S.I.B.M.

WORKSHOP

STUDIO E VALUTAZIONE
DEGLI ELASMOBRANCHI DELLE ACQUE ITALIANE.
LORO STATO DI SFRUTTAMENTO E CONSERVAZIONE

Chioggia 10-11 Maggio 2016

Metodiche per la raccolta dei dati: stadi di maturità, stima della fecondità

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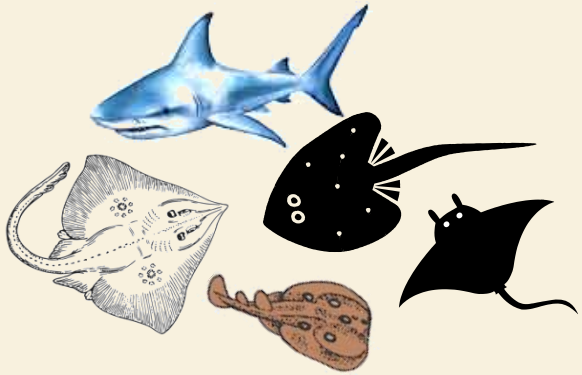
Gli Elasmobranchi sono considerati organismi aventi **strategia riproduttiva di tipo K** (o "*d'equilibrio*")

- **crescita lenta;**
- **età di prima maturità tardiva;**
- **bassa fecondità;**
- **uova di grosse dimensioni;**
- **scarsa mortalità naturale.**



(Hoenig & Gruber 1990; Musick, 1999; Cortés, 2000)

Le modalità riproduttive possono essere suddivise:

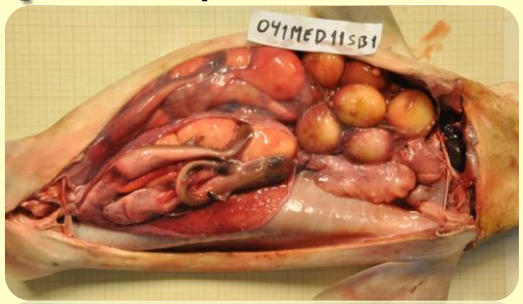
Wourms, 1981

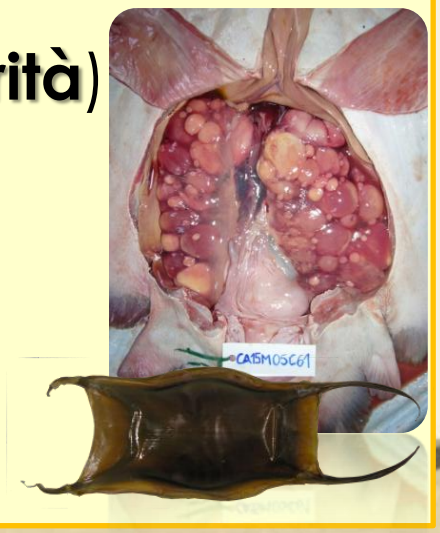
sulla base del nutrimento che riceve il feto

- la lecitotrofia, in cui l'intero sviluppo dell'embrione è supportato solamente dal vitello;
- la matrotrofia, in cui almeno una parte dello sviluppo fetale è supportata da nutrienti addizionali provenienti dalla madre.

in base a dove avviene lo sviluppo embrionale

- all'esterno del corpo della madre (**oviparità**)
- all'interno di esso (**viviparità**).





MODALITA' RIPRODUTTIVE

Viene deposto un uovo alla volta da ciascun ovidotto
(Rajidae e Heterodontiformes)

Musick & Ellis, 2005		Lecitotrofia	Matrotrofia
OVIPARITÀ	Singola	+	
	Multipla	+	
VIVIPAR	Sacco vitellino	+	
			+
			+
			+
			+
			+

Comporta la conservazione di un ridotto numero di uova nell'ovidotto durante la maggior parte dello sviluppo prima della deposizione
(e.g. *Galeus melastomus*)

Dopo un periodo iniziale di dipendenza dal tuorlo del sacco vitellino, l'embrione è nutrito dalla madre attraverso una placenta formata dalla fusione del sacco vitellino con la parete dell'ovidotto.

si accrescono ingerendo le uova non fecondate prodotte dalla madre, per sostenere il loro sviluppo

PARAMETRI RIPRODUTTIVI

Sebbene il ciclo riproduttivo dei maschi è generalmente

Lunghezza alla

Nelle specie ovipare si può determinare in acquario, in quelle vivipare, dagli embrioni in utero.

posseggono la cicatrice ombelicale.

gestazione.

GESTIONE DELLA PESCA E VALUTAZIONE DEGLI STOCK

1999 MEDITS

UNICA SCALA PER OVIPARI E VIVIPARI

1	IMMATURE
2	MATURING
3	MATURE

2008 MEDITS

UNICA SCALA PER OVIPARI E VIVIPARI

1	IMMATURE/VIRGIN
2	MATURING
3a	MATURE
3b	MATURE EXTRUDING/ACTIVE
4	RESTING

WKMSEL Malta 2010; WKMSEL2 Lisbona, 2012

2012 MEDITS

OVIPARI

1	IMMATURE/VIRGIN
2	MATURING
3a	MATURE
3b	MATURE EXTRUDING/ACTIVE
4a	RESTING
4b	REGENERATING

VIVIPARI

1	IMMATURE
2	DEVELOPING
3a	SPAWNING CAPABLE
3b	EARLY PREGNANCY
3c	MID PREGNANCY
3d	LATE PREGNANCY
4a	REGRESSING
4b	REGENERATING

SCALE DI MATURITÀ

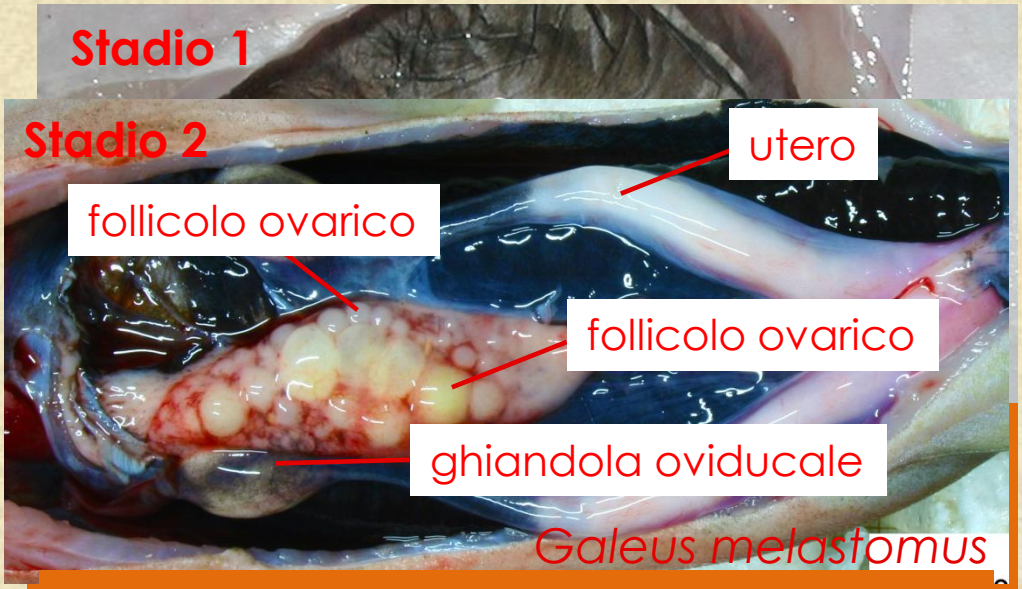
OVIPARI

Sex	GONAD ASPECT	MATURATION STATE	STAGE
I	Sex not distinguished by naked eye.	UNDETERMINED	0
F	Ovary is barely discernible with small isodiametric eggs. Distal part of oviducts is thick-walled and whitish. The nidamental glands are less evident.	IMMATURE/VIRGIN	1
M	Claspers are small and flaccid and do not reach the posterior edge of the pelvic fins. Spermducts not differentiated. Testis small and narrow.		
F	Whitish and/or few yellow maturing eggs are visible in the ovary. The distal part of oviducts (uterus) is well developed but empty. The nidamental glands are small.	MATURING*	2
M	Claspers are larger, but skeleton still flexible. They extend to the posterior edge of the pelvic fins. Spermducts well developed eventually beginning to meander.		
F	Ovaries contain yellow eggs (large yolk eggs). The nidamental glands are enlarged and oviducts are distended.	MATURE	3a
M	Claspers extends well beyond the posterior edge of the pelvic fin and their internal structure is generally hard and ossified. Testis greatly enlarged. Spermducts meandering over almost their entire length.		
F	Ovary walls transparent. Oocytes of different sizes, white or yellow. Nidamental glands large. Egg-cases more or less formed in the oviducts (Extruding Stage).	MATURE/EXTRUDING-ACTIVE	3b
M	Clasper longer than tips of posterior pelvic fin lobes, skeleton hardened with axial cartilages hardened and pointed. Spermducts largely. Sperm flowing on pressure from cloaca (Active Stage).		
F	Ovary walls transparent. Oocytes of different sizes, white or yellow. Oviducts appear much enlarged, collapsed and empty. The nidamental glands diameter are reducing.	RESTING	4a
M	Clasper longer than tips of posterior pelvic fin lobes, skeleton hardened with axial cartilages still hardened. Spermducts empty and flaccid.		
F	Ovaries full of small follicles similar to stage 2, enlarged oviducal glands and Uterus.	REGENERATING*	4b

