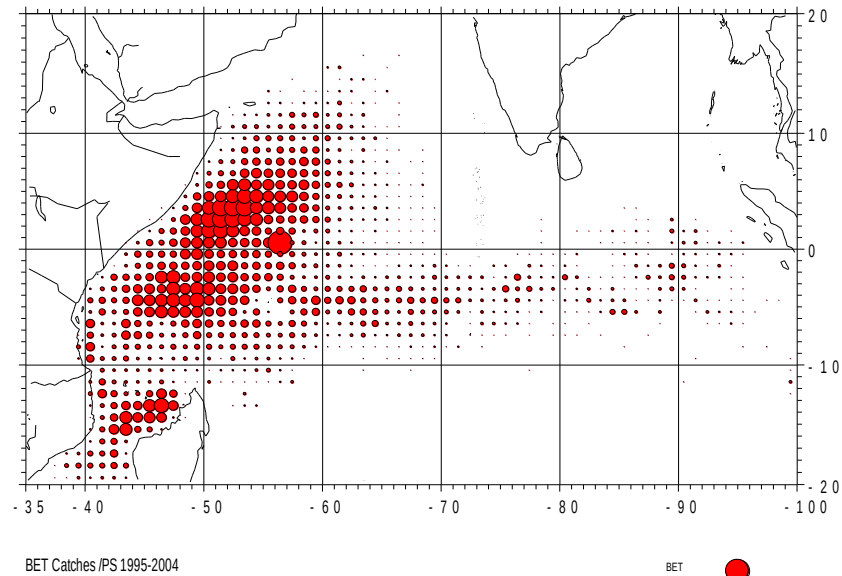
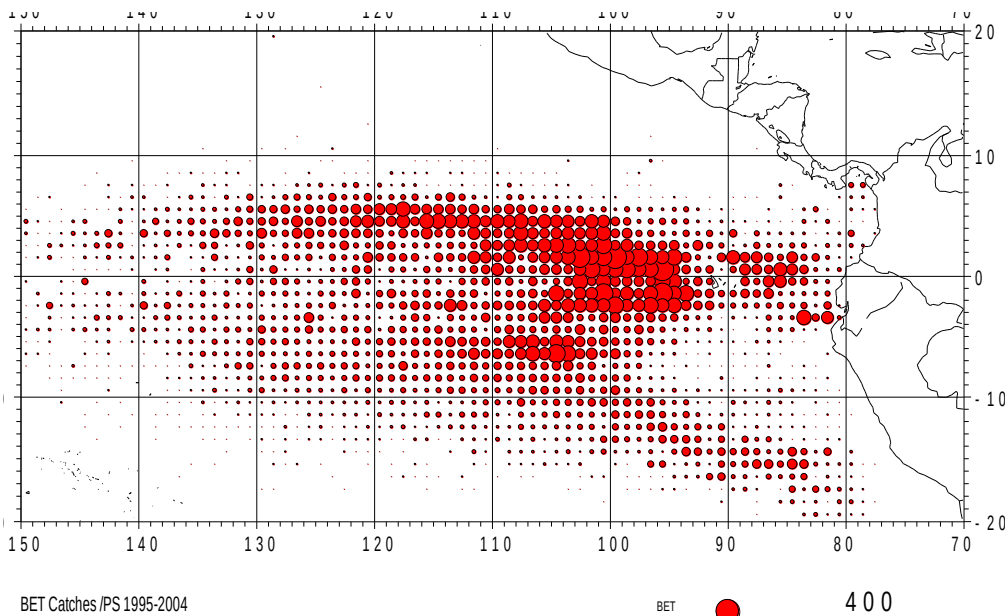


Nb Recov >12 months

Over 12 months

YFT BET SKJ

Geographical distribution of the observed recoveries, by species, as a function of time at liberty, and classified in 4 categories:



= Major importance of the area size: more relative mixing for a small ocean

Recent average catches of bigeye by purse seine fisheries (period 1995-2004) in the Indian Ocean (right figure) and in the Eastern Pacific (left figure).

