GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN (GFCM)
SCIENTIFIC ADVISORY COMMITTEE (SAC)

Workshop on Stock Assessment of Selected Species of Elasmobranchs in the GFCM area
Brussels 12 -16 December 2011

Age, growth and maturity of *Raja clavata* and *R. miraletus* (Rajidae) of the Gulf of Gabès (Tunisia)

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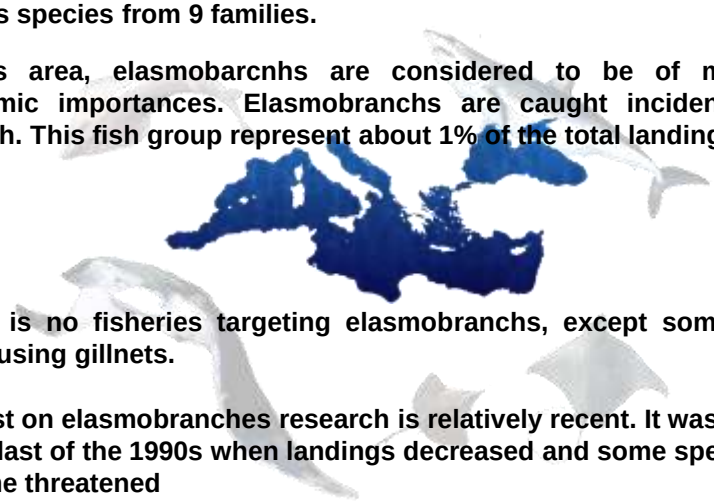
Mediterranean and Black Sea species

86 species of elasmobranchs thought to occur in this area. This number comprises 49 species of sharks from 17 families and 37 batoids species from 9 families.

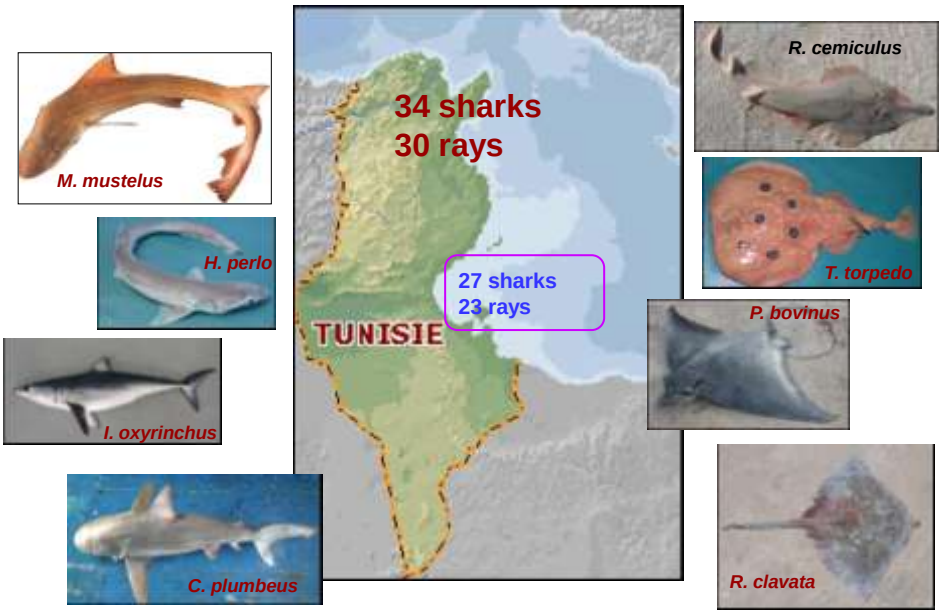
In this area, elasmobarcnhs are considered to be of moderate economic importances. Elasmobranchs are caught incidentally as bycatch. This fish group represent about 1% of the total landings.



There is no fisheries targeting elasmobranchs, except some small scale using gillnets.