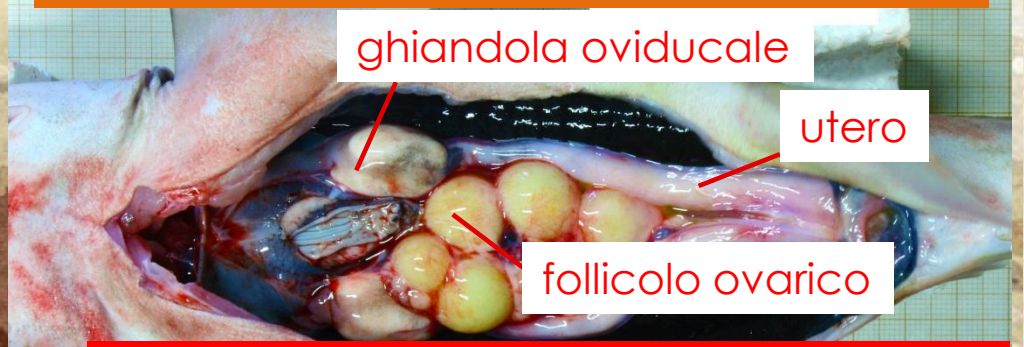
STADIO	STADIO
IMMATURO/ VERGINE	1
IN MATURAZIONE*	2
MATURO	3a
MATURO/ EXTRUDING	3b
A RIPOSO	4a
IN RIGENERAZIONE*	4b

FEMMINE

OVIPARI



E' importante, nello stadio in maturazione, che i follicoli ovarici in vitellogenesi, se presenti, siano al massimo di MEDIE dimensioni .

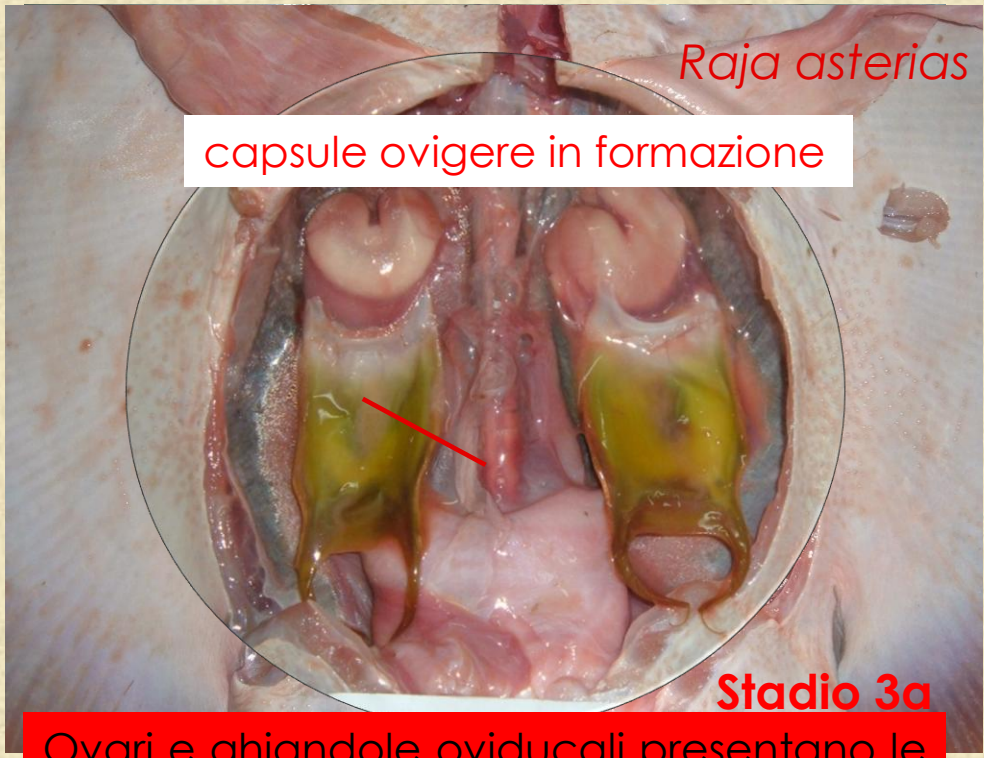


La presenza di follicoli ovarici ricchi di tuorlo GRANDI permette la corretta attribuzione dello stadio 3a.

STADIO	STADIO
IMMATURO/ VERGINE	1
IN MATURAZIONE*	2
MATURO	3a
MATURO/ EXTRUDING	3b
A RIPOSO	4a
IN RIGENERAZIONE*	4b

FEMMINE

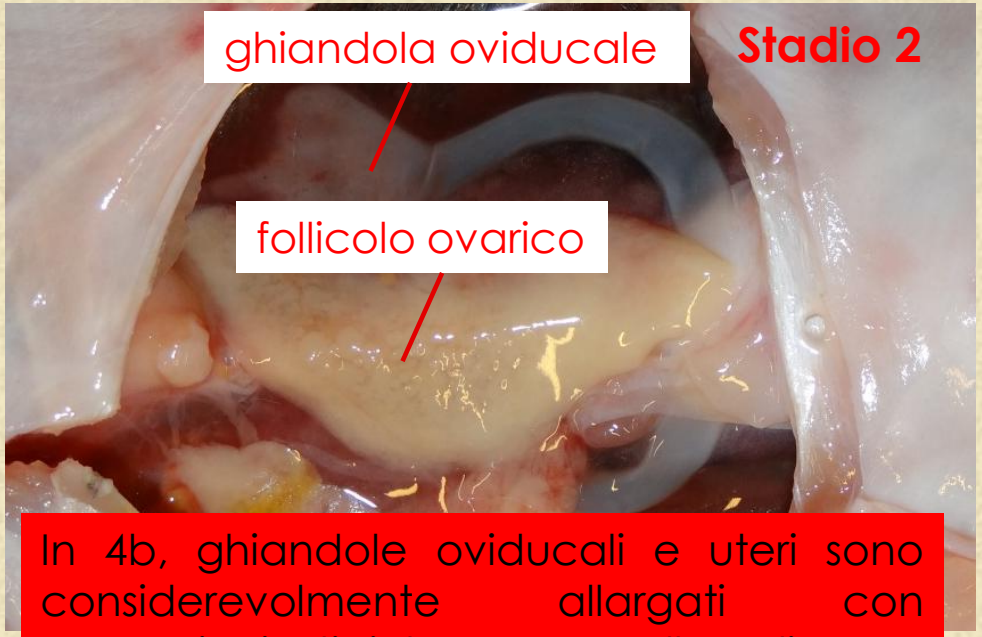
OVIPARI



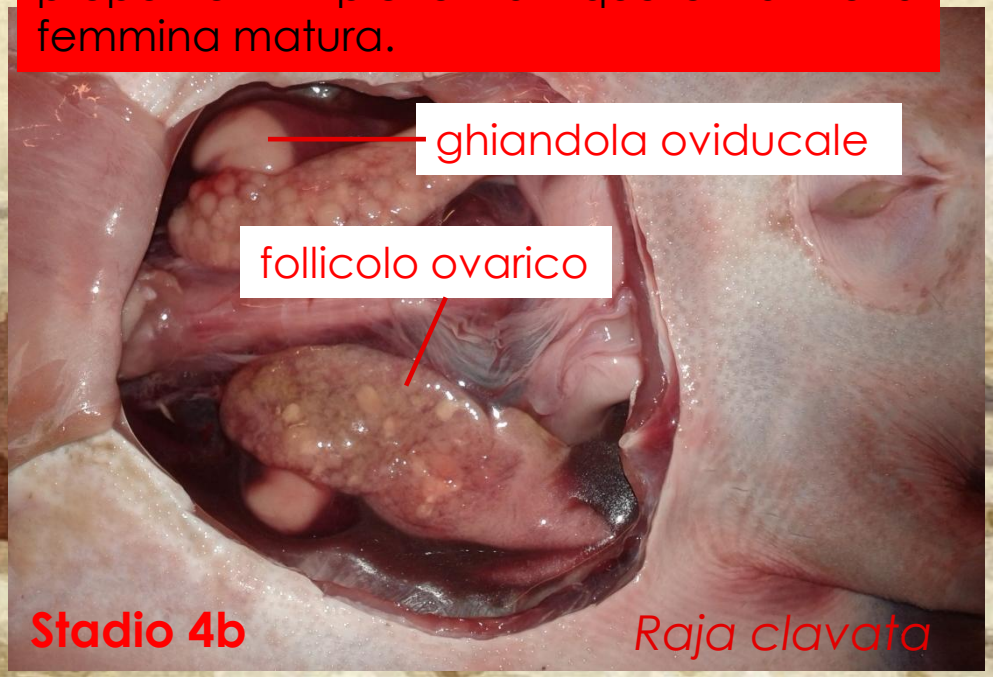
Ovari e ghiandole oviducali presentano le stesse caratteristiche dello stadio 3a.

ATRESICI.

