

Asexual and Sexual Reproduction

- **Different approaches to sex**

Parthenogenesis – (Gk. virgin + birth)

means the growth and development of an embryo or seed without fertilization by male

occurs naturally in some lower plants

very common in some invertebrates (eg. *Daphnia*, or “water fleas”)

And some vertebrates (eg. lizards, salamanders, some fish)

Hamlet bass,
Hypoplectrus genus



Hermaphroditism - both sex organs

- Protandry
 - start life as a male, then become female (Sea basses and groupers)
- Protogyny
 - start life as a female, then become male (Wrasses, parrot fish)
- Self-fertilizing
 - simultaneously male and female (Sea basses and grouper)

Bluehead wrasse,
Thalassoma
bifasciatum



mode of reproduction

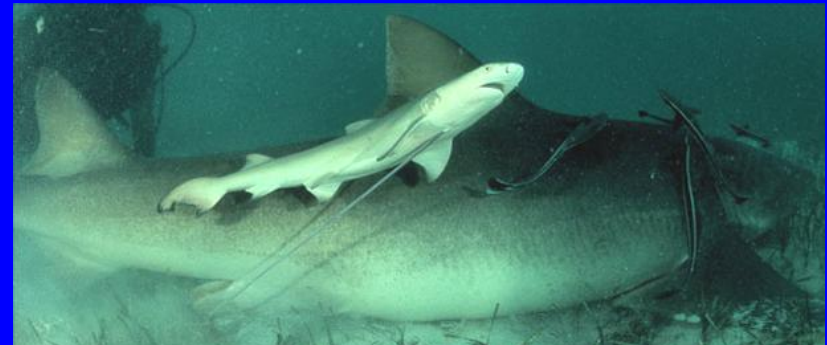
there are numerous ways to categorize fishes as to their reproduction

the simple breakdown into

egg-layers (oviparous); and

live-bearers (ovoviviparous and viviparous)

- **Three strategies of internal fertilization:**
 - **oviparity** - Eggs are fertilized internally and deposited outside mother's body to complete development-**some bony fish, most reptiles, some cartilaginous fish, some amphibians, a few mammals, all birds**
 - **ovoviviparity** - Fertilized eggs are retained within mother to complete development, but all nourishment gained from yolk sac-**some bony fish (mollies, guppies, mosquito fish), some cartilaginous fish, many reptiles**
 - **viviparity** - Young develop within mother and obtain nourishment directly from mother's blood- **most cartilaginous fish, some amphibians, a few reptiles, almost all mammals.**



advantages of viviparity

Several possible advantages are conferred by these patterns

the first and foremost is protection

- the eggs and embryos are safe from predators except those large enough to overwhelm the female
- they are protected from adverse water conditions – desiccation, anoxia, and injurious temperature, are not dangerous unless the female is unable to escape those conditions.

- **young are protected against loss by drifting, as egg or larvae away from suitable rearing areas**
- **another possible advantage might be conservation of energy**
- **no need of nest building**
- **there is no need for large number of eggs**

- **viviparity might have some advantages in species dispersal , as a single pregnant female might be able to accomplish an extension range**
- **survival of one pregnant female after a catastrophe might allow continued survival of the species**
- **generally no need to make a long migration to a specific breeding site**
- **usually fertilization is ensured, so that few eggs are wasted**