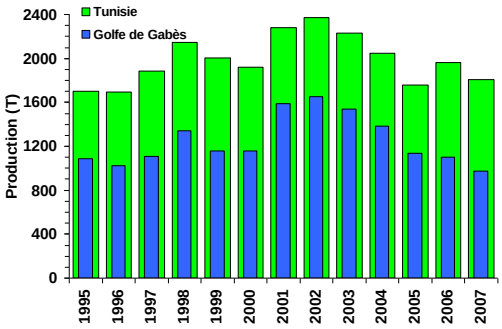
Interest on elasmobranches research is relatively recent. It was starting in the last of the 1990s when landings decreased and some species became threatened

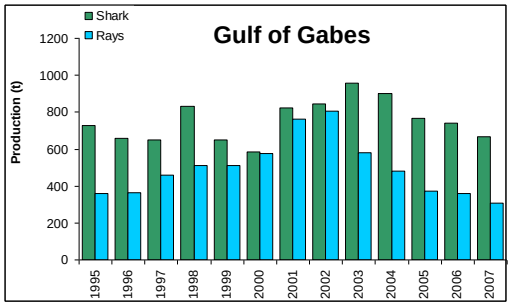
Elasmobranchs diversity in Tunisia



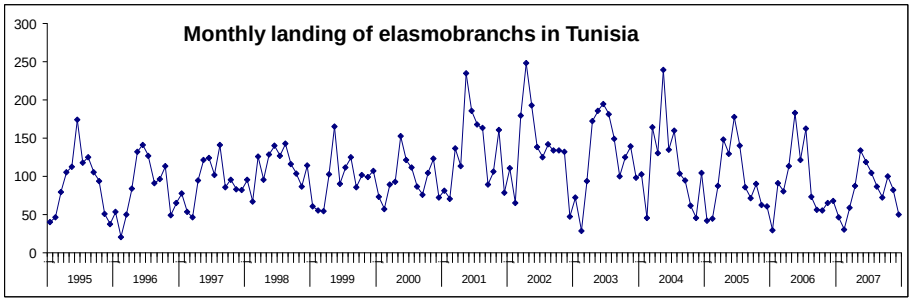
Fishing gears

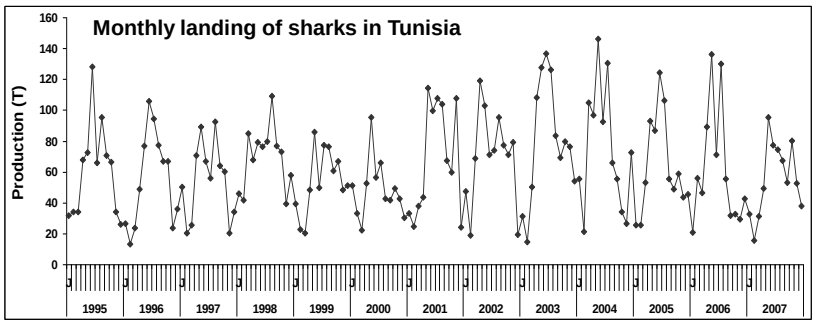
Elasmobranchs landings



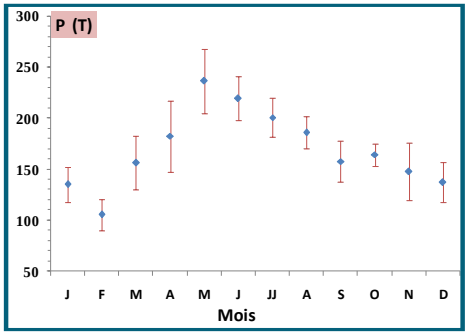


Elasmobranchs landings

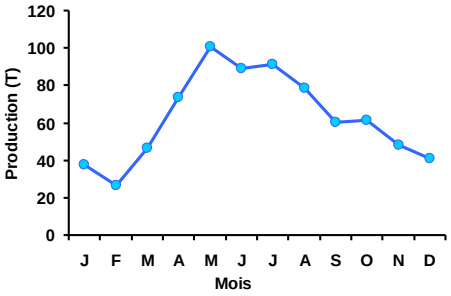




Monthly Elasmobranchs landings



Batoides



Sharks

Monthly Elasmobranchs landings

Taking into account the vulnerability of elasmobranch fishes and in the frame of implementation of the IPOA-shark and the Action Plan for conservation of the cartilaginous fishes in the Mediterranean Sea, the INSTM launched since 2002 a research program related to this taxonomic group, including studies on biology, ecology, systematic and fisheries.

Systematic studies

Our investigations showed that some groups (*Squalus* sp, *Dasyatis* sp, *Raja* sp.) present some systematic problems and then morphometrical and meristic data along with genetic analysis (DNA Inter Simple Sequence Repeats markers and molecular Barcoding methods) and parasitology studies are conducted to elucidate these problems.


Squalus megalops.