= In the Indian Ocean, 636 1° squares have been fished with an average bigeye catch >5t

= in the Eastern Pacific, 1358 1° squares have been producing this level of BET catches

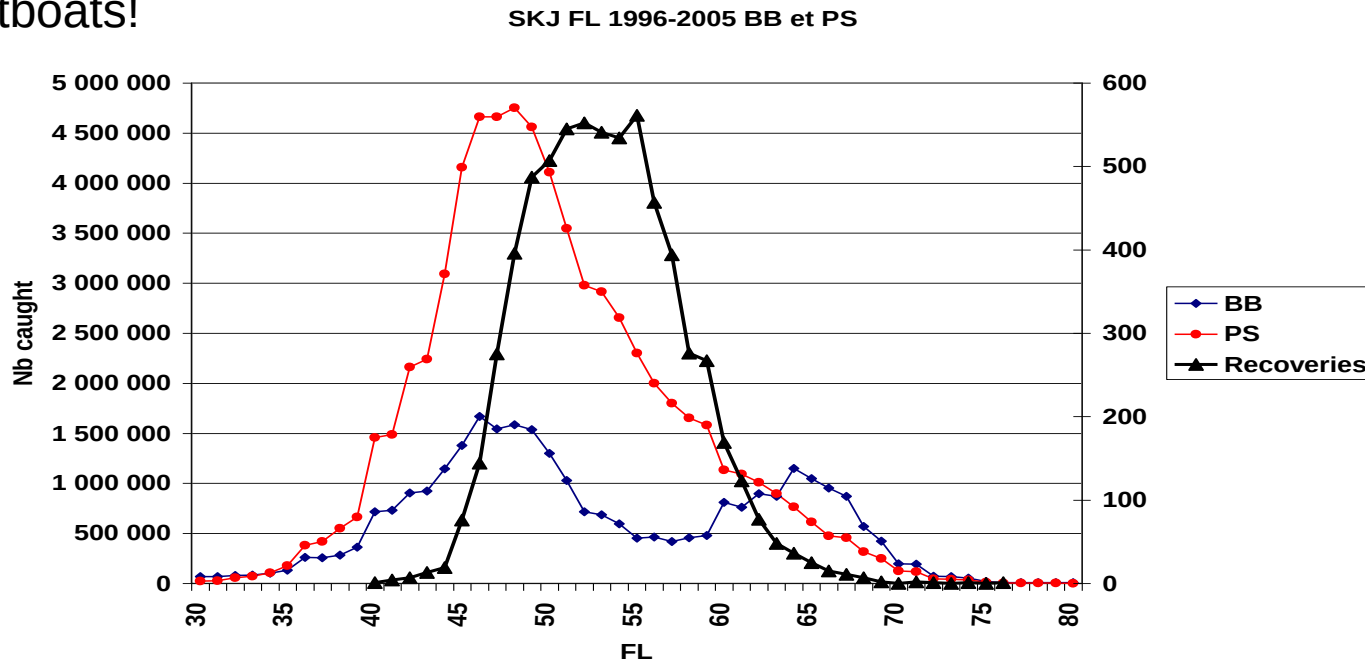
Why the Maldivian lack of skipjack recapture?

Sri Lanka+Maldives fisheries should have caught thousands of tagged SKJ....

Why the lack of significant recoveries by Maldives/Sri Lanka?

- no/low mixing between Western IO SKJ and Sri Lanka SKJ? Unrealistic!
- a major lack of reporting in Maldives Sri Lanka? Strange!
- major potential management consequences! In the present results, purse seiners can increase their skipjack catches without negative impact on Maldivian

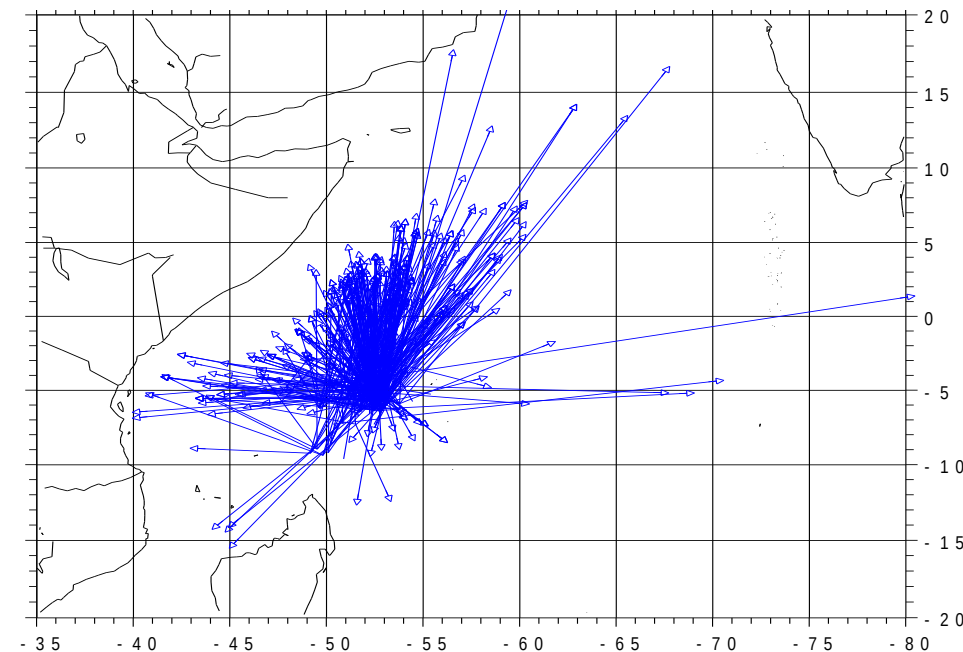
baotboats!



