

Why bother with Bluefin Tuna?

- **Blue fin tuna fishing and exploitation in the Mediterranean has increased dramatically in the last ten years.**
- **ICCAT recommendations and stock identification issues have had persisting problems**
- **FAO's statistics and reports identify some problems**
- **NGO concerns for over exploitation – GREENPEACE, WWF, BICREF (Malta)**
- **Modernised technologies, increased fishing effort and development of tuna ranching**

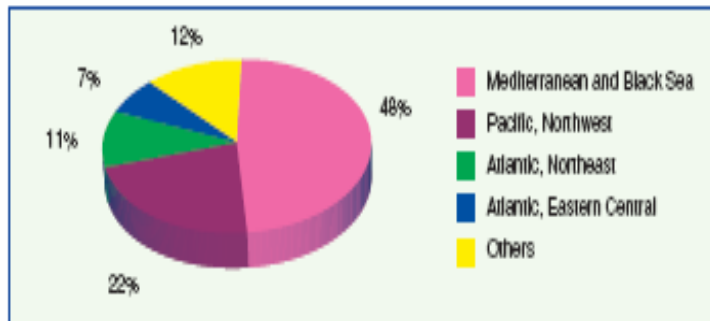


Why bother with Bluefin Tuna? *(cont.)*

- Increased interest in tuna by Tunisia and Libya with respective increase in “fishing area exclusive zones”.
- Decreasing catch, lower presence of tuna offspring and decreasing sizes of the tuna caught by Maltese Fishermen.
- Blue fin Tuna is synonym of Big Business – no place for artisanal fishing or sustainable considerations.
- Local fishermen and families shocked at dramatic decrease in this year’s catch when fishing season reduced to nearly one month (May) instead of two and a half months.

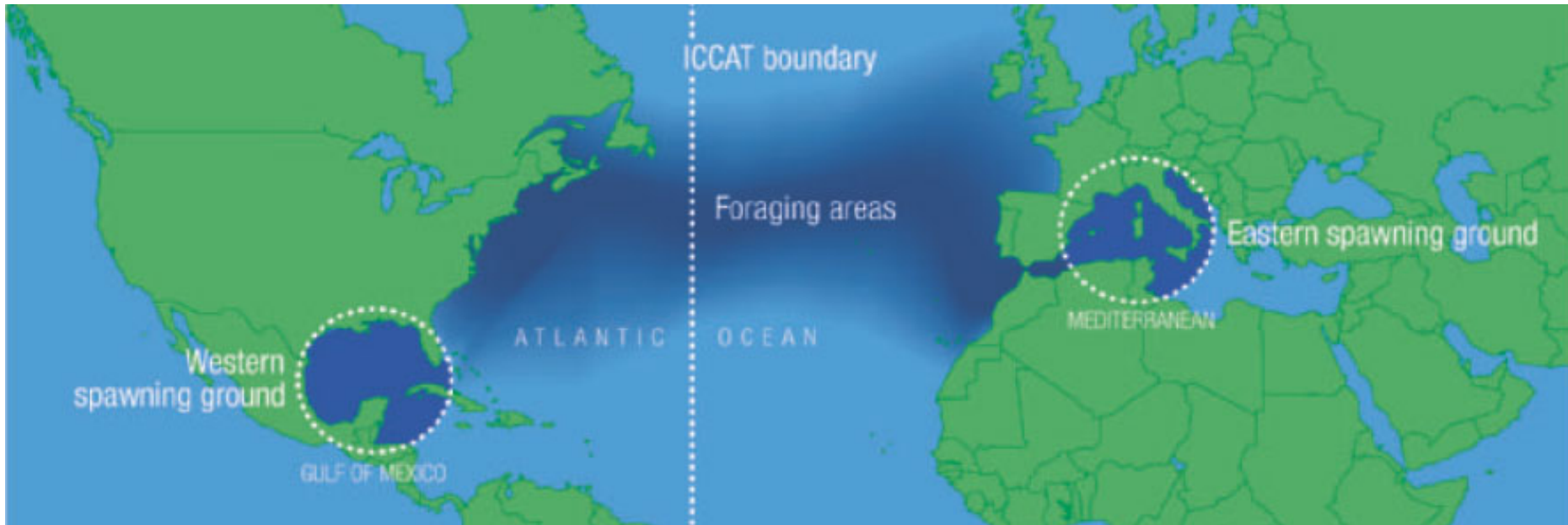
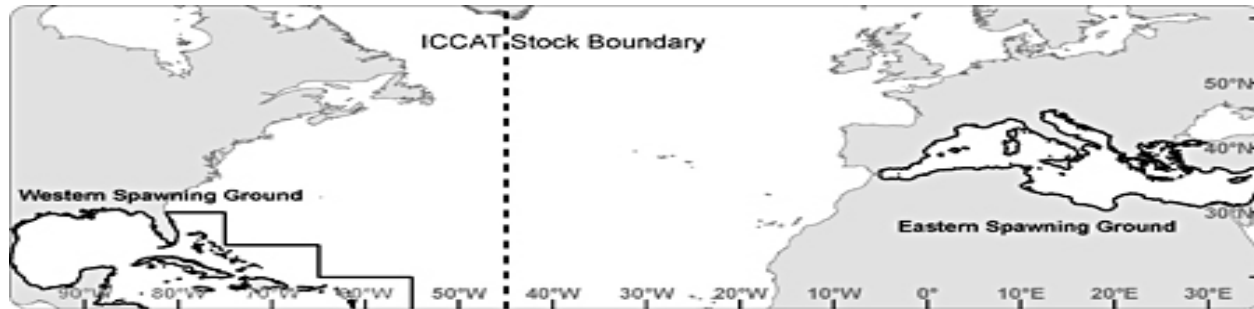


% Global catch in the Med.& Black Sea



- 48% Northern Blue fin tuna caught in the same in the Mediterranean and Black Sea in 2000 (FAO 2002)