STADIO	STADIO
IMMATURO/ VERGINE	1
IN MATURAZIONE*	2
MATURO	3a
MATURO/ EXTRUDING	3b
A RIPOSO	4a
IN RIGENERAZIONE*	4b



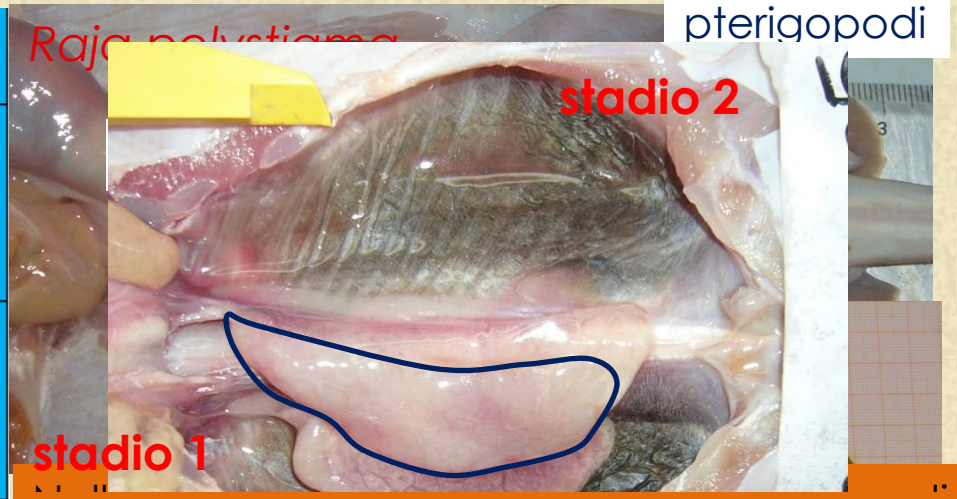
In 4b, ghiandole oviducali e uteri sono considerevolmente allargati con proporzioni tipiche a quelle di una femmina matura.



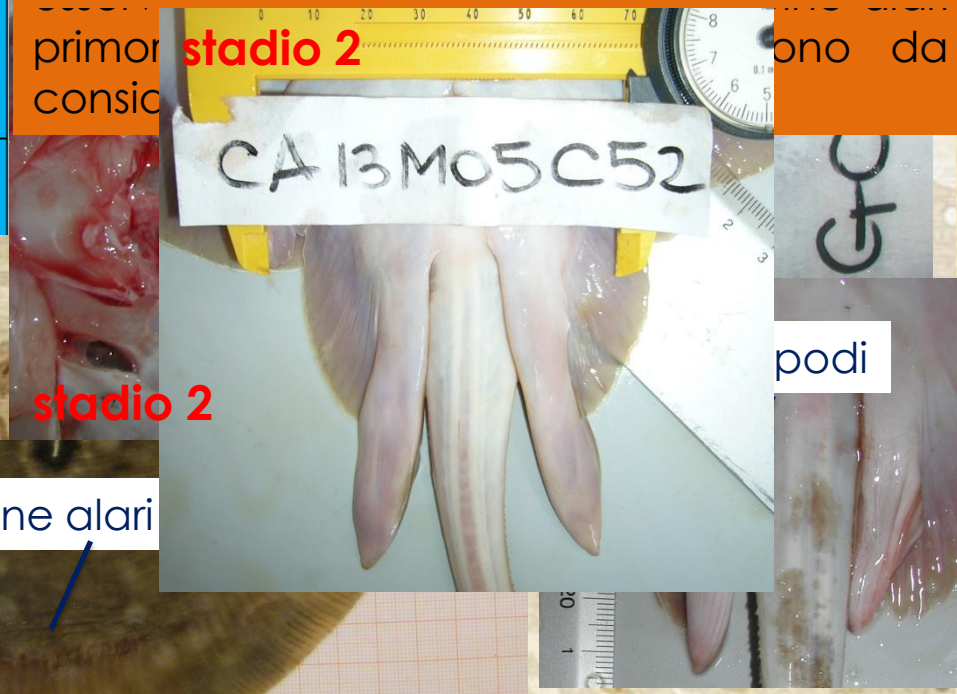
FEMMINE

OVIPARI

STADIO	STADIO
IMMATURO/ VERGINE	1
IN MATURAZIONE*	2
MATURO	3a
MATURO/ ATTIVO	3b
A RIPOSO	4



I maschi con testicoli pienamente sviluppati, ma con pterigopodi flessibili dovrebbero essere assegnati allo stadio 2.



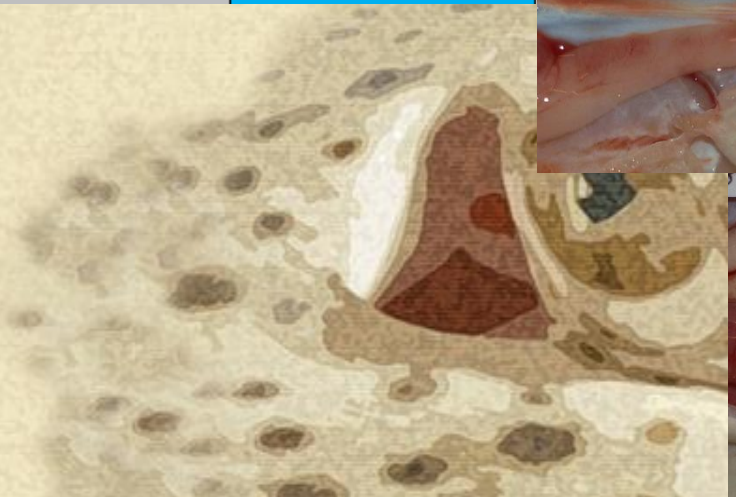
MASCHI

OVIPARI

STADIO	STADIO
IMMATURO/ VERGINE	1
IN MATURAZIONE*	2
MATURO	3a
MATURO/ ATTIVO	3b
A RIPOSO	4

Galeus melastomus

In alcune specie di gattucci (*S. canicula* e *S. stellaris*), gli pterigopodi non si estendono MAI oltre la pinna pelvica.



Scyliorhinus canicula

SCALE DI MATURITÀ

VIVIPARI

Sex	GONAD ASPECT	MATURATION STATE	MATURITY	STAGE
I	**Sex not distinguished by naked eye.**	UNDETERMINED	IMMATURE	0
F	Ovaries barely visible or small, whitish; undistinguishable ovarian follicles. Oviducal (nidamental) gland may be slightly visible. Uterus is thread-like and narrow.	IMMATURE	IMMATURE	1
M	Claspers flexible and shorter than pelvic fins. Testes small (in rays, sometimes with visible lobules). Sperm ducts straight and thread-like.			
F	Ovaries enlarged with small follicles (oocytes) of dif-ferent size. Some relatively larger yellow follicles may be present. Ovaries lack atretic follicles. Developing oviducal gland and uterus.	DEVELOPING	IMMATURE*	2
M	Claspers slightly more robust but still flexible. Claspers as long as or longer than pelvic fins. Testes enlarged; in sharks testes start to segment; in rays lobules clearly visible but do not occupy the whole surface. Sperm ducts developing and beginning to coil (meander).			
F	Large ovaries with enlarged yolk follicles all of about the same size so that they can be easily distinguished. Oviducal gland and uterus developed without yolky matter, embryos and not dilated.	CAPABLE to REPRODUCE	MATURE	3a
M	Claspers fully formed, skeleton hardened, rigid and generally longer than pelvic fins. Testes greatly enlarged; in sharks testes are fully segmented; in rays filled with developed lobules. Sperm ducts tightly coiled and filled with sperm.	SPAWNING CAPABLE		
F	Uteri well filled and rounded with yolk content (usually candle shape). In general segments cannot be distinguished and embryos cannot be observed.	EARLY PREGNANCY	MATERNAL	3b
M	Description similar to stage 3a, however with clasper glands dilated, often swollen and reddish (occasion-ally open). Sperm often present in clasper groove or glans. On pressure sperm is observed flowing out of the cloaca or in the sperm ducts.	ACTIVELY SPAWNING	MATURE	
F	Uteri well filled and rounded, often with visible segments. Embryos are always visible, small and with a relatively large yolk sac.	MID PREGNANCY	MATERNAL	3c
F	Embryos fully formed, yolk sacs reduced or absent. Embryos can be easily measured and sexed.	LATE PREGNANCY	MATERNAL	3d
F	Ovaries shrunken without follicle development and with atretic (degenerating) follicles. The oviducal glands diameter may be reducing. Uterus appears much enlarged, collapsed, empty and reddish.	REGRESSING	MATURE	4a
M	Claspers fully formed, similar to stage 3. Testes and spermducts shrunken and flaccid.	REGRESSING	MATURE	4
F	Ovary with small follicles in different stages of de-velopment with the presence of atretic ones. Uterus enlarged with flaccid walls. Oviducal gland distinguishable.	REGENERATING (mature)	MATURE*	4b

MATURATION STATE	MATURITY	STAGE
IMMATURE	IMMATURE	1
DEVELOPING	IMMATURE*	2
CAPABLE to REPRODUCE	MATURE	3a
EARLY PREGNANCY	MATERNAL	3b
MID PREGNANCY	MATERNAL	3c
LATE PREGNANCY	MATERNAL	3d
REGRESSING	MATERNAL	4a
REGENERATING	MATURE*	4b

E' importante, nello stadio in maturazione, che i follicoli ovarici in vitellogenesi, se presenti, siano al massimo di MEDIE dimensioni .

La presenza di follicoli ovarici ricchi di tuorlo GRANDI permette la corretta attribuzione dello stadio 3a.

FEMMINE

VIVIPARI

MATURATION STATE	MATURITY	STAGE
IMMATURE	IMMATURE	1
DEVELOPING	IMMATURE*	2
CAPABLE to REPRODUCE	MATURE	3a
EARLY PREGNANCY	MATERNAL	3b
MID PREGNANCY	MATERNAL	3c
LATE PREGNANCY	MATERNAL	3d
REGRESSING	MATERNAL	4a
REGENERATING	MATURE*	4b

Esiste una certa soggettività nella distinzione degli stadi mid e late pregnancy. In caso di difficoltà, è raccomandato rilevare le dimensioni corporee degli embrioni.