Total sizes of skipjack caught by purse seiners and by baitboats during recent years, period 1996-2005, and sizes of skipjack presently recovered and declared to the IOTC.

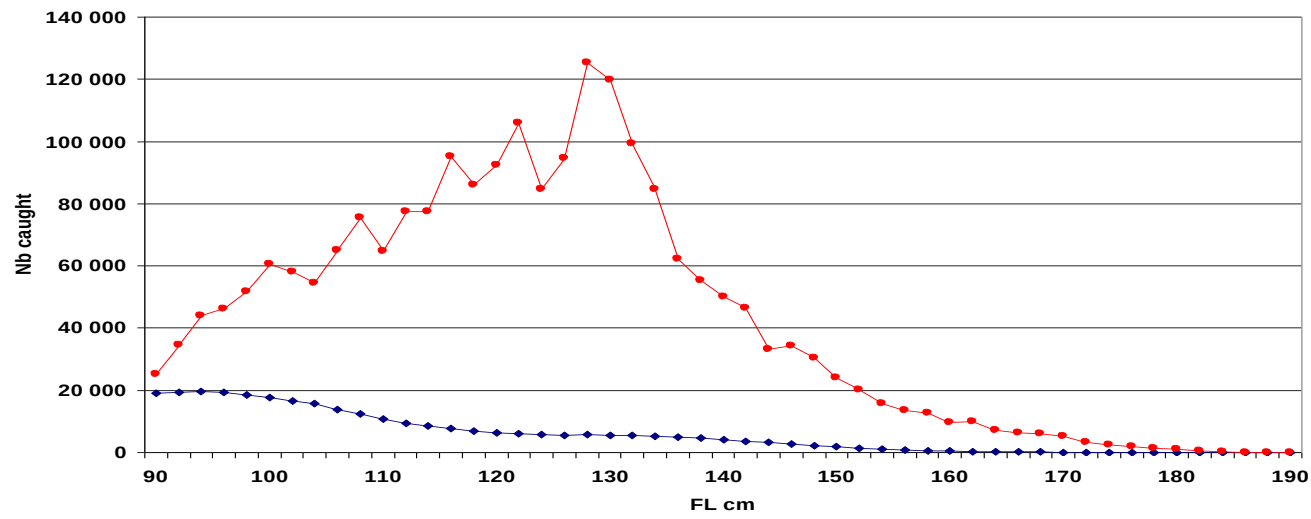
A bias to Kenya/Tanzania dominant tagging?

- Most tagging **DONE** off Kenya/Tanzania, a quite peculiar coastal area, located in the south-Western range of the main fishing zones.
- However, this peculiar area cannot be classified as a frontier area, being located at about 15° and 900 miles north of the main fishing zones of the purse seine fishery
- Sea surface temperatures in the tagging area are suitable for tropical tunas all year round, with SST fluctuating between 25°C and 29°C
- Tagging off Kenya and Tanzania area is special, but not really extreme in the habitat of tropical tunas.
- The limited number of 400 recoveries from the Seychelles tagging cruises show average distances of nearly 500 miles (yellowfin: 483 miles, skipjack: 481 miles and bigeye: 403 miles) and also similar dispersion patterns