ICCAT Stock Boundary for Blue fin Tuna and Spawning areas



Nature

Published online: 27 April 2005; | doi:10.1038/4341056a

Satellite tags give fresh angle on tuna quota [Rex Dalton](#)

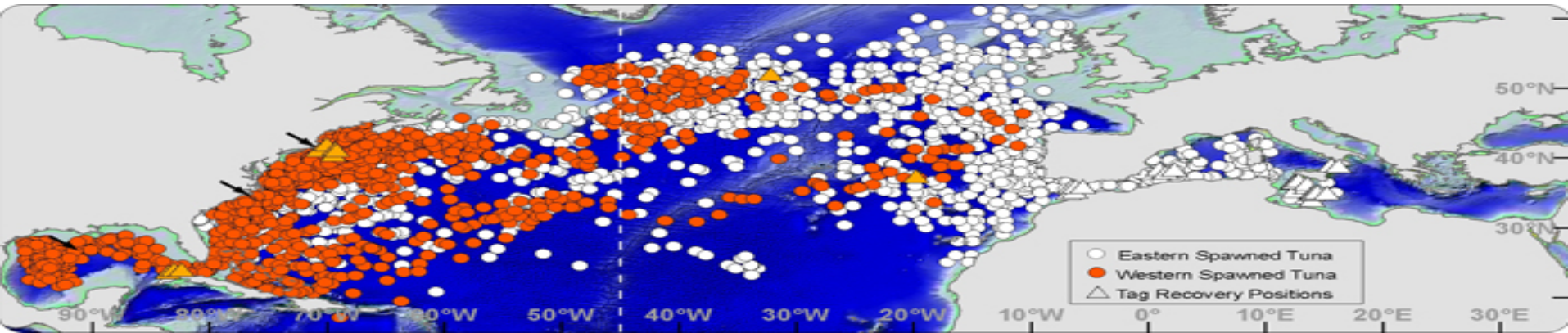


Bluefin tuna Spawning areas

- To determine the presence of spawning sites, there have been several studies ranging from larval surveys to analyses of the reproductive status of the female bluefin tuna.
- The study conducted by Medina *et al.*, 2002, has shown that the females collected at the Balearic Islands had a five-fold more highly yolked oocytes than samples collected from the Strait of Gibraltar. Moreover specimen from the Balearic Islands also had shown the presence of postovulatory follicles in their ovaries, thus indicating the presence of recent egg release.
- Another study by Nishida *et al.*, 1998, has shown the presence of high larval concentrations around the Balearic Islands, around the Maltese Islands, eastern Sicily and south Tyrrhenian Sea.
- Another two studies by Karakulak *et al.*, 2004, and Oray *et al.*, 2005, focused on whether or not there are any eastern Mediterranean spawning sites apart from those at the western and central Mediterranean.
 - These two studies through the use of histological and larval surveys respectively, have shown the presence of a spawning site in the Levantine Sea, between Cyprus and Turkey.



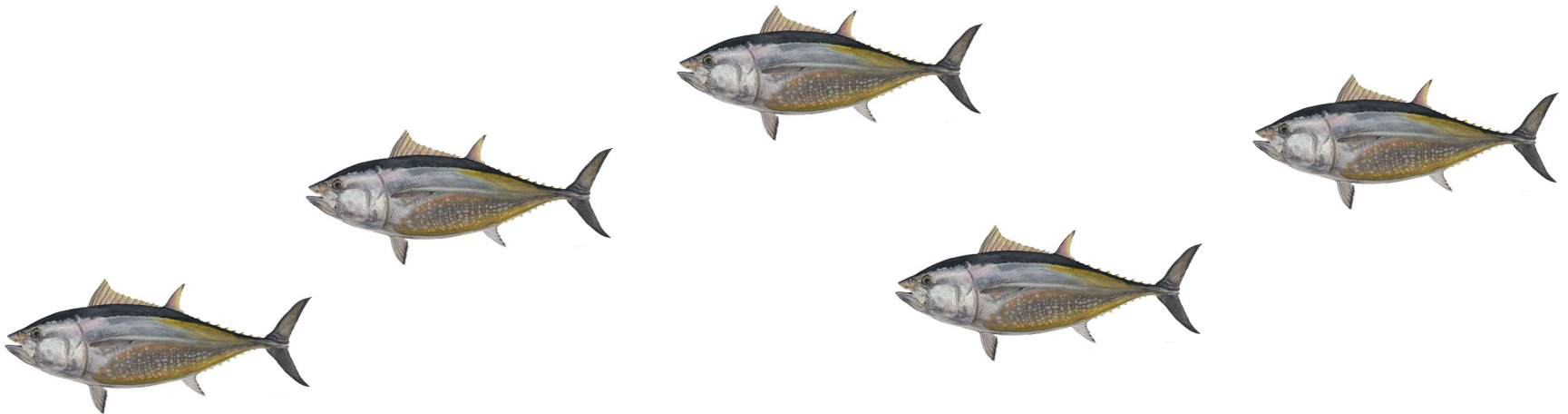
Tag Recovery Studies outside and within the Med.