Dalatias licha

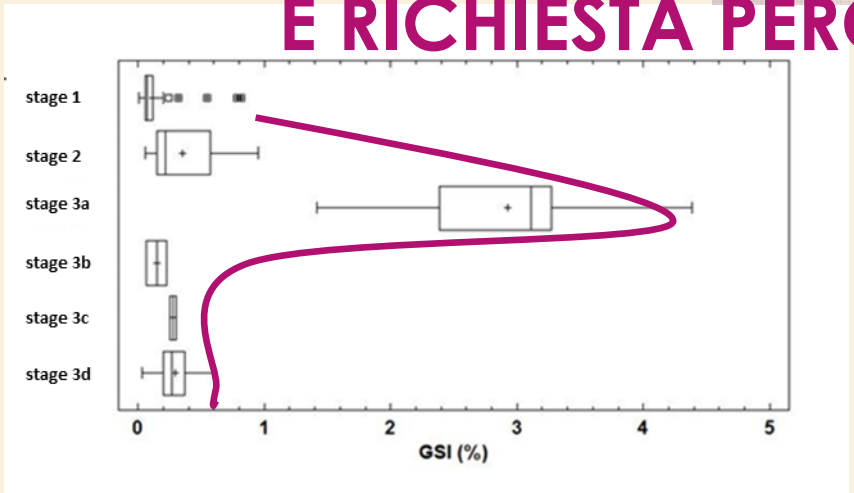
FEMMINE

VIVIPARI

FASE OVARICA E UTERINA **ASINCRONE**

E. spinax

NEGLI STADI MATERNI 3b, 3c, 3d, L'OSSERVAZIONE DELLA GONADE NON È RICHIESTA PERCHÉ:

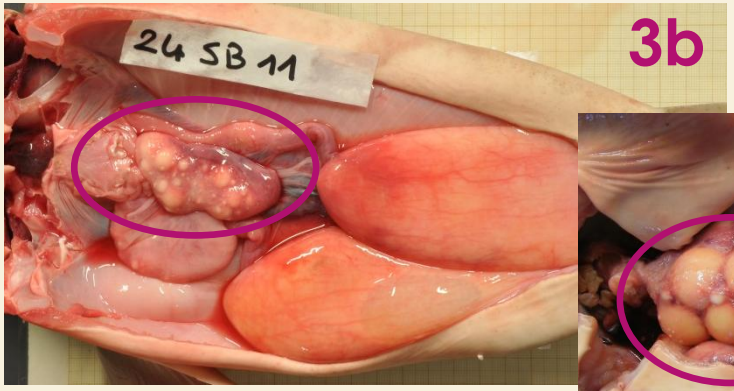


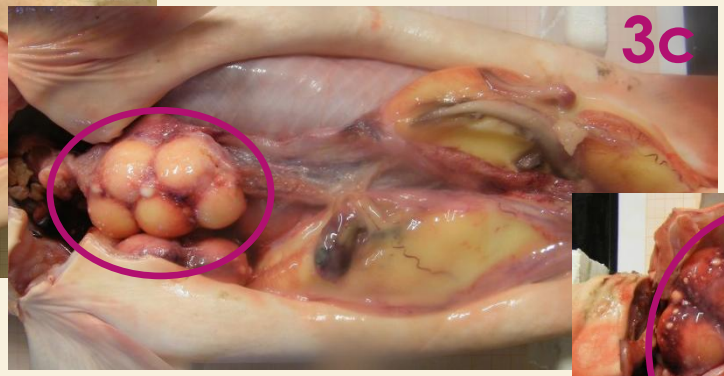
FEMMINE

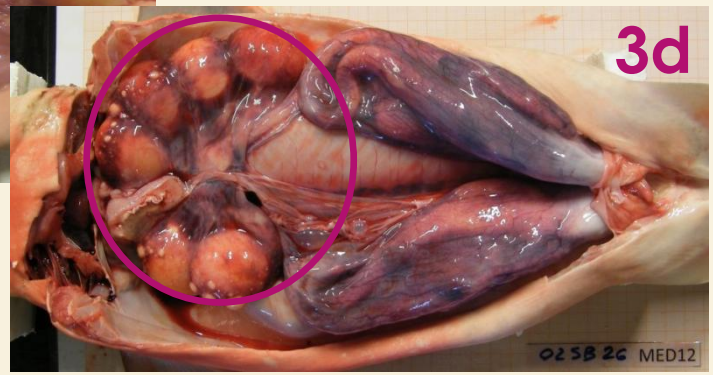
VIVIPARI

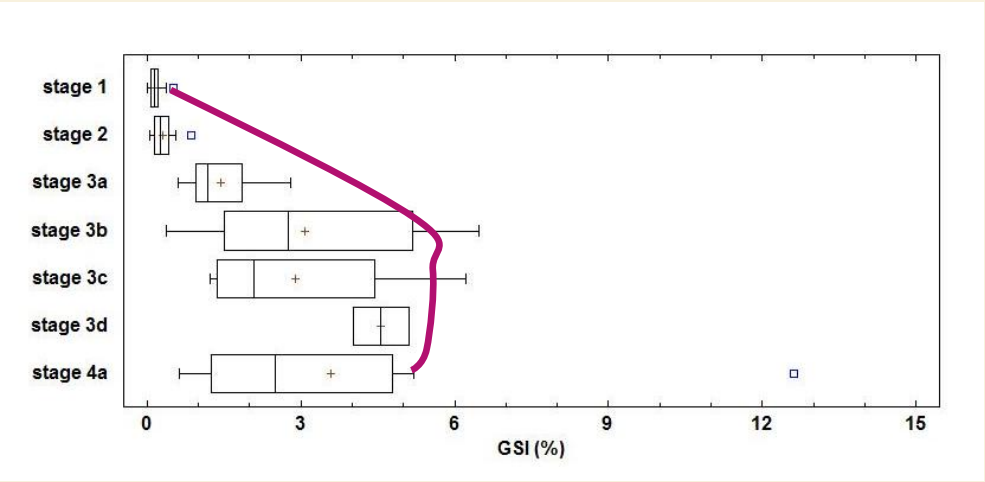
FASE OVARICA E UTERINA **SINCRONE**

S. blainville









FEMMINE

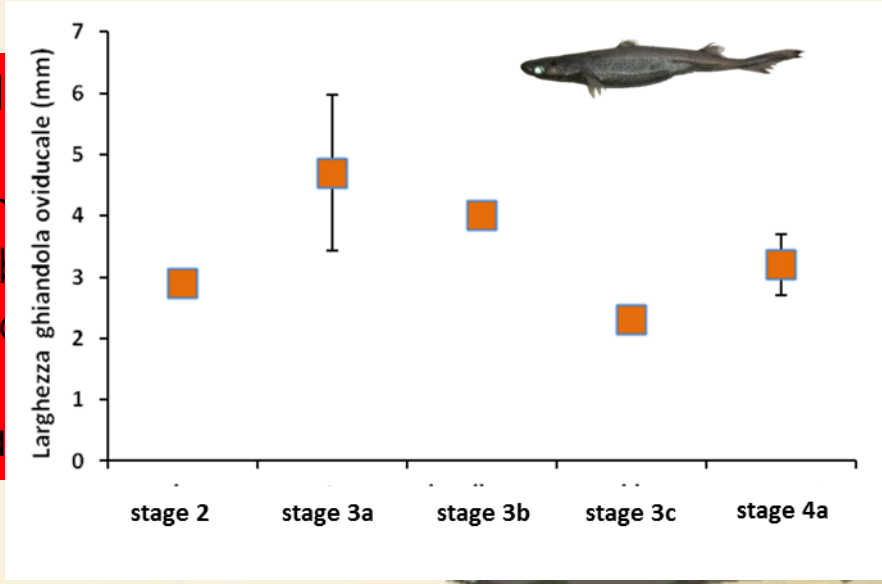
VIVIPARI

MATURATION STATE	MATURITY	STAGE
IMMATURE	IMMATURE	1
DEVELOPING	IMMATURE*	2
CAPABLE to REPRODUCE	MATURE	3a
EARLY PREGNANCY	MATERNAL	3b
MID PREGNANCY	MATERNAL	3c
LATE PREGNANCY	MATERNAL	3d
REGRESSING	MATERNAL	4a
REGENERATING	MATURE*	4b

NEGLI STADI MATERNI 3b, 3c, 3d, L'OSSERVAZIONE DELLA GHIANDOLA OVIDUCALE NON È RICHIESTA

Durante le fasi di gra
le ghiandole oviduca
regressione (e.g.
coelolepis; Etmopteru

Nelle specie ap
aborto a causa
questo caso fer
abortito) potrebb
post-nascita. E' r
di altre strutture
corretta classifica