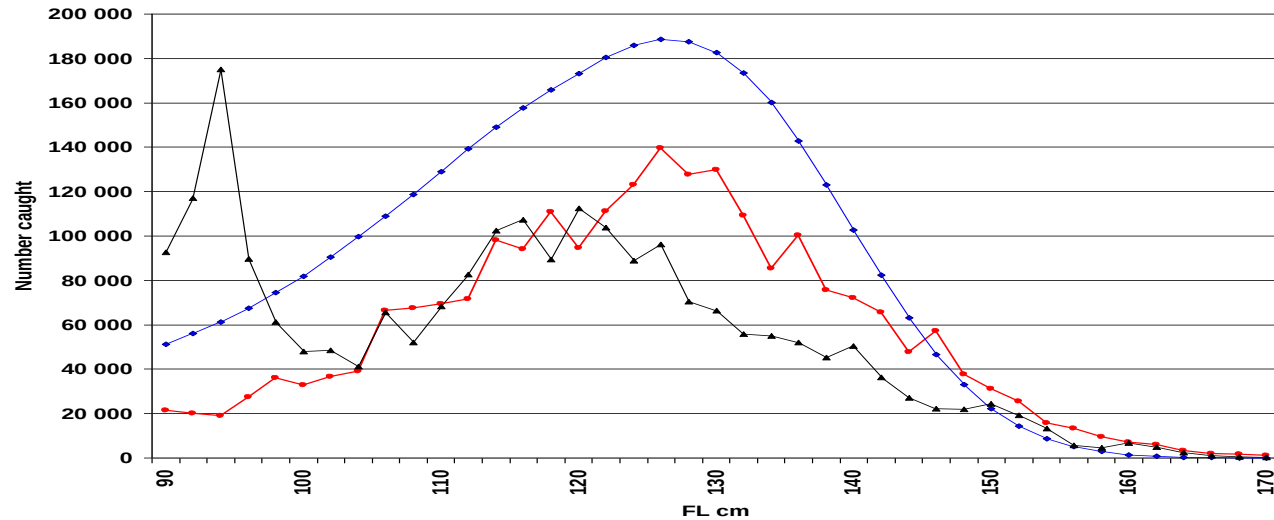
Linear trajectories of all the tuna recoveries of tunas tagged in Seychelles waters

	YFT	SKJ	BET	Total/Average
Number Recov	160	164	74	398
Average Distanc	483	481	403	467