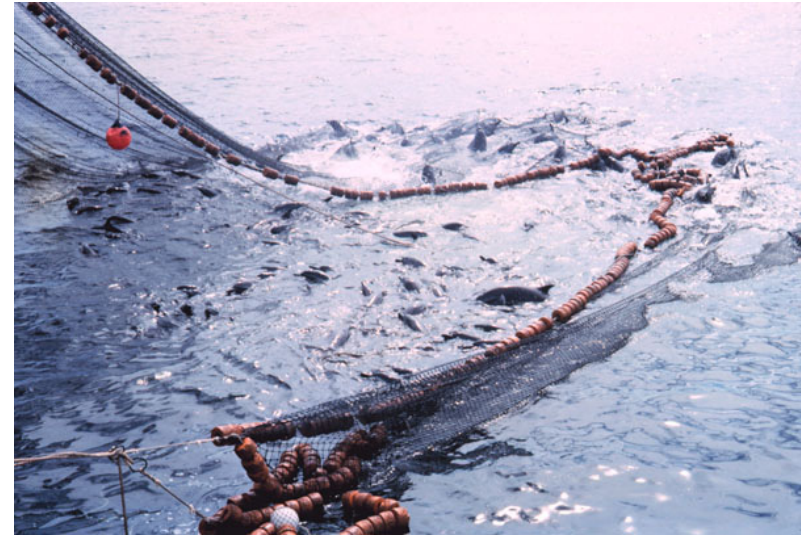
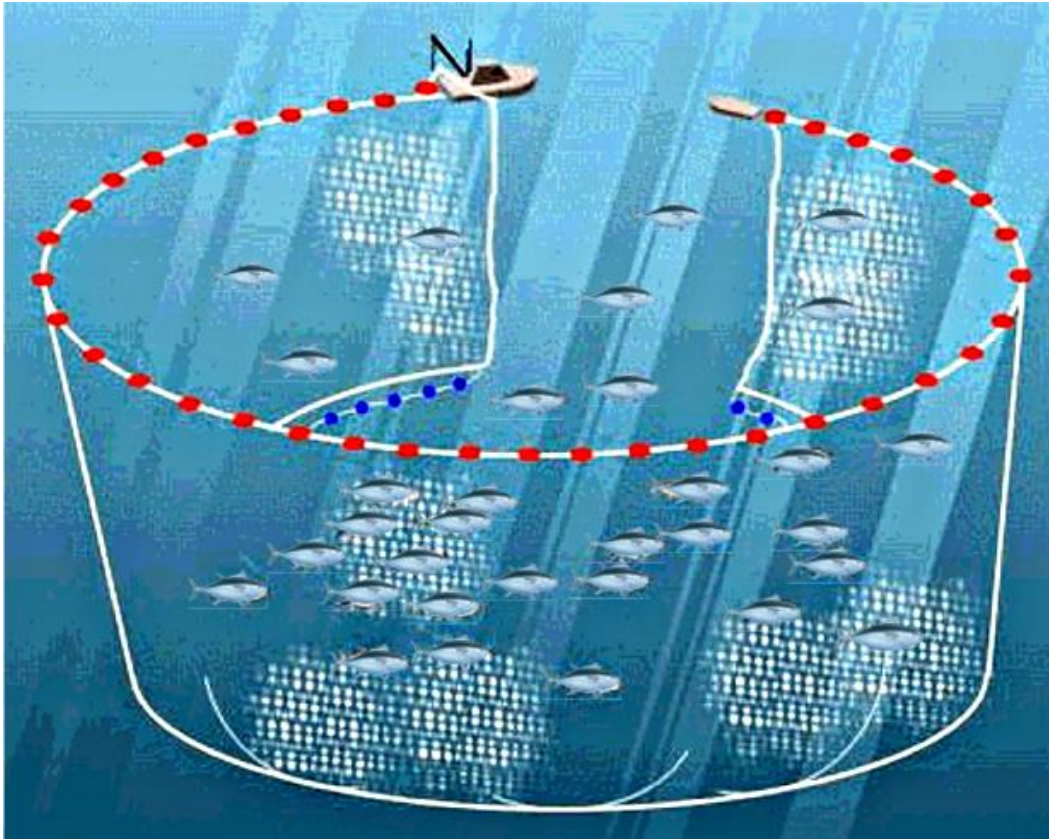
- Migratory patterns:
- One of the major techniques used in this kind of analyses is the use of electronic tagging. A study by Block *et al.*, 2001 & 2005 indicated spawning in the Atlantic and in the Central Med.

Blue fin tuna migratory patterns

- While a study by De Metrio *et al.*, 2003, has shown that electronically tagged bluefin tuna do not migrate towards the Strait of Gibraltar after reproduction, but they stay in the eastern Mediterranean.



Fishing for tuna – Purse seine



Purse seining for Blue fin Tuna



- The drastic increase in purse seine fishing effort in the Central and Southern Mediterranean Area (Vella 2002 - International Conference on Mediterranean Fisheries).

- Vessels from Malta and Tunisia found themselves being joined by Italians, Spanish, France and recently increasing Libyan fishing vessels.
- The sudden increase in exclusive fishing zones by Tunisia and Libya further proves the increasing desire to increment the income from this fish species.



Purse seining for Blue fin Tuna



- The drastic increase in purse seine fishing effort in the Central and Southern Mediterranean Area (A. Vella 2002 - International Conference on Mediterranean Fisheries).



- **Tuna penning**
- This involves the catch of wild blue fin tuna to be caged alive, transported close to coast and fattened for few months to be sold off season.