the modification for internal fertilization

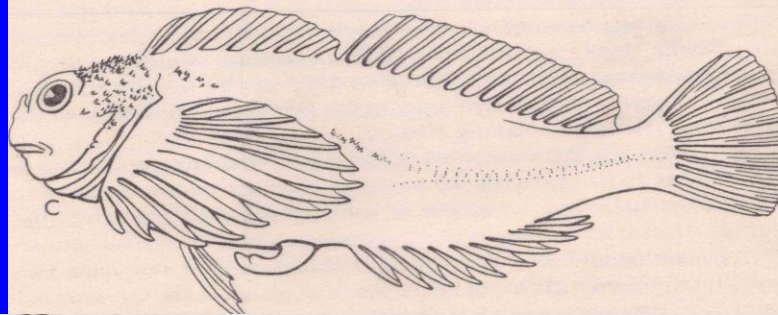
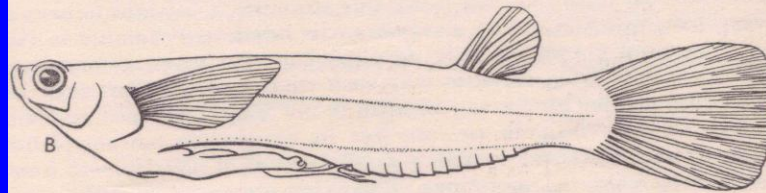
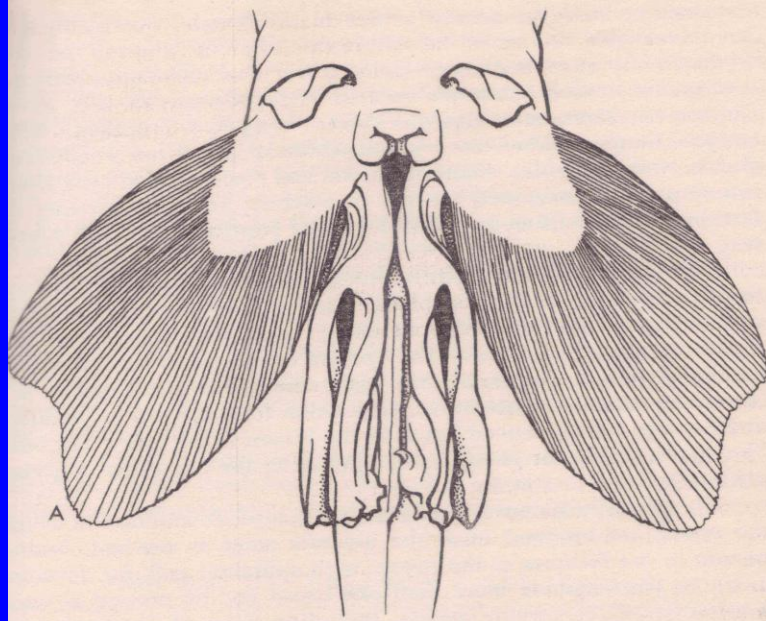
internal fertilization requires modification of behavior and the development of the means of introduction of spermatozoa into the genital orifice of the female

some of the most remarkable intermittent organs among fishes are seen in chimera, skates and sharks – pelvic ‘**clasper**’

in *Tomeurus* (Poeciliidae) and in Horaichthyidae the anal fin is modified into a ‘**gonopodium**’

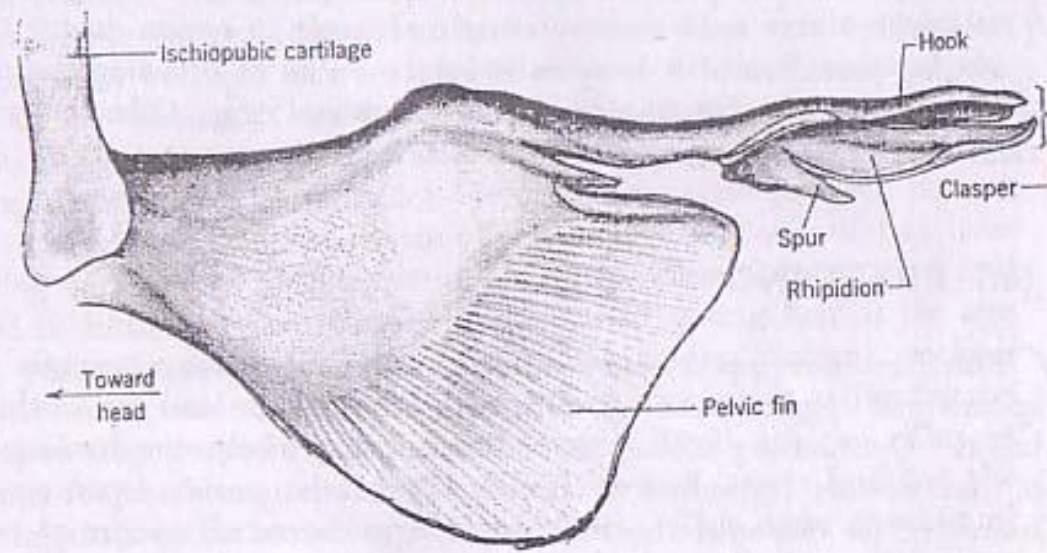
Fishes in the family Phallostethidae and Neostethidae have elaborate structure to clasp and inseminate the female