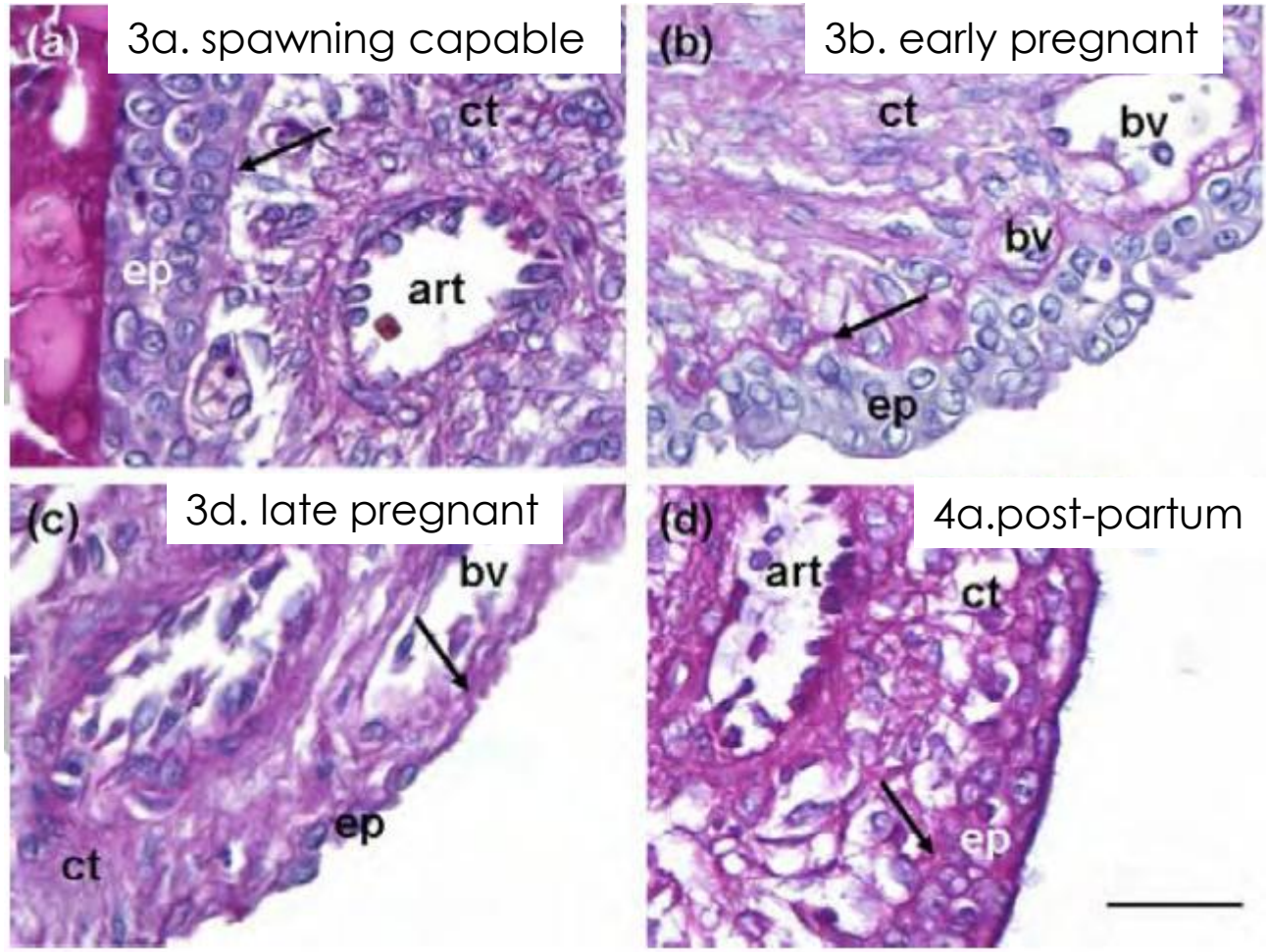
FEMMINE

VIVIPARI

UTERO – analisi istologica

Centroscymnus coelolepis

Moura e Figueiredo (WKMSEL2, 2012)



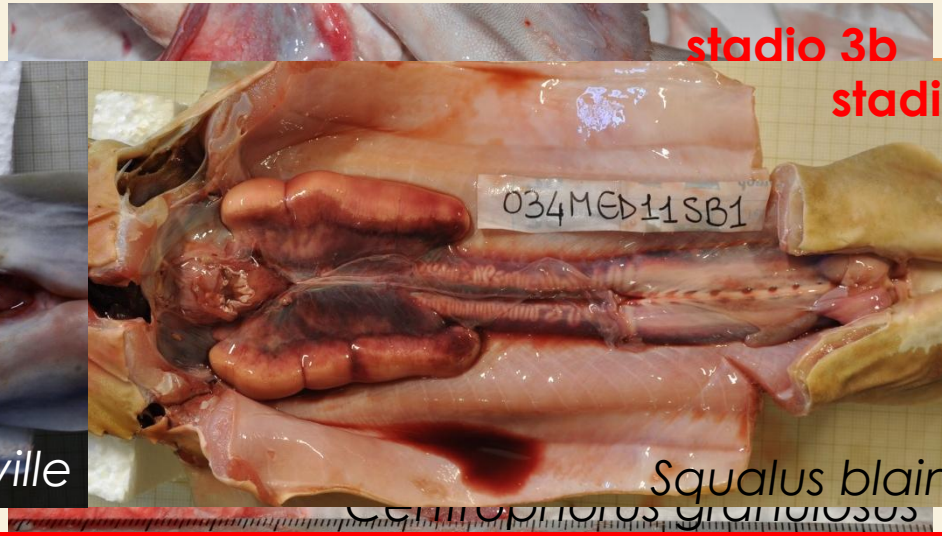
l'epitelio dei villi uterini è costituito da tessuto connettivo fiancheggiato da un epitelio stratificato in femmine mature e early pregnant.

l'epitelio dei villi diventa semplice squamoso, diminuendo notevolmente il suo spessore. Il numero di vasi sanguigni vicini all'epitelio incrementano in numero e diametro.

Dopo il parto, l'epitelio di villi recupera la struttura iniziale presentato prima dell'ovulazione.

trophonemata

MATURATION STATE	MATURITY	STAGE
IMMATURE	IMMATURE	1
DEVELOPING	IMMATURE	2
CAPABLE to REPRODUCE	MATURE	3a
ACTIVELY SPAWNING	MATURE	3b
REGRESSING	MATURE	4



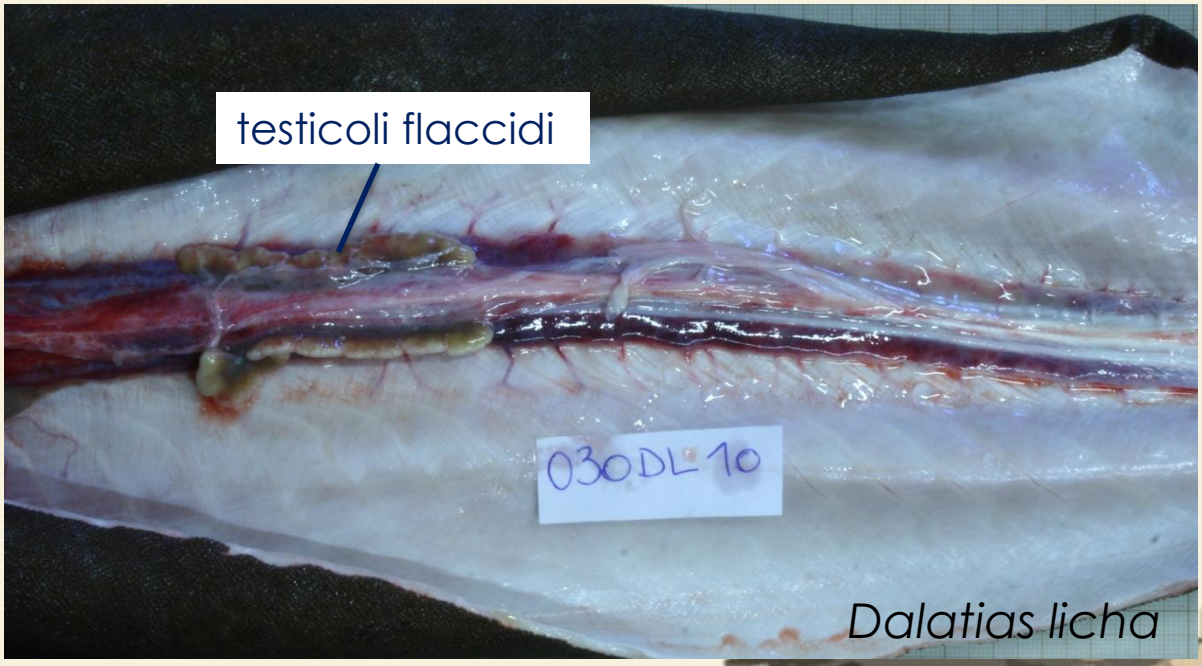
MASCHI

VIVIPARI

La distinzione tra stadio 3a e 3b spesso risulta difficoltosa. In questo caso, è auspicabile assegnare l'individuo allo stadio 3a in modo da essere più conservativi.

MATURATION STATE	MATURITY	STAGE
IMMATURE	IMMATURE	1
DEVELOPING	IMMATURE	2
CAPABLE to REPRODUCE	MATURE	3a
ACTIVELY SPAWNING	MATURE	3b
REGRESSING	MATURE	4

Lo stadio REGRESSING è molto difficile da individuare probabilmente perché avviene troppo velocemente.