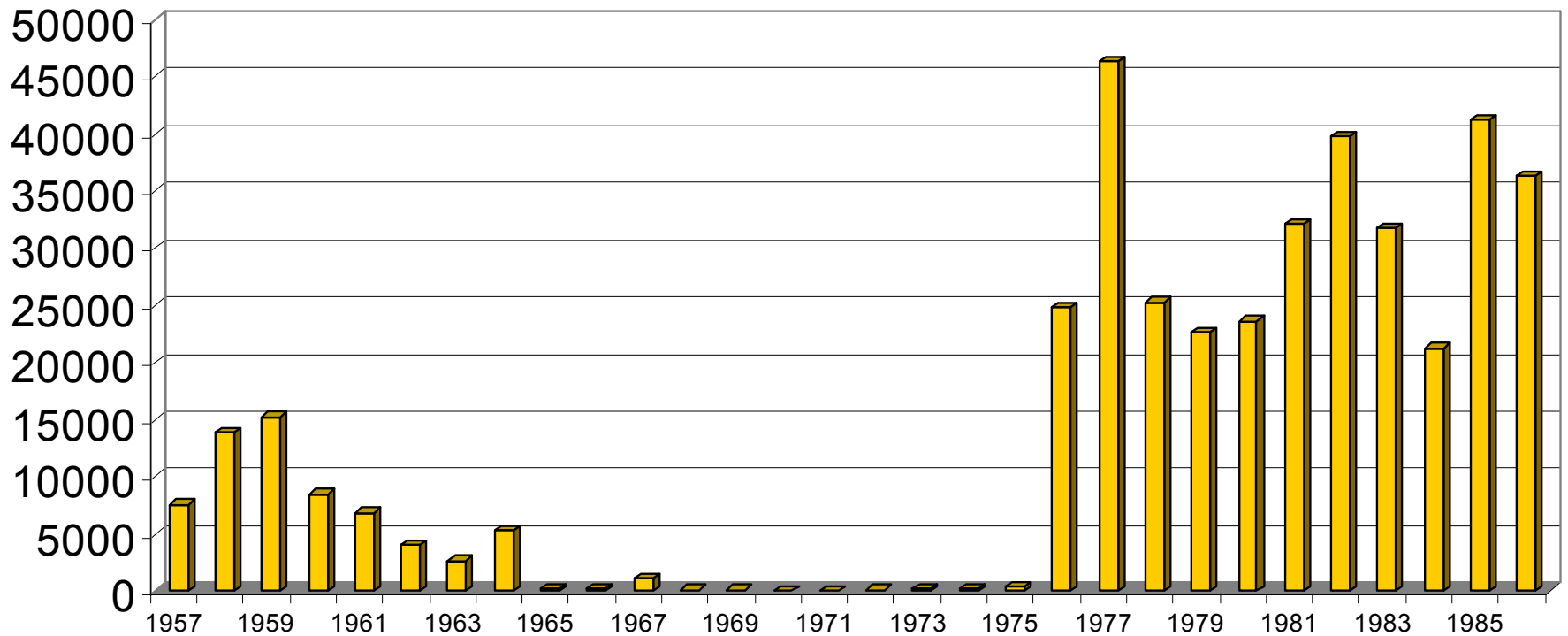


Historic Bluefin tuna catches in the Maltese Islands

- Tuna has been caught in the Maltese Islands with traps since 1748 reaching a stable usage around 1948.
- However this fishing method was finally replaced by long-line, initially as a by-catch in the swordfish fisheries prior to focusing on the blue fin tuna long-lining in 1995 when the Japanese opened the doors to Blue fin tuna trade caught by the Maltese.