some sculpins have fleshy genital papillae that reach a large size

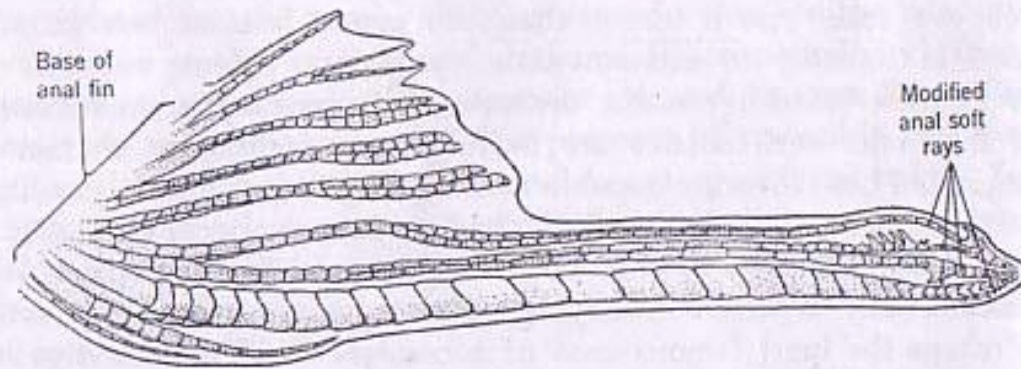


Examples of male oviparous fishes with large intromittent organs.
 A, Pelvic claspers of a chimaera (*Hydrolagus*); B, *Horaichthys*; C, *Clinocottus*.

INTROMITTENT ORGANS



(a) Shark clasper (myxopterygium)



(b) *Gambusia* gonopodium

Fig. 10.5 Male intromittent organs of two fishes: (a) left pelvic fin of a horn shark (*Heterodontus francisci*) showing its modification into a myxopterygium, ventral view; (b) anal fin modified into a gonopodium in the mosquitofish (*Gambusia affinis*), lateral view. Part (a) based on Daniel, 1934, and (b), on Turner, 1941).

dogfish female



dogfish male





chimaera



hermaphroditic

fishes

hermaphroditism

- some fish individuals are both males and females, either simultaneously or sequentially
- about 21 families of fish are hermaphrodites

simultaneous or synchronous hermaphrodite

-  **there are some instances where being a member of both sexes could have its advantages**
-  **in the deep sea, the low light levels and limited food supply make for a very low population density; meaning that potential mates are few and far between**
-  **members of the simultaneous hermaphrodites can spawn with any individual encountered**

simultaneous or synchronous hermaphrodite

- *Serranus subligarius*, a marine species of Florida, has fertilized its own eggs in captivity
- *Rivulus marmoratus* can fertilize its eggs internally before oviposition

MANGROVE RIVULUS

Order - Cyprinodontiformes

Family - Aplocheilidae

Species - *Rivulus marmoratus*



- the mangrove rivulus is found in the tropical and subtropical portions of the western Atlantic/Caribbean basin from central Florida to the Bahamas and Caribbean, south to Brazil including the Yucatan and Venezuela