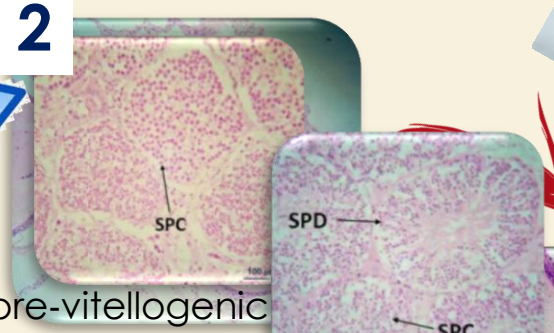
Dalatias licha

MASCHI

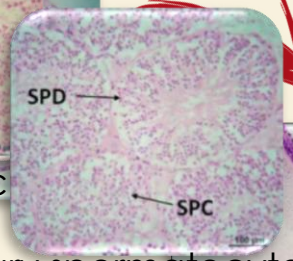
VIVIPARI

ISTOLOGIA

2

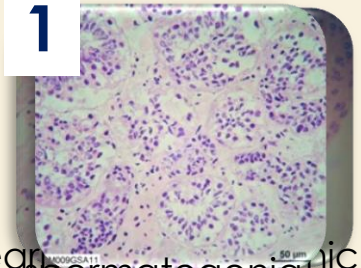


pre-vitellogenic



secondary spermatocytes

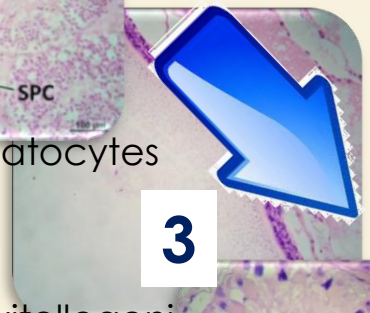
1



ear ic

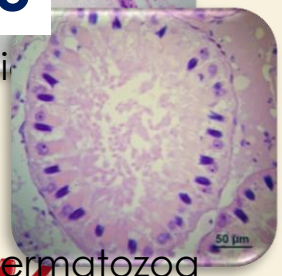
spermatogonia

follicles



3

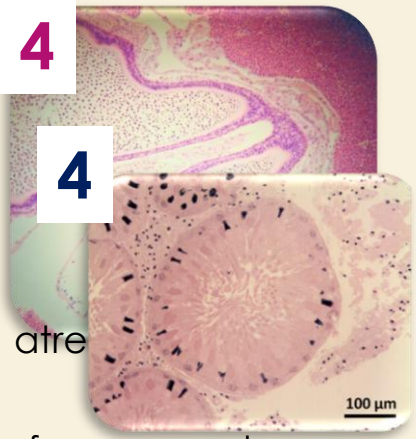
vitellogeni



spermatozoa

4

4

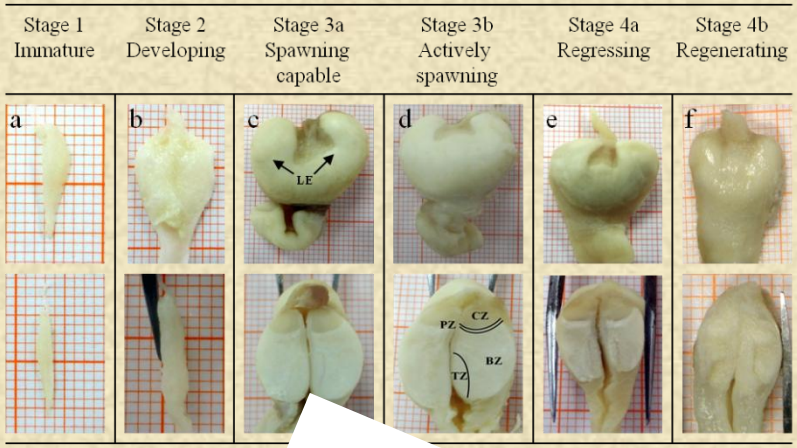


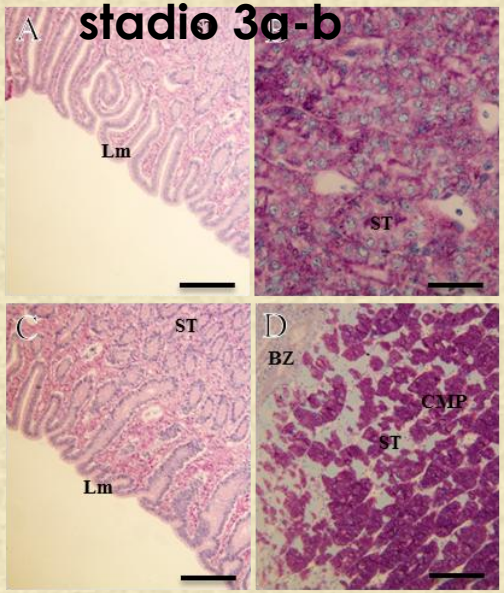
atre

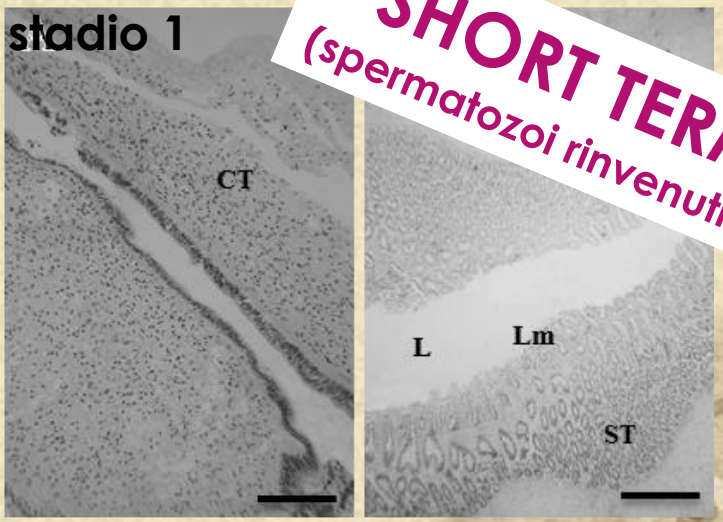
few spermatozoa

MASCHI

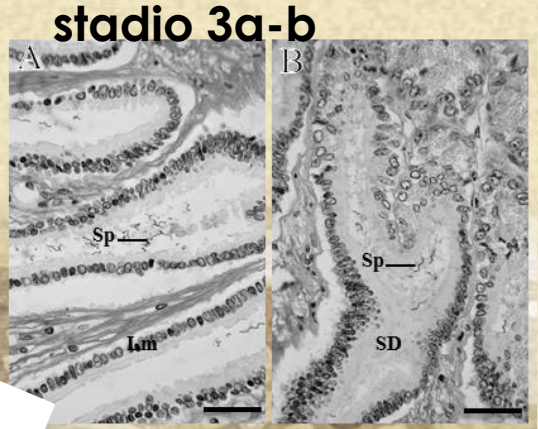
GHIANDOLA OVIDUCALE -analisi istologica

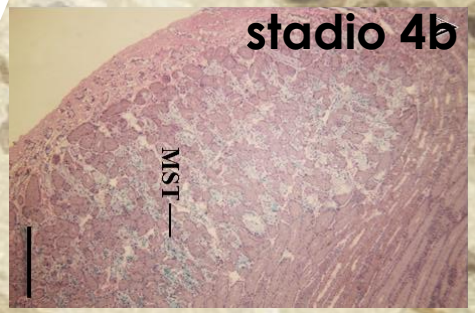






SHORT TERM SPERM STORAGE
(spermatozoi rinvenuti nelle lamelle della baffle zone)