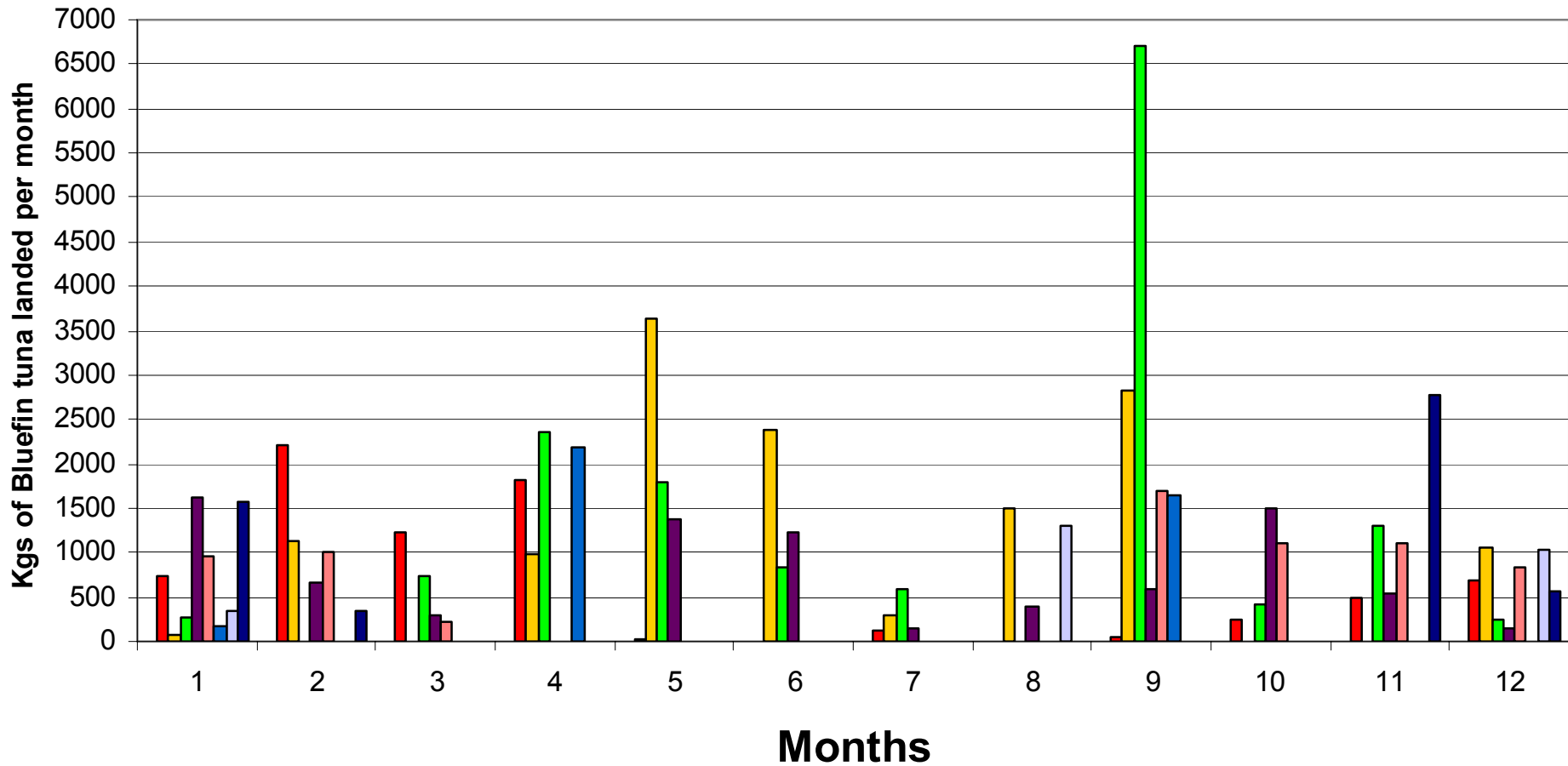
Bluefin tuna landings

**Annual Bluefin Tuna landings (Kgs)
in Malta between 1957 and 1986**



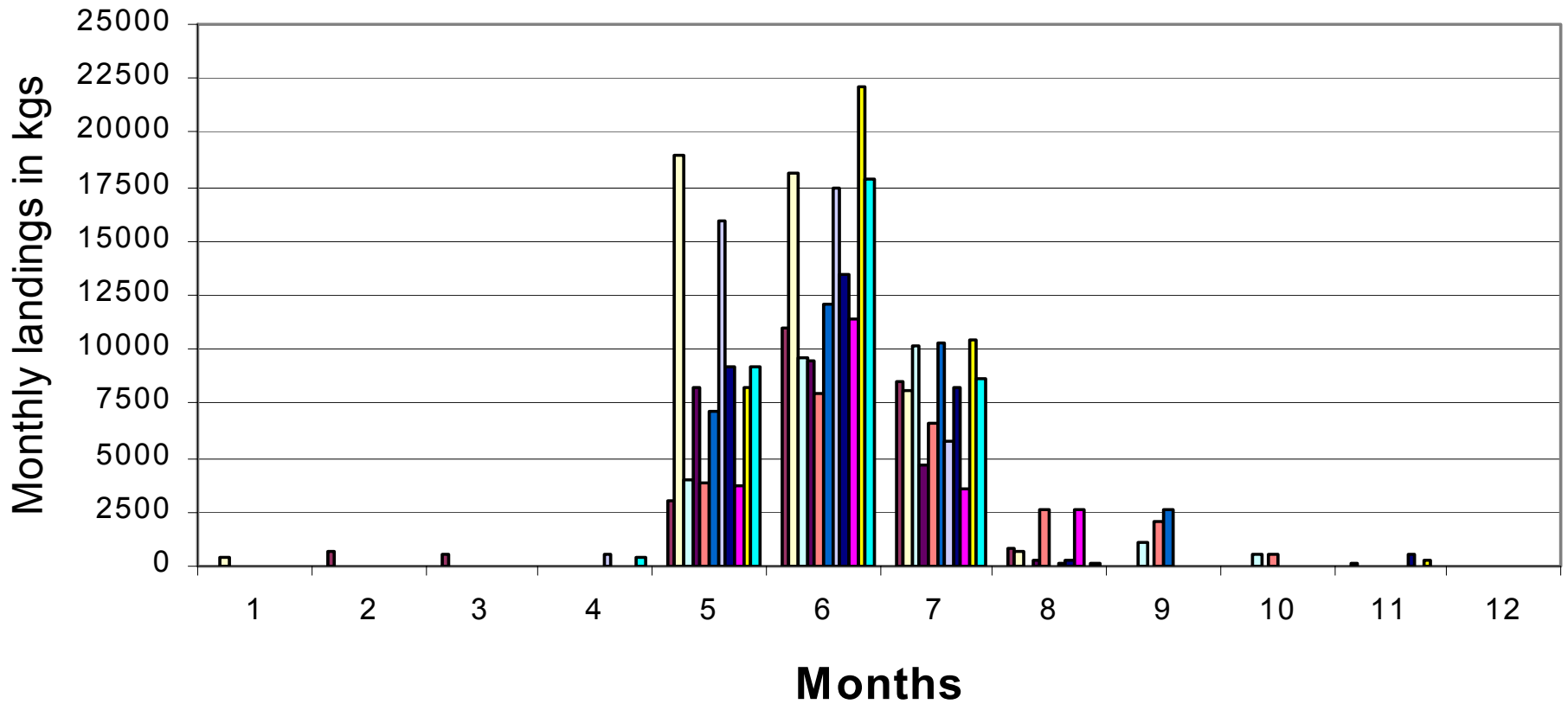
Monthly variations in landings

**Landings of Bluefin tuna per month
between 1957 and 1964 in Malta**



Monthly variations in landings

**Monthly landings of Blue fin tuna
between 1975 and 1986 in Malta**

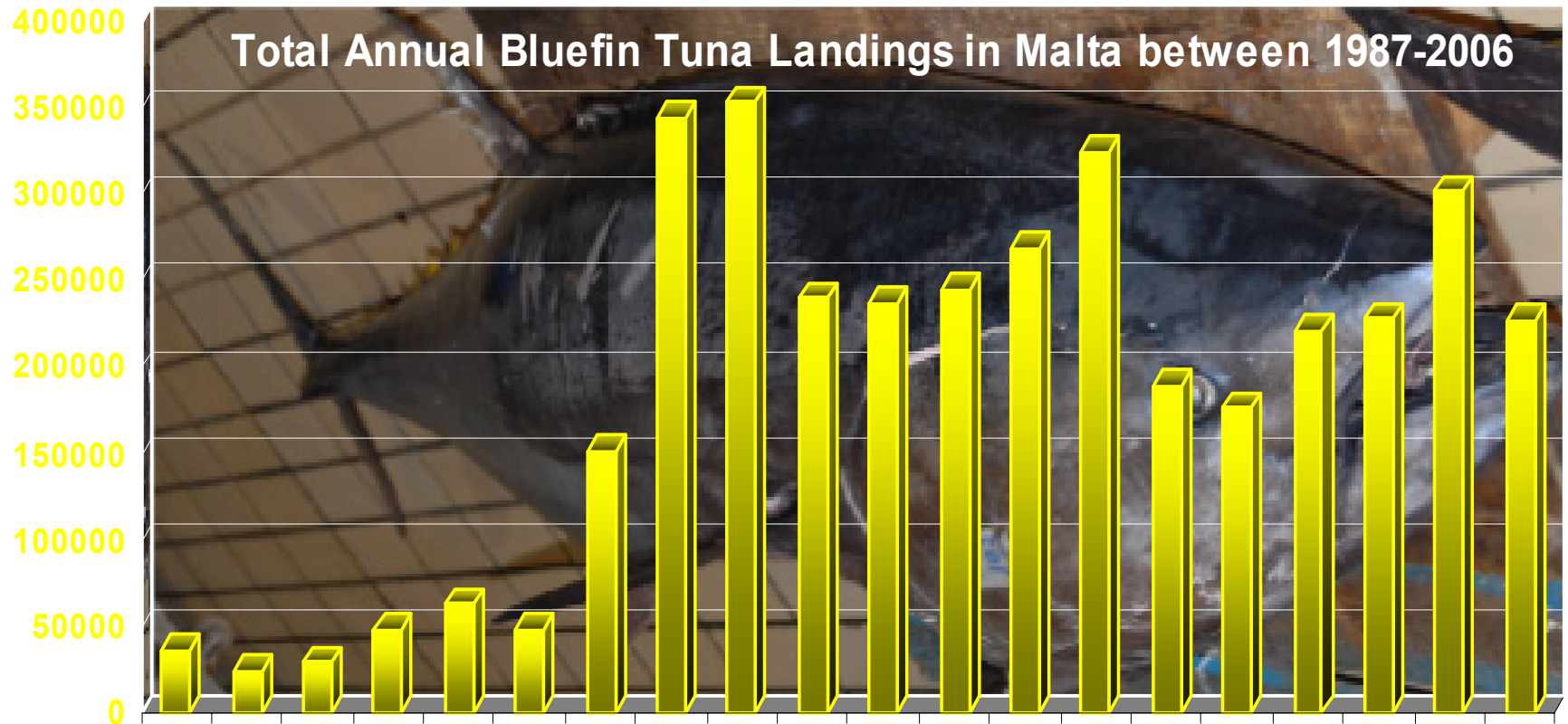


Maltese Long-line fishing for Blue fin Tuna.

- Blue fin tuna fishing is a seasonal activity for Maltese Fishermen undertaken between May and mid July.
- Each fishing expedition involves on average 4 days of effort with 40 to 50 miles of long line, set at least three times, each extending down to 100m with bait which is mostly imported Mackerel.
- Boats utilised for this fishing measure between 10 to 26m.

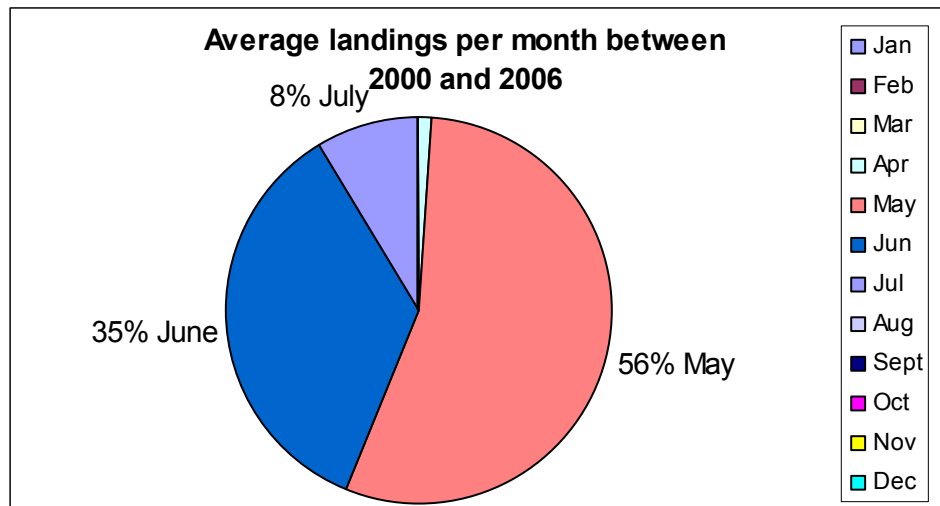