Large bigeye are
Significantly caught

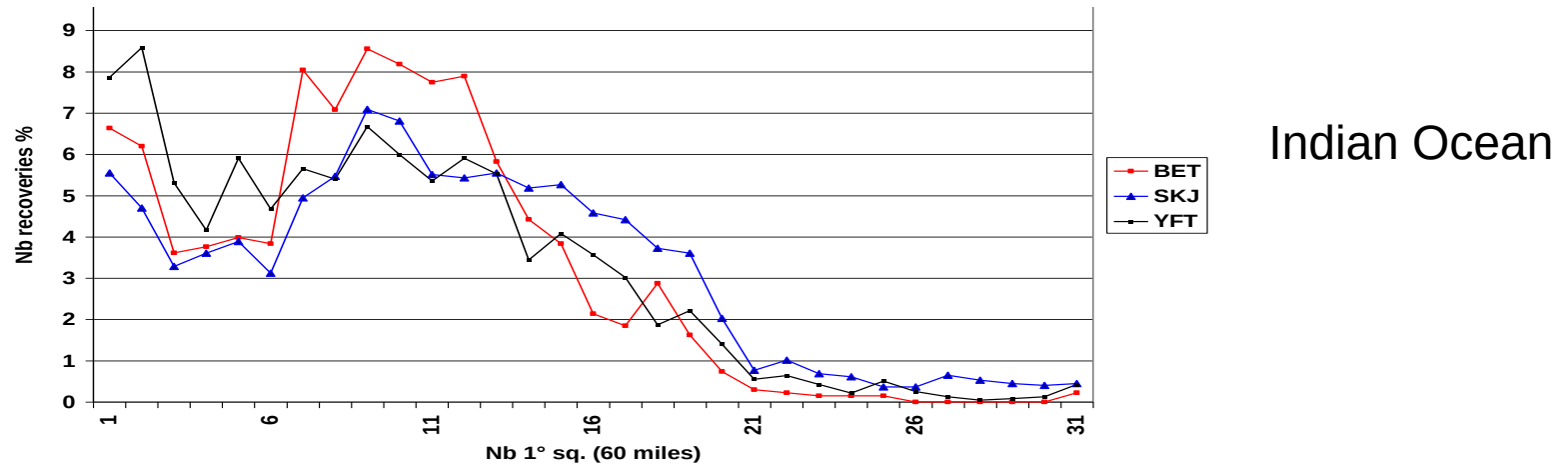
only by LL



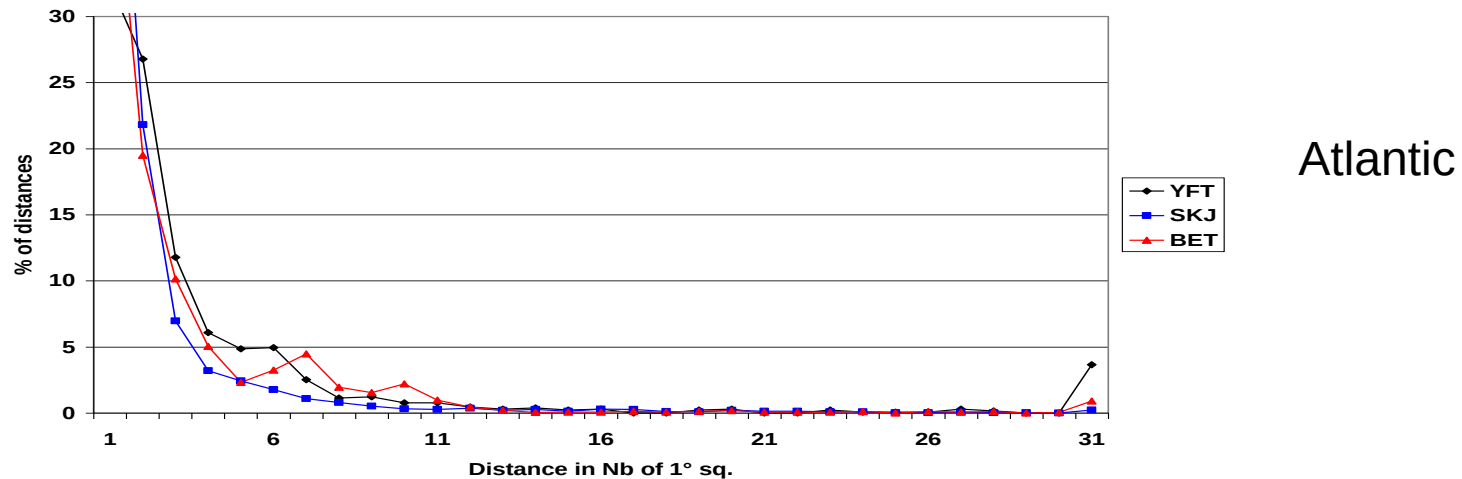
Large YFT caught by
PS and LL,
But PS areas are very
limited in their sizes

Average catch at size of large bigeye (upper figure) and for large yellowfin (lower figure) taken during recent years by the main Indian Ocean fisheries,

Comparing distances travelled by recovered tunas in the Indian and Atlantic oceans:
large distances common in the IO, rare in the Atlantic (and in the Pacific?)



Frequency of the distances between tagging and recoveries, in the present IOTTP Indian Ocean recoveries of yellowfin, bigeye and skipjack (expressed in numbers of 1° squares, i.e. by intervals of 60 miles)



Frequency of the distances between tagging and recoveries, for the ICCAT/Atlantic recoveries of yellowfin, bigeye and skipjack (expressed in numbers of 1° squares, i.e. by intervals of 60 miles)

Conclusion

- **Already a wide range of completely new and surprising knowledge on tuna movements: fast and large scale movements observed for the 3 species. Unique world wide!**
- **Luckily, the present results have not been heavily biased by the peculiar/limited tagging areas**
- **Still a lot of potential results to expect for yellowfin and bigeye in the coming years from the longline fisheries in the entire Indian Ocean, if return rates of tags can be improved on this fleet.**
- **A major pending question: the need to evaluate if the lack of Skipjack recoveries by the Maldivian pole and line fishery is real or not**

Map of quarterly catch at size and quarterly recoveries by species

An ad hoc software allows to do quarterly maps combining any subset of tag recoveries, and of catch at size by purse seiners. These maps are real ones, but alternative maps could easily be done by the WG using this automated fast software.