Eco-biology studies

Species	Reproduction	Age and growth	Diet
M. mustelus	x		x
M. punctulatus	x		x
C. plumbeus	x		x
R. rhinobatos	x		x
R. cemiculus	x	x	x
Raja clavata	x	x	x
R. miraletus	x	x	x
R. Radula	x	x	x
R. Oxyrinchus	x	x	x
R. alba	x	x	x
Squalus blainvillei	x	x	x
Squalus megalops	x	x	x

- **Nurseries**
- **Fisheries survey: (By-catch; CPUE,…..)**

Age, growth and maturity of *Raja miraletus*

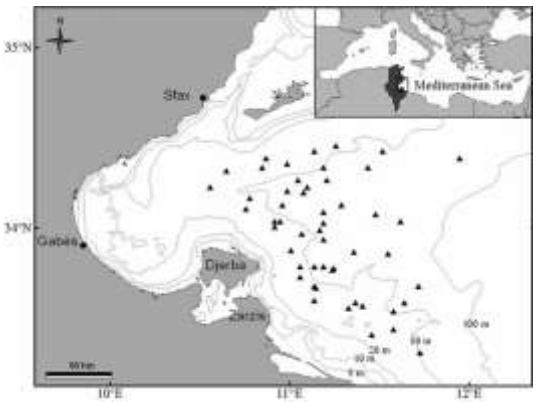
- **The brown ray, *Raja miraletus* is a medium-sized skate inhabiting the Mediterranean Sea and the western African coast.**

- **In the Mediterranean Sea, it is mainly caught off the southern shore and in the eastern basin.**
- ***Raja miraletus* is a regular component of discarded fishes of the benthic trawl fishery in the Gulf of Gabès (Central Mediterranean Sea).**

Material and methods

Sampling

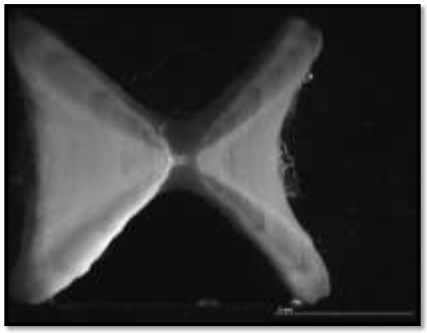
- **1170 Specimens of *Raja miraletus* :**
  - **Brought by commercial trawls, regularly twice a month, from January to December 2007**
  - **Captured as bycatch between 30 and 130 m depth in the Gulf of Gabès**



Material and methods

Age and growth

- **Vertebral samples, taken from the thoracic region, were removed from a subsample of 180 brown skates:**
  - **95 females (13.5 – 56.0 cm TL)**
  - **85 males (13.5 – 58.0 cm TL)**



- **One vertebra, from each specimen, was cut through the centrum with a double bladed low-speed saw to create thin sections.**
- **Vertebral sections were viewed under transmitted light and growth bands were counted using an Olympus S2X9 stereomicroscope at × 20 magnification.**

Material and methods

- **The annual periodicity of growth ring deposition :**
  - ✓**edge analyses**
  - ✓**Marginal Increment Ratio (Hayashi 1976):**

$$MIR = \frac{R - R_n}{R_n - R_{n-1}}$$

R is the centrum radius
Rn are radius of the and penultimate annuli.
Rn−1 are radius of the penultimate annuli.

- **Growth for male and female skates was expressed using VBGE:**

$$TLt = TL_\infty (1 - e^{-K(t - t_0)})$$

TL = total length at age t,
TL∞ = theoretical asymptotic length,
k = growth rate coefficient,
t0 = the theoretical age at zero length.

- **Longevity :**
  - ***A*99 = 5×Ln (2)/*k* (Fabens 1965)**
- **Natural mortality *M:***
  - **ln (M) = 1.46 – 1.01 ln (tmax) (Hoenig 1983)**
  - **M= 1.65/ t mat (Jensen 1996)**

Material and methods

Size and age at maturity

- sexual maturity stage were determined macroscopically.
- Size at maturity was defined as the TL at which 50% of the individuals of each sex were mature (L50%).

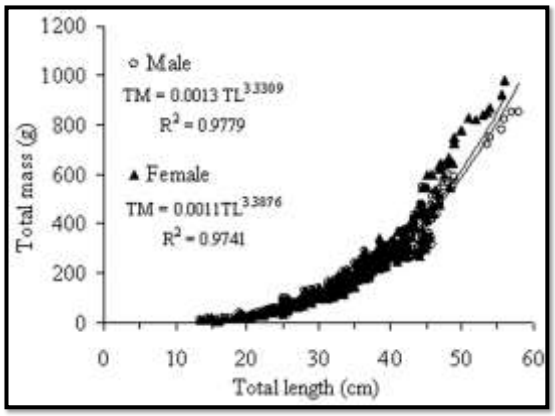
- Age at 50% maturity (A50) was directly estimated for each sex from paired age and maturity data using the above methods.