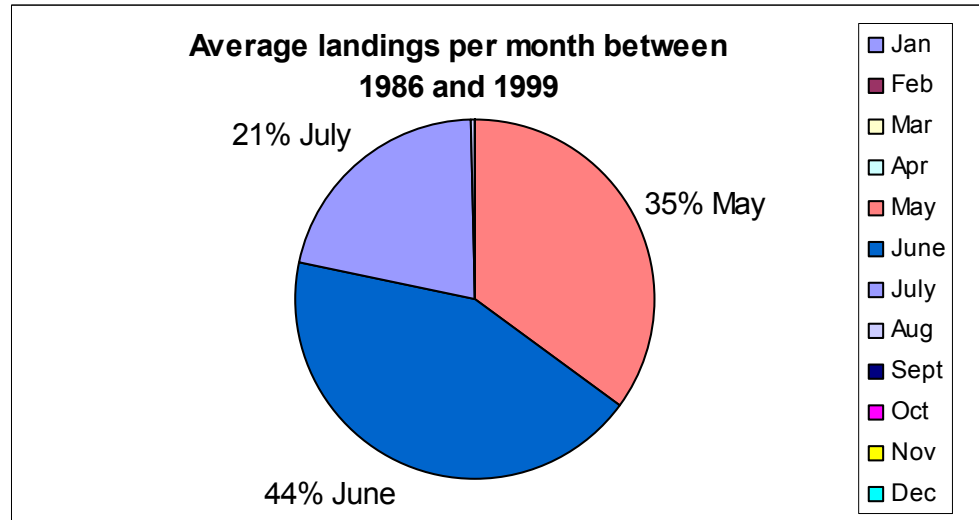


Blue fin tuna landings in Malta



Maltese Blue fin tuna % landings per month in the Central and Southern Mediterranean

- May
- June
- July



Why Molecular Genetic Analyses

- Due to the need to manage in a sustainable way the exploitation of a species at stock or population level, several studies have looked at the use of genetic techniques to assess the population structure and subdivisions present in its global or regional distribution. Blue fin tuna is no exception.
- Previous genetic studies have focused on three main techniques:
 - **allozymes** (Pujolar *et al.*, 2003),
 - **mitochondrial DNA** (Vinas *et al.*, 2000; Ely *et al.*, 2001; Takeyama *et al.*, 2001; Vinas *et al.*, 2003; Manchado *et al.*, 2004);
 - **microsatellites** (Takagi *et al.*, 1999; McDowell *et al.*, 2002; Clark *et al.*, 2004; Carlsson *et al.*, 2004).