Yellowfin recoveries and catch at size by PS

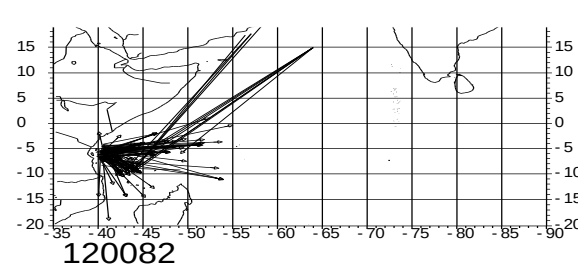
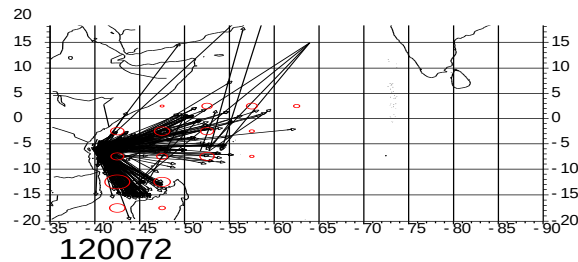
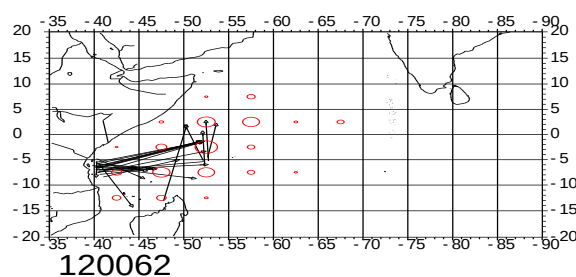
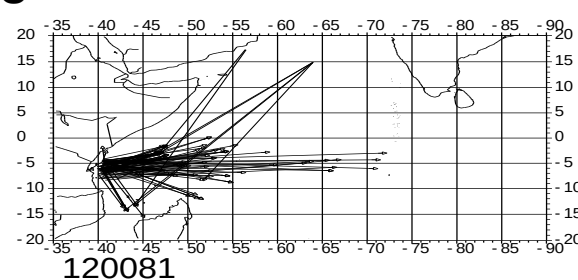
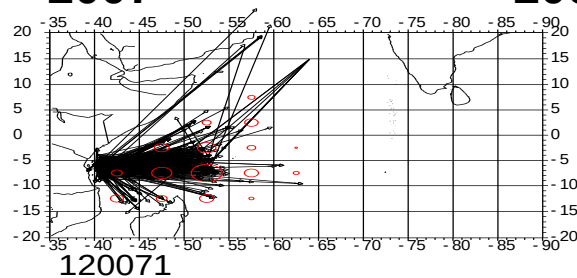
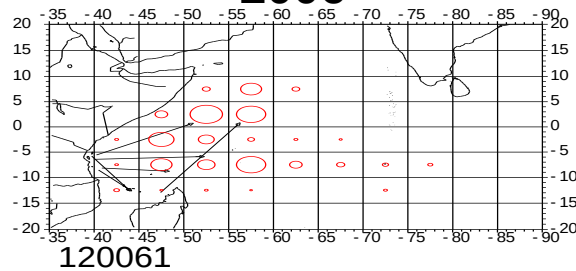
Quarter

2006

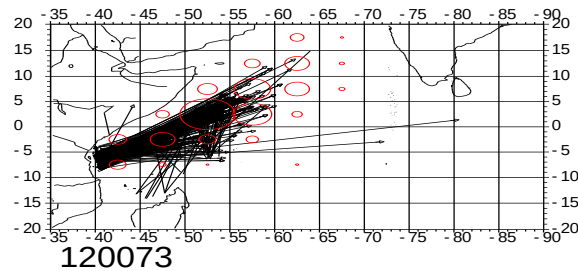
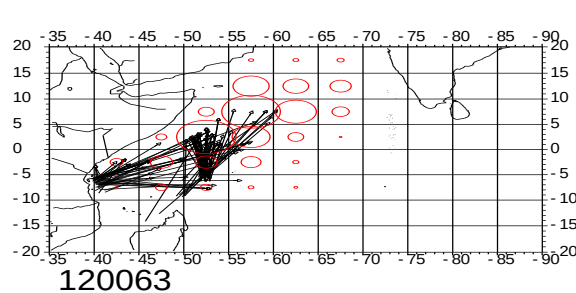
2007

2008

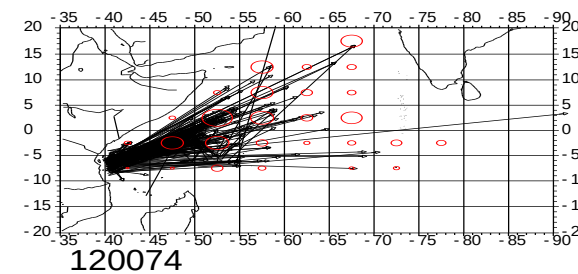
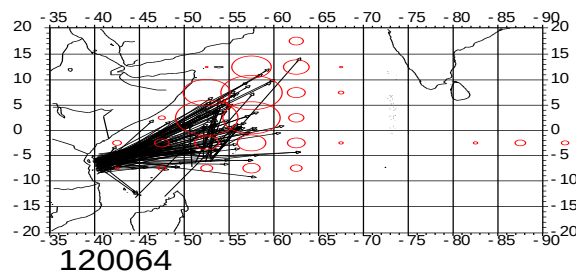
1