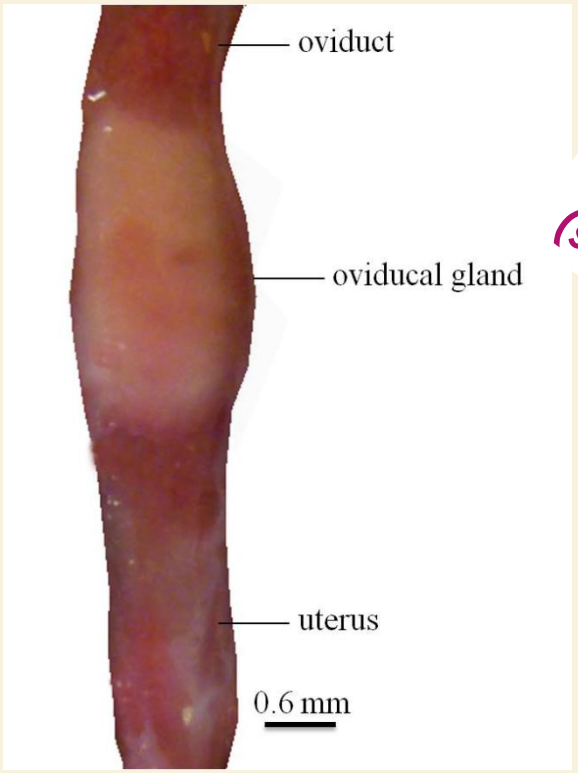


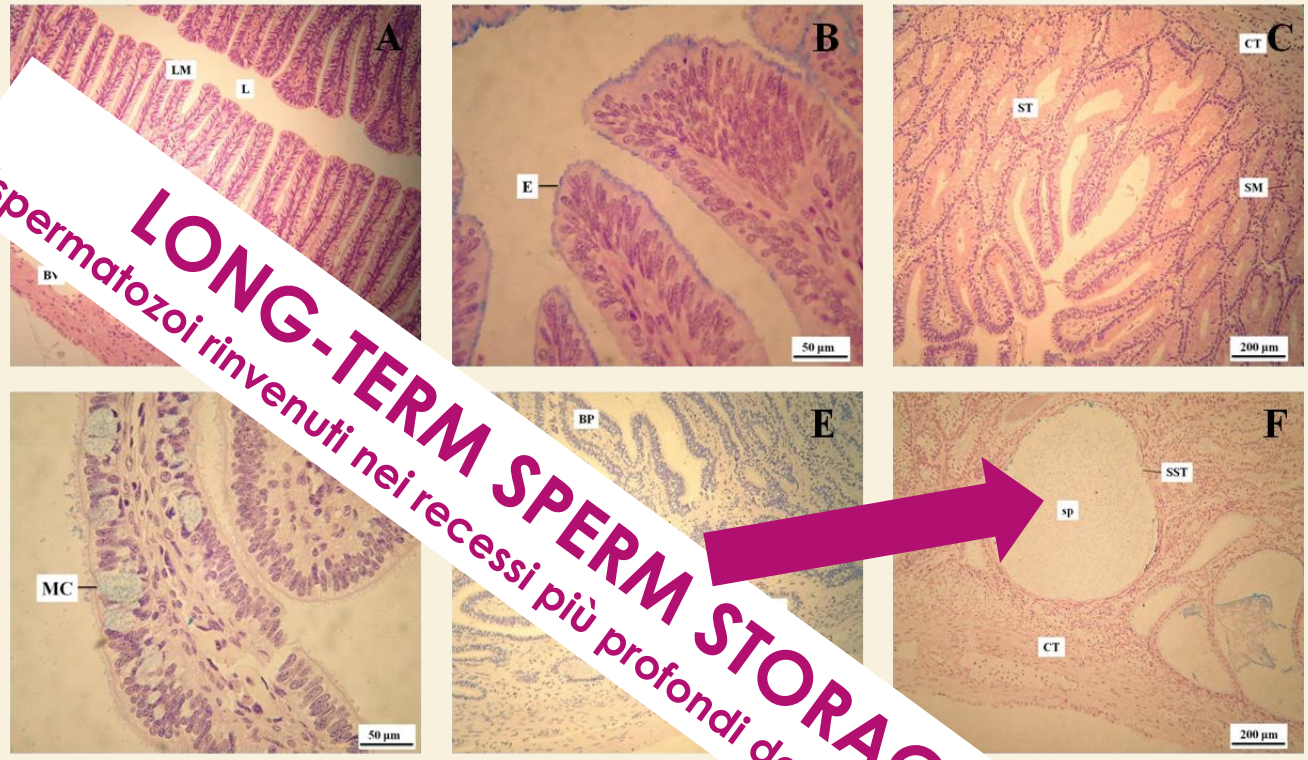


OVIPARI

GHIANDOLA OVIDUCALE -analisi istologica

E. spinax





LONG-TERM SPERM STORAGE

(spermatozoi rinvenuti nei recessi più profondi della ghiandola)

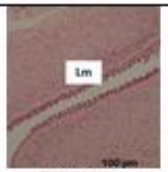
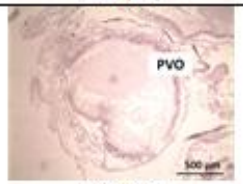
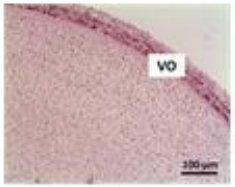
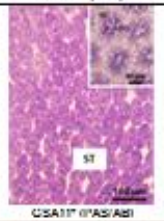
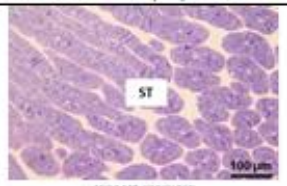
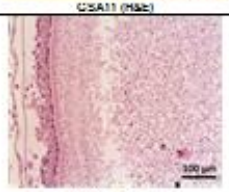
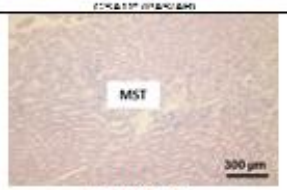
VIVIPARI

Dipturus oxyrinchus - DCF

STAGE	MATURATION STATE	
1	IMMATURE/ VIRGIN	
2	MATURING*	
3a	MATURE	
3b	MATURE/ EXTRUDING	
4a	RESTING	
4b	REGENERATING*	

Dipturus oxyrinchus - DCF CODE: RJO - MEDITS CODE: RAJA OXY

FEMALES

STAGE	MATURATION STATE	MICRO_PHOTOS (ovary)	MICRO_PHOTOS (oviducal gland)
1	IMMATURE/ VIRGIN	 CSA11 (H&E)	 CSA11* (H&E)
2	MATURING	 CSA11 (H&E)	 CSA11* (H&E)
3a	MATURE	 CSA11 (H&E)	 CSA11* (PAS/Alb)
3b	MATURE/ EXTRUDING		 CSA11* (H&E)
4a/4	RESTING	 CSA11 (H&E)	
4b	REGENERATING	 CSA11 (H&E)	 CSA11* (PAS/Alb)

* from MARONGIU M.F., PORCU C., BELLODI A., CUCCU D., MULAS A., FOLEIA M.C. Oviducal gland microstructure of two Rajidae species. *Raja miraletus* and *Dipturus oxyrinchus*. Journal of Morphology (submitted).

ITS CODE: RAJA OXY
ALES
OTOS

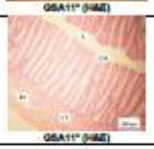






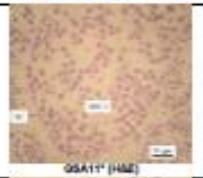

OVIPARI

Etmopterus spinax - DCF CODE: ETX - MEDITS CODE: ETMO SPI

Etmopterus spinax - DCF CODE: ETX - MEDITS CODE: ETMO SPI			
		FEMALES	MALES
STAGE	MATURATION STATE	MICRO_PHOTOS (ovary)	MICRO_PHOTOS (oviducal gland)
1	IMMATURE		
2	DEVELOPING		
3a	CAPABLE TO REPRODUCE		NOT AVAILABLE
3b	EARLY PREGNANCY		
3c	MID PREGNANCY	NOT AVAILABLE	NOT AVAILABLE
3d	LATE PREGNANCY	NOT AVAILABLE	NOT AVAILABLE
4a	REGRESSING	NOT AVAILABLE	NOT AVAILABLE
4b	REGENERATING (mature)	NOT AVAILABLE	NOT AVAILABLE

TL 30.5 cm; TW 203 g; GT: November; GSA11

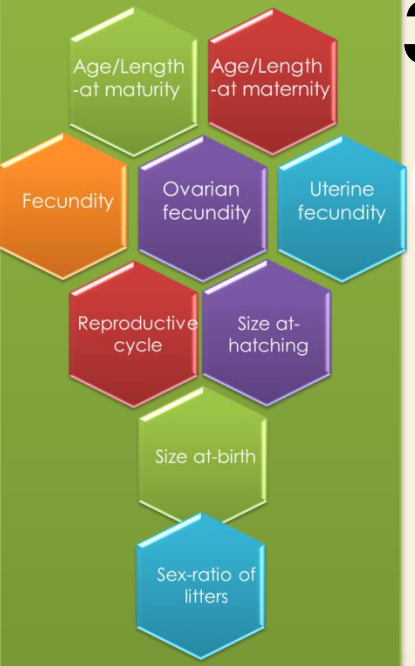
Etmopterus spinax - DCF CODE: ETX - MEDITS CODE: ETMO SPI

Etmopterus spinax - DCF CODE: ETX - MEDITS CODE: ETMO SPI		
		MALES
STAGE	MATURATION STATE	MICRO_PHOTOS
1	IMMATURE	
2	DEVELOPING	
3a	SPAWNING CAPABLE	
3b	ACTIVELY SPAWNING	
4	REGRESSING	NOT AVAILABLE