- **functioning as hermaphrodites, the mangrove rivulus is able to fertilize their own eggs internally, producing viable offspring**
- **each hermaphroditic fish produces both sperm and eggs in its ovaries**

④ **Synchronous hermaphrodites are known from the following families:**

- Chlorophthalmidae
- Bathypteroidae
- Alepisauridae
- Paralepididae
- Ipnopidae
- Evermannellidae
- Cyprinodontidae
- Serranidae
- Maenidae, and
- Labridae

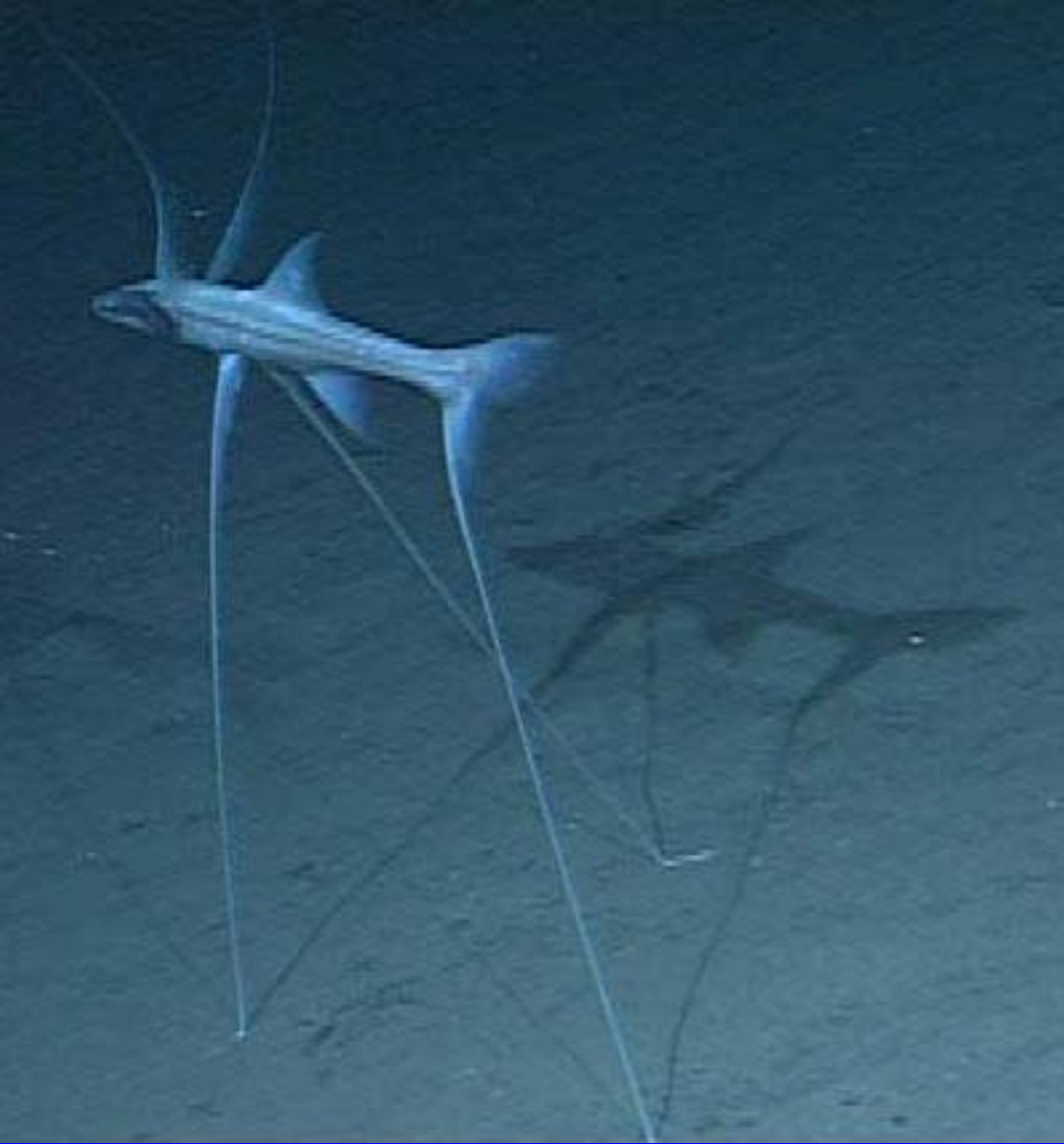
④ individuals of other families may exceptionally be hermaphrodites