2



3



Yellowfin recoveries and catch at size by PS

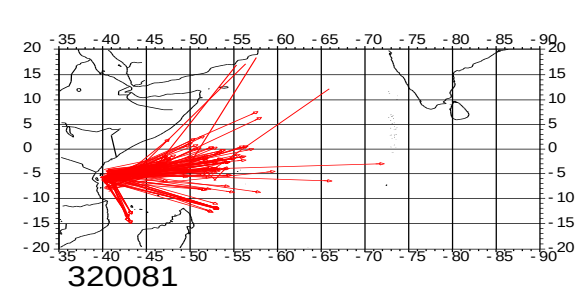
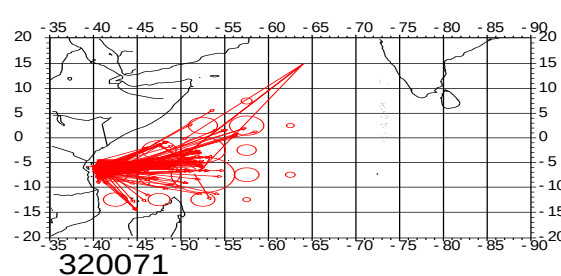
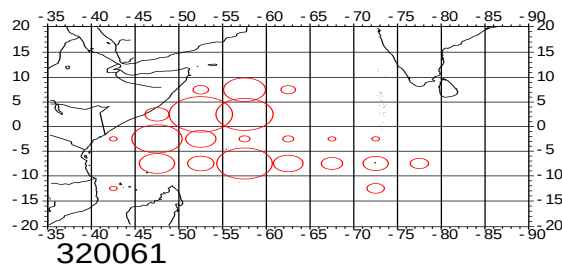
Quarter

2006

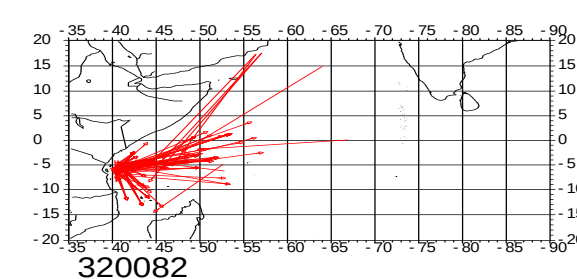
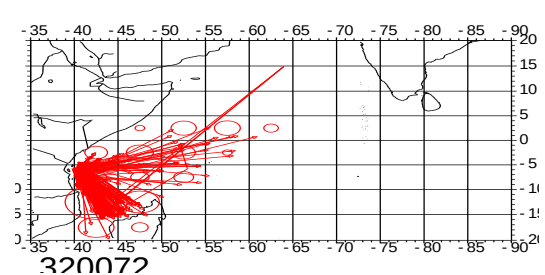
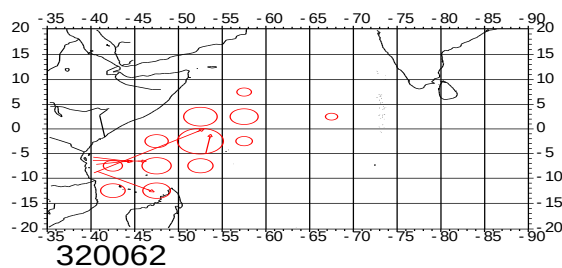
2007