- Fecundity :

  Fecundity was assessed by using the method of Holden (1975), based on estimation of the average number of eggs produced by adult females.

Results and Discussion

- 650 females [13.5 to 56.0 cm TL; 7–980 g (TM)]
- 520 males [13.5 to 58.0 cm TL ; 8–850 g TM]

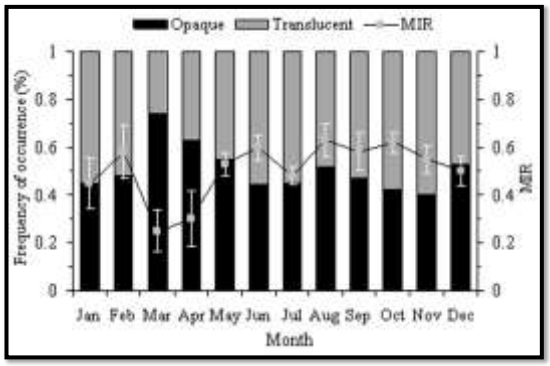


- The TM - TL relationships was significantly different between sexes

(ANCOVA, F1, 1151= 29.17, P<0.05)

Results and Discussion

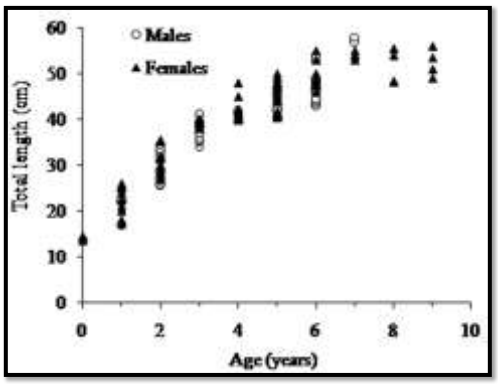
- Sexes-combined MIR values were significantly different between months (Kruskal–Wallis test, $\chi 2 = 51.75$, d.f =11, $P < 0.001$)



- The highest frequency of opaque edges appears during March, April and May.
- A single opaque band may be formed annually on vertebral centra during this period.

Results and Discussion

- Males: 0+ to 7 years
- Females: 0+ to 9 years



	Sex	L∞(cm)	k year^{-1}	t_0 year
	Females	69.2 ±1.23	0.18 ±0.011	0.11 ± 0.08
	Males	67.0 ± 1.31	0.22 ± +0.02	1.01 ± 0.2

Results and Discussion

Longevity

- The oldest male : 7 years ⟹ 15.75
- the oldest female: 9 years ⟹ 19.25

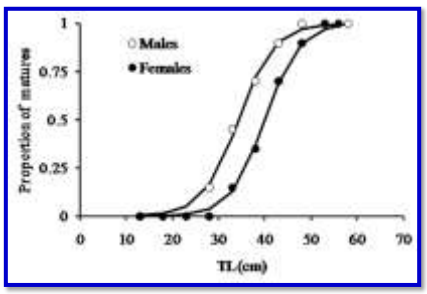
Natural mortality

Method	Variables	Values (years)		*M*	
		Males	Females	Males	Females
Hoeing(1983)	t_{max}	7	9	0.60	0.47
Jensen (1996)	t_{50}	2.7	4.41	0.61	0.37

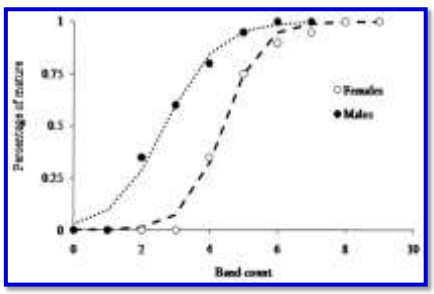
Results and Discussion

Size and age at maturity

- Males
  - Smallest mature: 28 cm
  - Largest immature: 43 cm
  - L 50% = 34.31 cm
- Females
  - Smallest mature : 33 cm
  - Largest immature: 48 cm
  - L50% = 41.8 cm



- Males
  - A50% = 2.7 years
- Females
  - A50% = 4.4 years



Results and Discussion

Fecundity

Months	Proportion with capsules	Relative proportion	Days	Number of eggs laid
Jan.	25	0.75	31	23.27
Feb.	25	0.75	28	21.77
Mar.	31.8	0.95	31	29.60
Apr.	30	0.90	30	27.03
May	30	0.90	31	27.93
Jun.	24.5	0.74	30	22.07
Jul.	17.4	0.52	31	16.20
Aug.	31	0.93	31	28.86
Sep.	25	0.75	30	22.52
Oct.	26	0.78	30	24.20
Nov.	21.7	0.65	30	19.55
Dec.	33.3	1	31	31
				294

Considering the assumption of a rate of one egg case laid per 2 day in skates

The egg case production could be assessed to 147.