④ a familiar example is the striped bass (Percichthyidae), in which occasional hermaphrodites are seen



hermaphroditic - chlorophthalmidae; green eye

Chlorophthalmus agassizi



hermaphrodite - Bathypteroidae - tripod fish



hermaphrodite Alepisauridae

Longnose lancetfish

Alepisaurus ferox



Hermaphroditte - Ipnopidae - Longnose greeneye

Parasudis truculenta



Hermaphrodite - Evermannellidae - sabertooth fish
Coccoxella atlantica

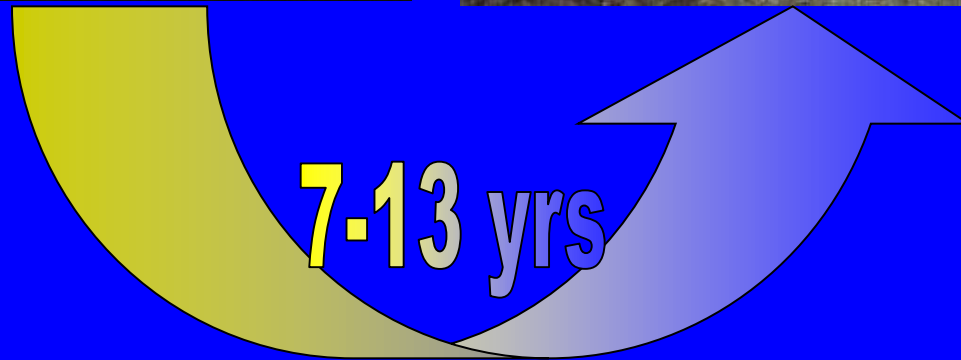
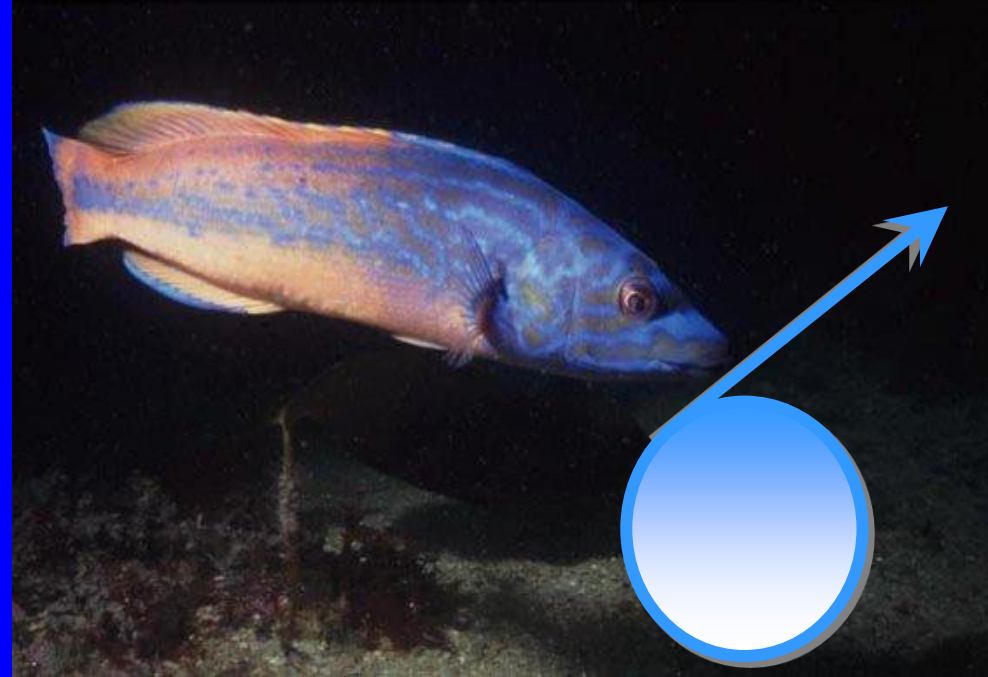
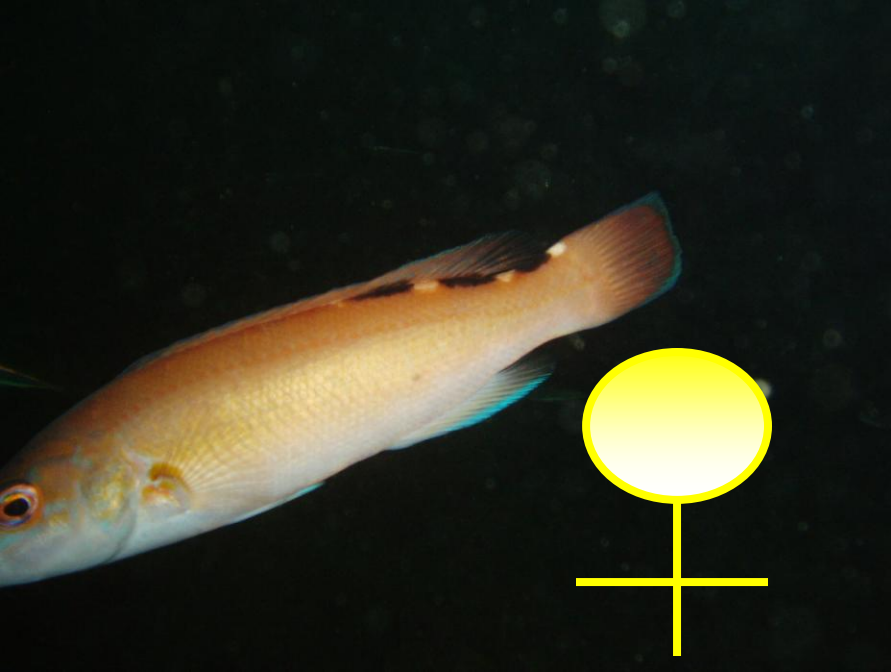