2008

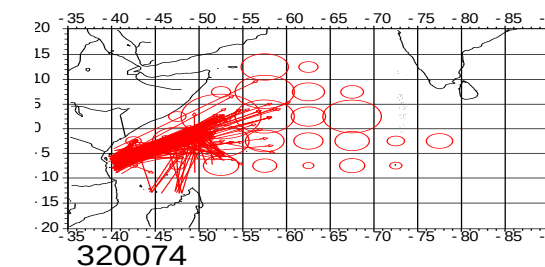
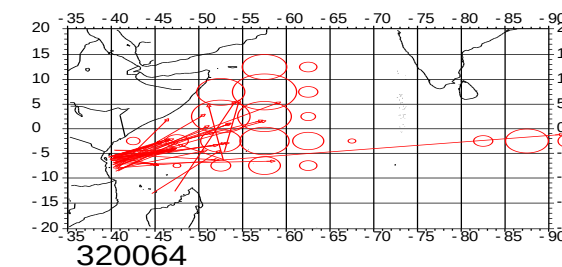
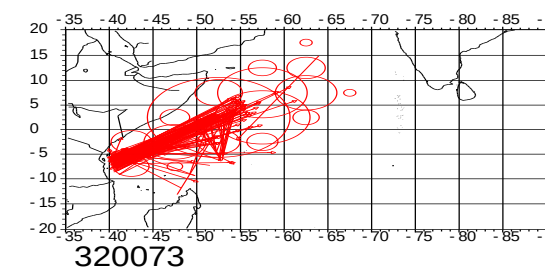
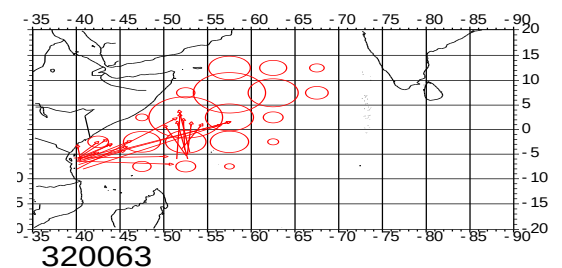
1



2



3



Skipjack recoveries and catch at size by PS

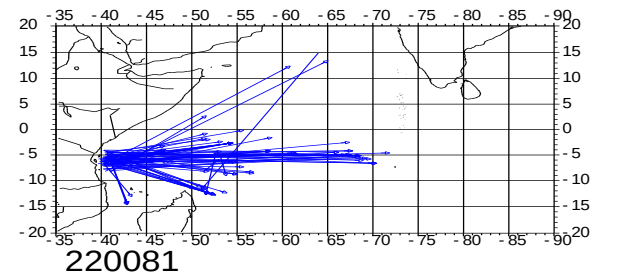
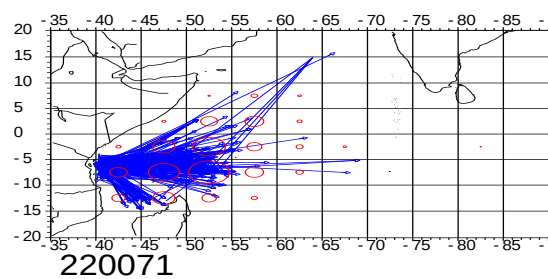
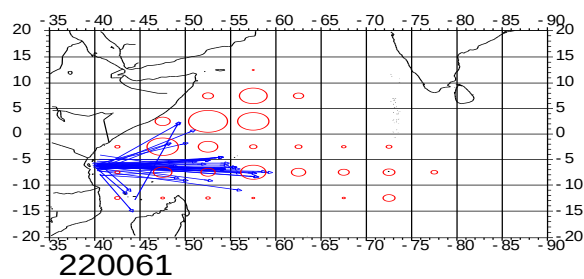
Quarter

2006

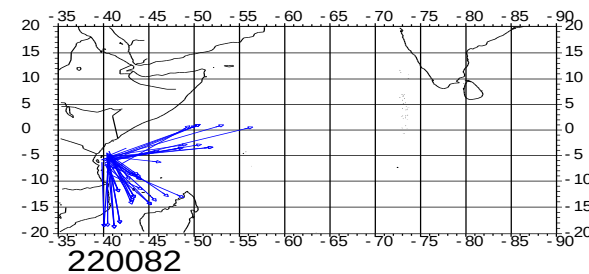
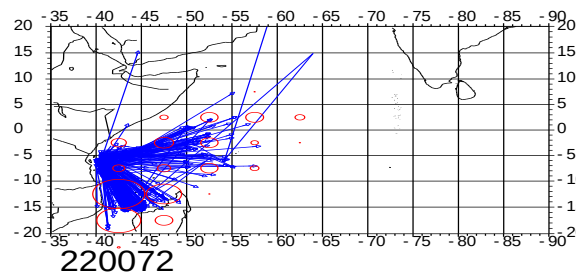
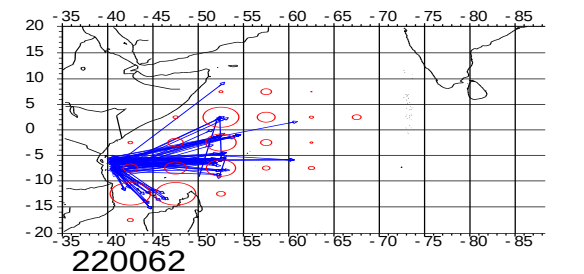
2007

2008

1



2



3