Perspectives

The results made and the data collected increase our knowledge on the life history of the brown ray , thus underscoring the need for scientific collaboration among countries facing the Mediterranean Sea, as well as the crucial necessity of collecting information on marine biodiversity and its conservation.

Age, growth and maturity of *Raja clavata*

Skates are becoming economically valuable in the Mediterranean fisheries, mainly due to the depletion of many commercial bony fish.

Owing to their commercial interest, obtaining life history information for skates has become more important when trying to manage their captures

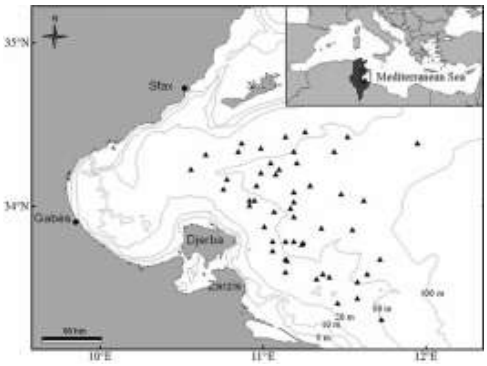
The thornback ray *Raja clavata* is the more common and widespread skate in the Mediterranean Sea and is the dominant species in commercial landings.

Life history traits of *Raja clavata* in the Gulf of Gabès were estimated in this study.

MATERIALS and METHODS

1280 specimens were examined in this study.

Specimens of *R. clavata* were brought by commercial trawl, regularly twice a month, from January to December 2007.



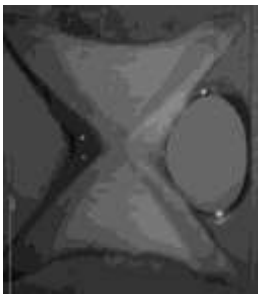
Specimens were captured at depths of 30-150 m in the Gulf of Gabès.

MATERIALS and METHODS

Age and growth

Vertebral samples, taken from the thoracic region, were removed from

- 160 females (16.5 – 104 cm TL)
- 125 males (21.7 – 85 cm TL)



One vertebra, from each specimen, was cut through the centrum with a double bladed low-speed saw to create thin sections.

Vertebral sections were viewed under transmitted light and growth bands were counted using a stereomicroscope at × 20 magnification.

A growth ring was defined as a pair of bands, consisting of one highly calcified (light) band and one less-calcified (dark) band

The first band near the focus was defined as hatch mark (age zero).

MATERIALS and METHODS

The annual periodicity of growth ring deposition was investigated :

- ✓edge analyse
- ✓Marginal Increment Ratio (Hayashi 1976):

$$MIR = \frac{R - R_n}{R_n - R_{n-1}}$$

R is the centrum radius
Rn is radius of the and penultimate annuli.
Rn−1 is radius of the penultimate annuli.

The von Bertalanffy growth model (VBGM) was fitted separately to sex-specific observed size-at-age data using the equation.

$$TLt = TL_{\infty}\left(1 - e^{-K(t - t_0)}\right)$$

TL = total length at age t,
TL∞ = theoretical asymptotic length,
k = growth rate coefficient,
t0 = the theoretical age at zero length.

Longevity :

- *A*99 = 5×Ln (2)/*k* (Fabens 1965)

Natural mortality *M:*

- ln (M) = 1.46 – 1.01 ln (tmax) (Hoenig 1983)
- M= 1.65/ t mat (Jensen 1996)

MATERIALS and METHODS

Size and age at maturity

Sexual maturity stages were determined by macroscopic examine of reproductive organs.

Size at maturity was defined as the TL at which 50% of the individuals of each sex were mature (L50%).

Age at 50% maturity (A50) was directly estimated for each sex from paired age and maturity data using the above methods.