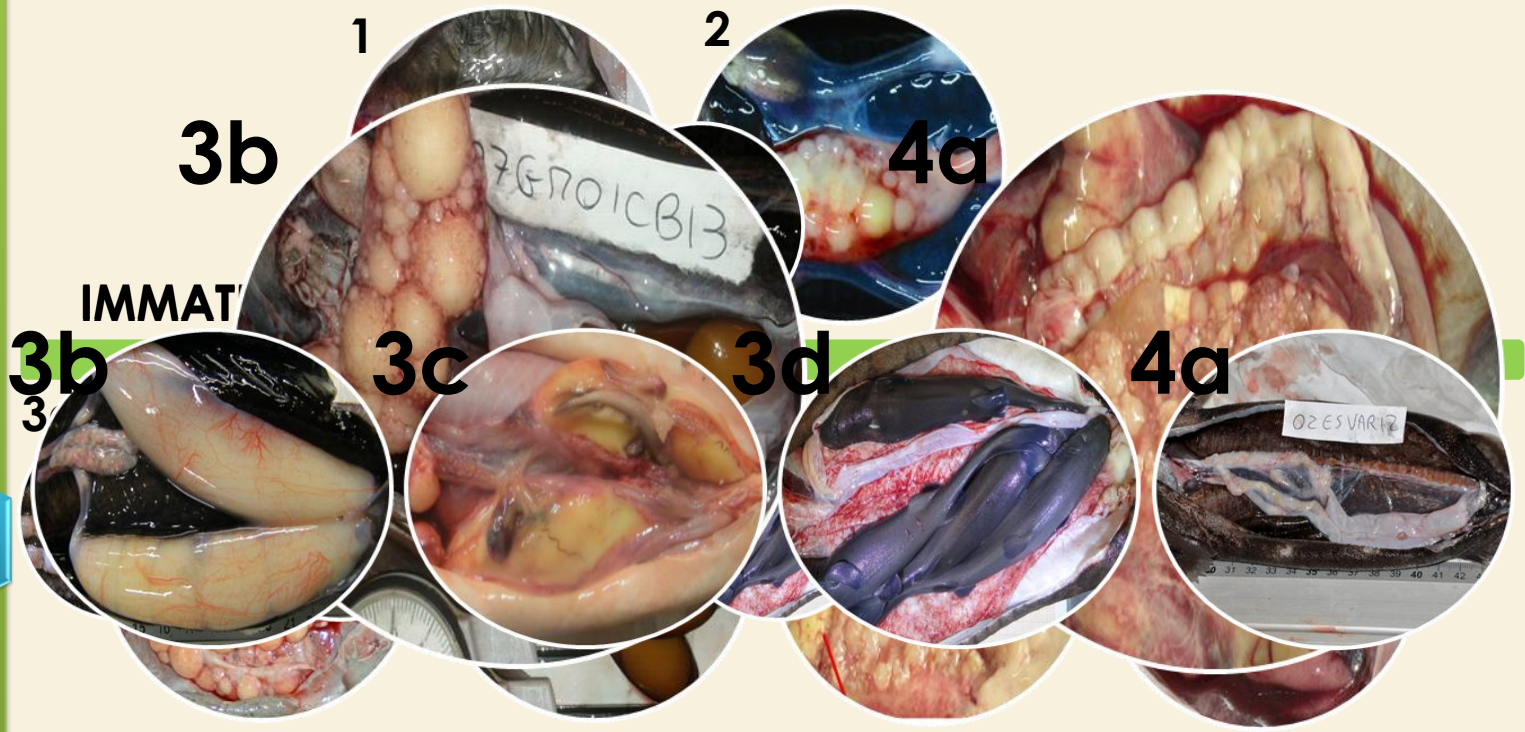
* from PORCU C., MARONGIU M.F., FOLLESA M.C., BELLODI A., MELAS A., RECCI F., CAU A. (2014) - Reproductive aspects of the velvet belly *Etmopterus spinax* (Chondrichthyes: Etmopteridae), from the central western Mediterranean Sea. Notes on gametogenesis and oviducal gland microstructure. Mar. Medit. Sci., 15/2: 313-326.

VIVIPARI

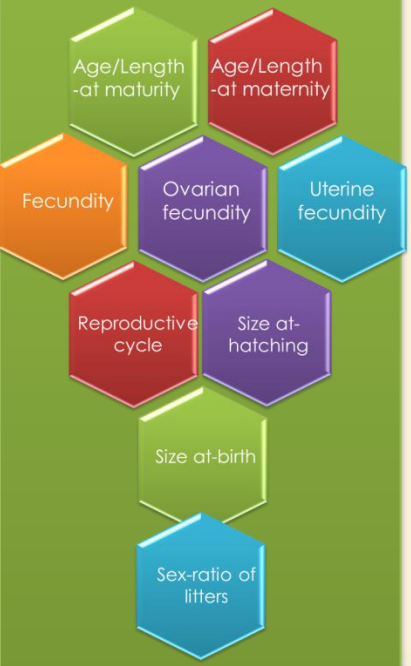
CONCLUSIONE



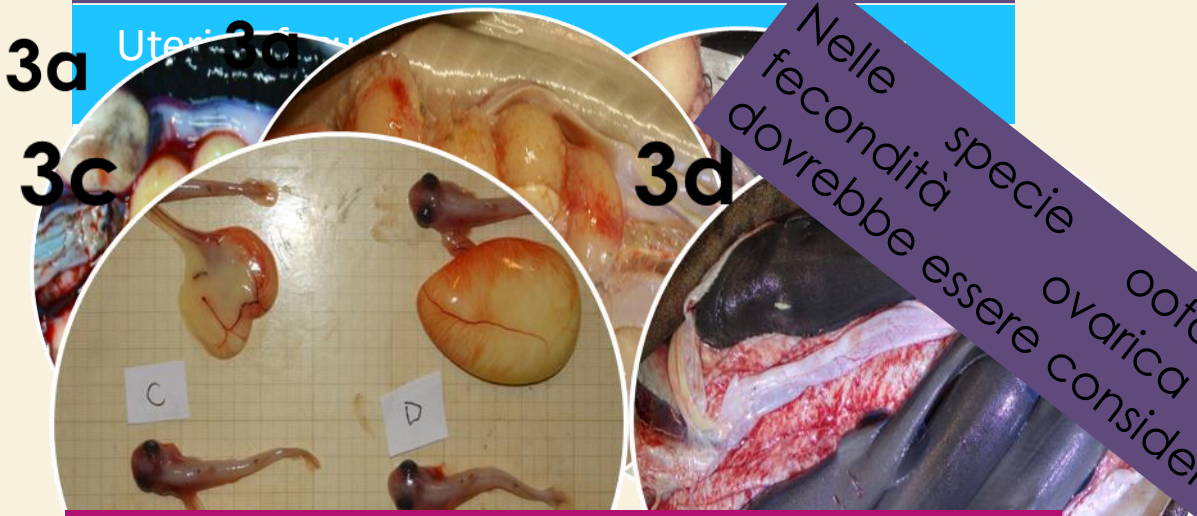
	OVIPARI	VIVIPARI
Age/Length at maturity	X	X
Age/Length at maternity	X	X



CONCLUSIONE



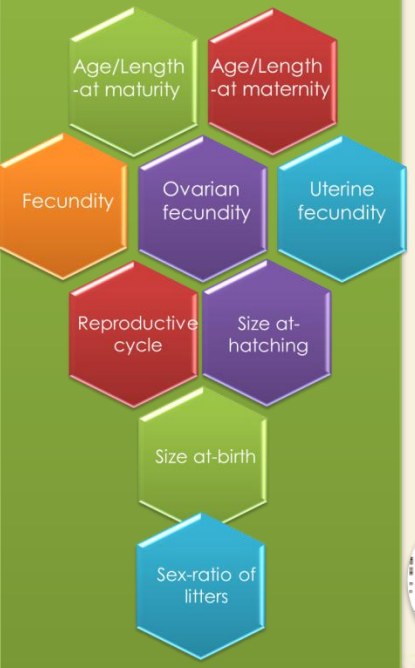
	OVIPARI	VIVIPARI
Age/Length at maturity	X	X
Age/Length at maternity	X	X
Ovarian fecundity	X	X
Uteri[illegible]		



Nelle specie oofaghe, la fecondità ovarica non dovrebbe essere considerata.

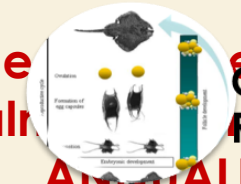
FASE OVARICA E UTERINA **ASINCRONE**

CONCLUSIONE



	OVIPARI	VIVIPARI
Age/Length at maturity	X	X
Age/Length at maternity	X	X
Ovarian fecundity	X	X
Uterine fecundity		X
Reproductive cycle	X	X

Maschi ovipari e [illegible] e femmine ovipare hanno generalm[illegible] ciclo riproduttivo ANNUALE.



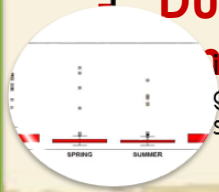
CICLO RIPRODUTTIVO

Femm[illegible]ipare posso avere cicli rip[illegible]vi molto lung[illegible]ni), dipendenti da:

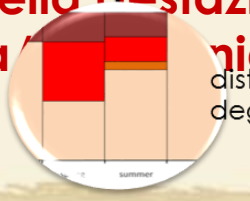
- **Mod[illegible]riproduttiva;**
- **Durata della [illegible]estazione;**
- **[illegible]ncronia [illegible]nia tra fa[illegible]ca e fase**

stato della gonade

stato dell'utero

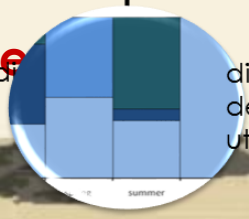


Indice gonado-somatico



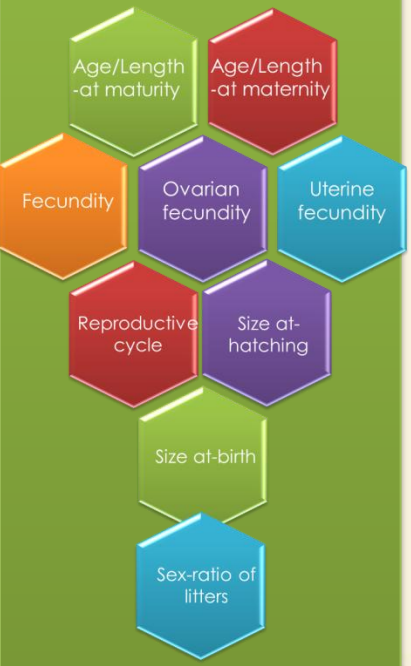
distribuzione degli stadi

distribuzione di taglia degli embrioni



distribuzione degli stadi uterini

CONCLUSIONE



	OVIPARI	VIVIPARI
Age/Length at maturity	X	X
Age/Length at maternity	X	X
Ovarian fecundity	X	X
Uterine fecundity		X
Reproductive cycle	X	X
Size at-hatching	X	
Size at-birth		
ratio of