Examples of Molecular Genetics of Blue fin tuna

- Genetic studies conducted by Takagi *et al.* 1999, using four microsatellites; *Ttho-1*, *Ttho-4*, *Ttho-6* and *Ttho-7* (all four had dinucleotide motif repeats), have shown that there was no significant difference between the N.W. Atlantic samples and the Mediterranean samples, though the use of a larger sample size may have been required since the loci used tend to be considerably polymorphic.

- The study by Carlsson *at al.* 2004, has used nine microsatellites; Tth5, Tth8, Tth10, Tth21, Tth34, *Ttho-1*, *Ttho-4*, *Ttho-6* and *Ttho-7* (first five were with tetranucleotide motif repeats; last four had dinucleotide motif repeats).
 - It was observed that there were significant genetic differences between collections from the Tyrrhenian and Ionian Sea. The latter maybe due to the way the oceanographic conditions (currents) within the Mediterranean Sea might limit the mixing of larvae and eggs.

- Other examples using mitochondrial control region in or close to Maltese Islands' fishing area.
 - Vinas *et al.* (2003) have analysed the mitochondrial control region of 22 tunas caught in Libyan waters, 23 in Tunisian waters and 12 in Maltese fishing area. 24 Blue fin tunas from the Gulf of Cadiz in the East Atlantic Ocean were also analysed. The only significant result was obtained between the Maltese samples and other regions sampled ($F_{st} = 0.013$, $p < 0.001$). This difference was interpreted as being due to small sample size.

Three dimensional, temporal and varied environment.

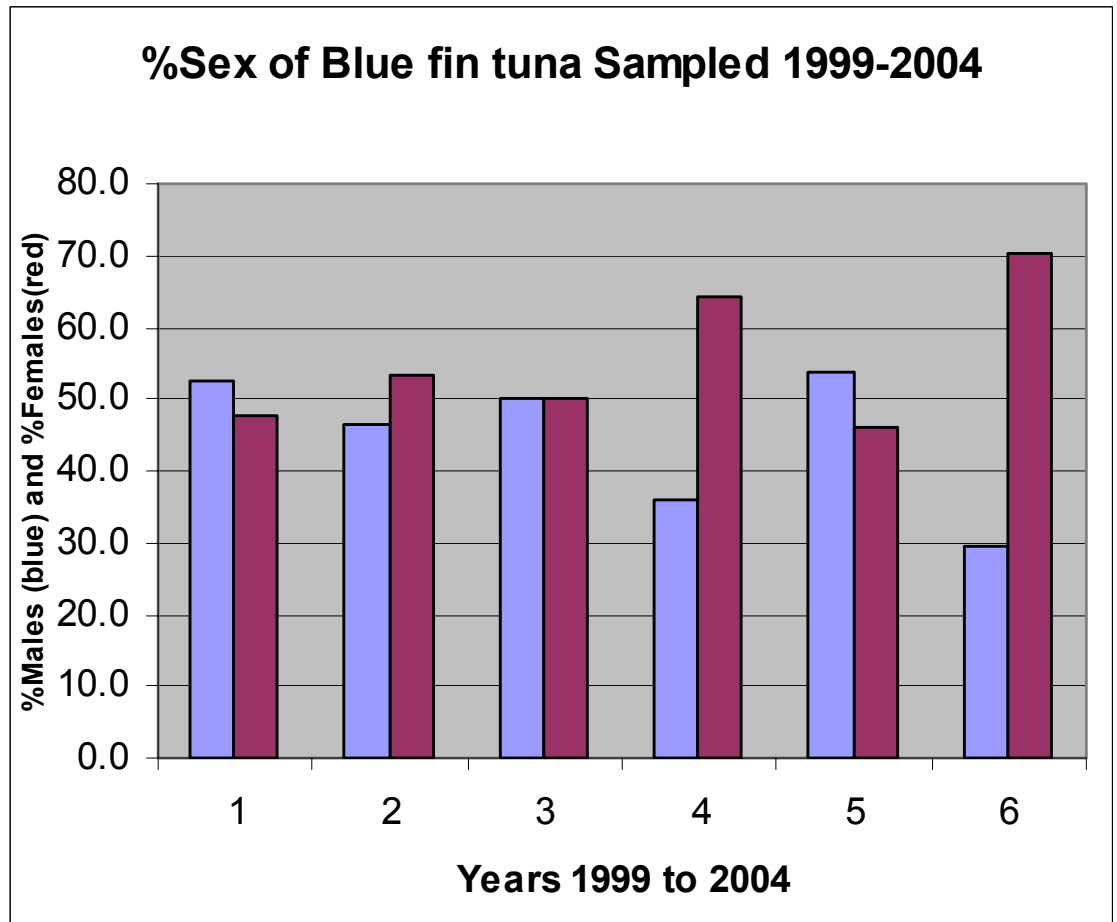
- In a three dimensional oceanic world, it is not difficult to imagine that pelagic species, such as the Blue fin tuna, may be utilising different geographical regions but also different depths and ecological niches at different parts of their life and even at different seasons in each year, according to their growing, feeding, reproducing/spawning and migratory requirements.....