Fecundity :

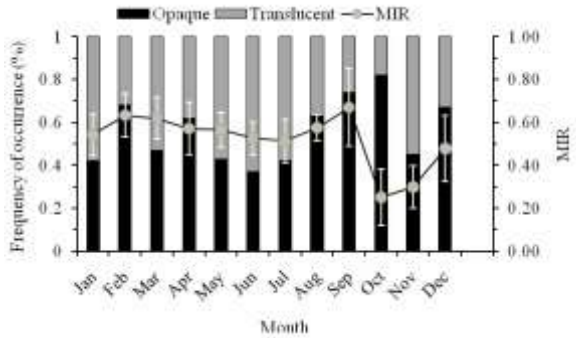
Fecundity was assessed by using the method of Holden (1975), based on estimation of the average number of eggs produced by adult females

RESULTS

The sexes-combined MIR were significantly different among months (Kruskal-Wallis, H = 50.76, dl =11, P <0.05).

The MIR lowest during October and November

The highest frequency of opaque edges appears during September and October

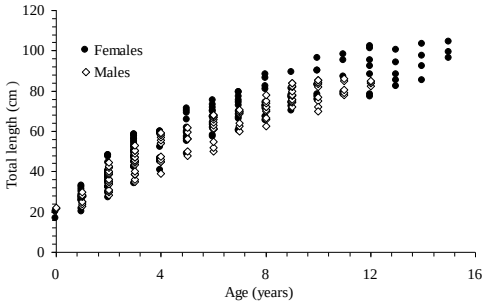


A single opaque band may be formed annually on vertebral centra during October and November

RESULTS

Males: 0 -12 years

Females : 0 -15 years.



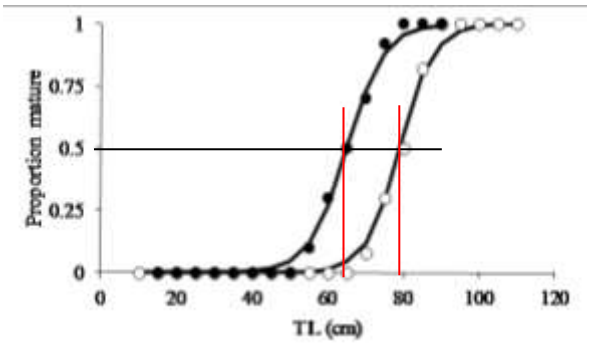
	Von Bertallanffy parameters		
	LT∞ (cm)	K	t_0
Mâles	100.8 ± 3,34	0.14±0.012	-1.13±0,02
Femelles	111.46±2,25	0.11±0.003	-1.23±0,03

Longevity

The oldest male : 12 years **22.76**

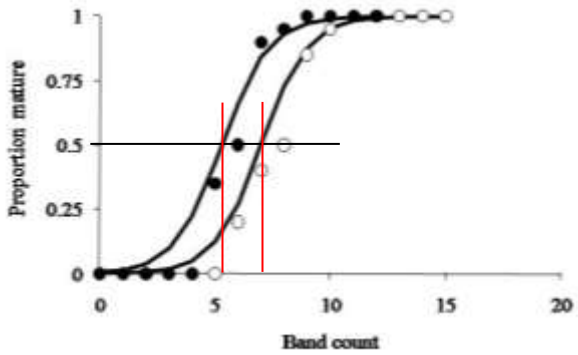
The oldest female: 15 years **28.5**

RESULTS



- **Female reach maturity: 72-85 cm, L50% = 79 cm TL.**
- **Male reach maturity: 55-75 cm, L50% = 65 cm TL.**

RESULTS



Female: 6-10 years.
Male : 5-8 years.
The A50% was estimated to be 8 years for females and 6 years for males.

RESULTS

Months	Proportion with capsules	Relative proportion	Days	Number of eggs laid
Jan.	40	1	31	31
Feb.	14.8	0.37	28	10.73
Mar.	34.6	0.87	31	26.81
Apr.	21.7	0.54	30	16.27
May	11.1	0.28	31	8.6
Jun.	23.3	0.58	30	17.48
Jul.	23.08	0.58	31	17.89
Aug.	17	0.43	31	13.17
Sep.	12.9	0.32	30	9.67
Oct.	16.6	0.42	30	12.86
Nov.	29.03	0.73	30	21.77
Dec.	9.6	0.24	31	7.44
				≈194

Considering the assumption of a rate of one egg case laid per 2 day in skates

The egg case production could be assessed to 97.

Some other available data

Glaucostegus (Rhinobatos) cemiculus

- **Length frequency distribution**
- **Age and growth parameters**
- **Structure by age**
- **Biological data (size at maturity, fecundity..)**

THANKS FOR YOUR ATTENTION