Blue fin tuna Average Body Length (St.Dev) per year



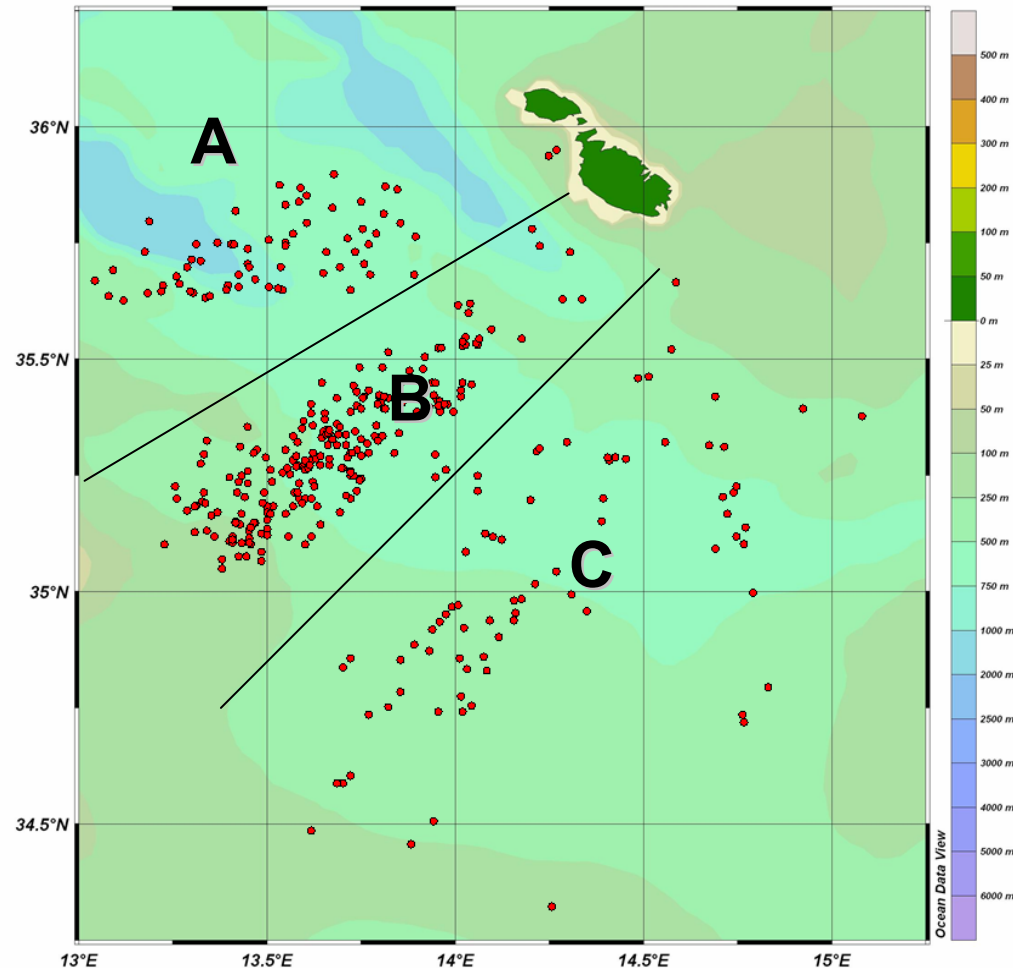
%Males and %Females sampled

- Males on the decrease while females on the increase.



Microsatellite Genetics Results: Sampling region differences

- Investigating the genetic distance between samples from different areas South of the Maltese Islands (1999-2004).
- Genetic diversity between Individuals sampled from region A against those sampled in region C was found to be significant on a pairwise test:
- $F_{st} = 0.01755$
 $P < 0.0001$



Tuna Genetics and future: urgent conservation needs.....

- The significant molecular genetics distance of groups of individuals of Blue fin tuna sampled in relatively close proximity, may indicate that some marine parameter or parameters may indeed encourage some reproductive separation in certain regions.

Correlating other observations

- The observation that fishermen increasingly depend on the May catch instead of a June to July catch in the same fishing ground, may also indicate the possibility that distinctive population/s may have been exploited more heavily during its presence in the region. In particular the June and July which this year has seen a record low in landings, even though the weather was fine.

Conservation concerns

- The increasing fishing effort and efficiency of catch of the past six years by international fishing fleets in this fishing ground may be affecting the Mediterranean population by:
 - reducing the average size of tuna, and also
 - affecting population sex ratio, apart from
 - acting as a barrier inhibiting undisturbed mixing and reproduction between blue fin tuna coming from the West tunas already on the eastern part of this fishing ground.
- Tuna ranching/penning activities in this same region has further increased the effort and disturbance on this fishing grounds, with offshore activities which are rarely if ever monitored for quotas, discards, etc.

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Blue fin Tuna (*Thunnus thynnus*) Fisheries of the Maltese Islands in the Central and Southern Mediterranean Sea

Adriana Vella

Tuna has been caught in the Maltese Islands with traps since 1748 reaching a stable usage around 1948, however this fishing method was finally replaced by long-line, initially as a by-catch in the swordfish fisheries prior to focusing on the blue fin tuna long-lining in 1995 when the Japanese opened the doors to Blue fin tuna trade caught by the Maltese. Thus looking back at historic data with changing efforts and gear may not be the only single method to understand the causes for Bluefin tuna decline in certain regions, where a variety of environmental and fishing gear changes leading to fishing intensification has been taking place.

Total blue fin tuna catch in kgs in the Maltese Islands, in the centre of the Mediterranean Sea, have followed an over all decline from its peak of 353,014kg in 1995 to 227,008kg in 2006. This in itself may be expected when one considers the increasing number of fishing vessels in the same area during this timeframe. However as the Maltese fishermen have been increasing their effort in time and gear this decline may also be considered a serious signal of blue fin tuna stock depletion in this Mediterranean region during its spawning season between April and July.

The ecological considerations of this study, side by side with the population's DNA study targets a more detailed picture of the blue fin tuna species spawning in the Mediterranean. Blue fin tuna stock and its viability and genetic diversity: fisheries landing statistics; blue fin tuna biogeography and; tuna molecular genetics in this fishing area are being considered in detail. Over 300 blue fin tuna specimens caught offshore were sampled since 1998 in order to study variations in sizes, sex ratios, biogeographical setting and molecular genetic identity. With such detail in number sampled and period covered, this study was a necessary first in order to obtain an important indication of the conservation management needs of this highly valued and exploited species.

With increasing purse-seining and the advent of tuna penning (cage storage of live tuna for a number of months after the fishing season has come to an end) and the greater interest in this same species with poor off shore monitoring tools, the results of this study assists in better understanding the impacts and extinction risks of this species in one of its important spawning areas.