Hermaphrodite – Sparidae - Whitebone porgy

Calamus leucosteus

consecutive or sequential hermaphrodites

- 📖 consecutive hermaphrodites are either first male (**protandrous**) or first female (**Protogynous**)
- 📖 many of the species begin life with undifferentiated gonads that contain both male and female elements
- 📖 the **protandrous** condition is known in members of the Gonostomatidae, Serranidae, Sparidae, Maenidae, Labridae, and Platycephalidae
- 📖 **protogynous** hermaphrodites have been noted in the Synbranchidae, Serranidae, Maenidae, and Labridae



Cuckoo Wrasse *Labrus bimaculatus* Family- Labridae are born female but between the ages of 7 and 13 some of them change sex and colouring and become fully functional males

reasons behind hermaphroditism in fishes

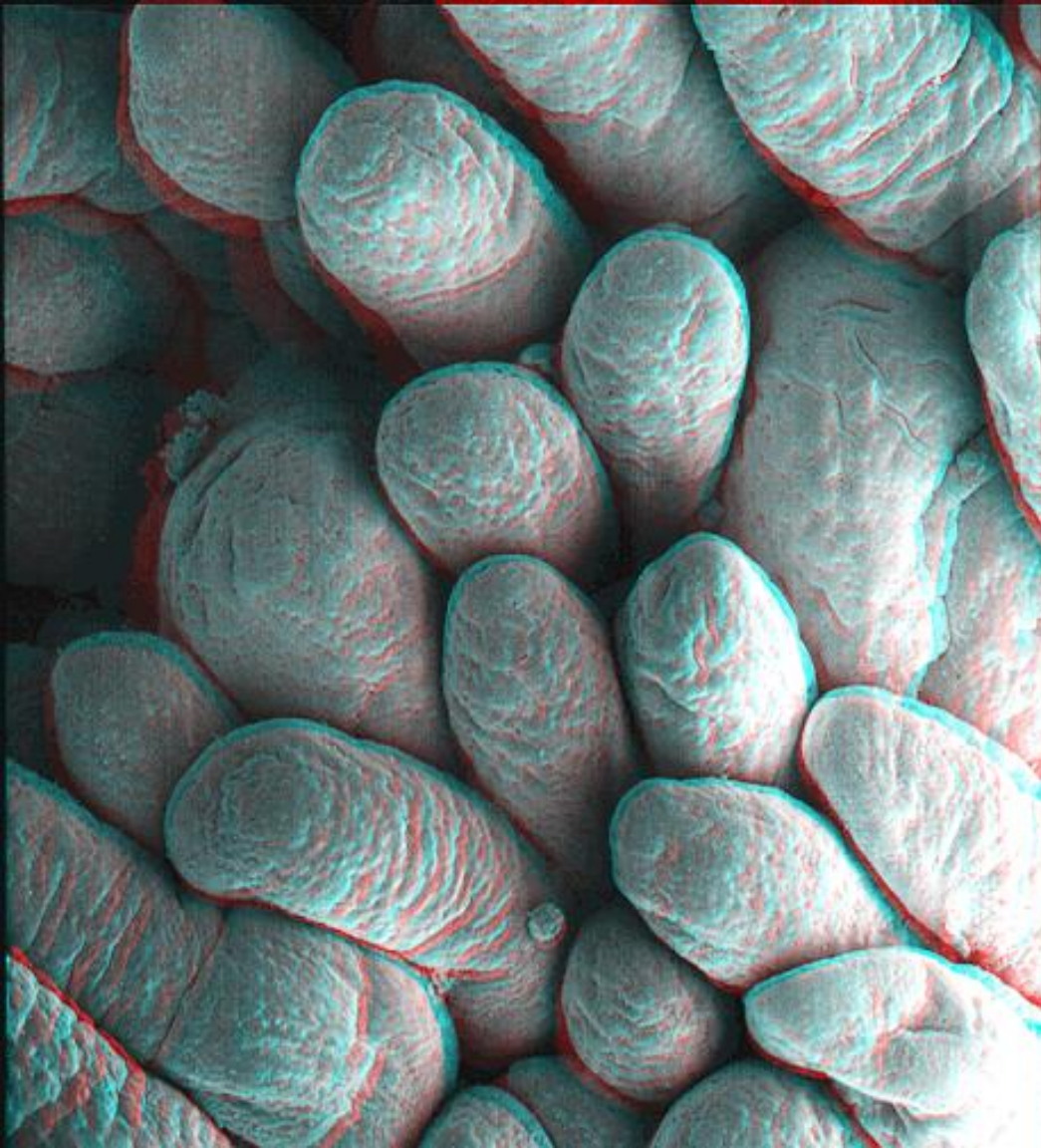
- ❖ hermaphroditism comes in when we analyze what the reproductive success of a smaller male may be
- ❖ as only the largest male, the 'Super Male' gets to mate with females, a smaller male would enjoy zero reproductive success
- ❖ there is no advantage to being a small male, and this is where the hermaphroditism comes in

- ➡ if all the smaller fish were females, they could all enjoy a limited reproductive success while they are growing
- ➡ if the male dies, the one that has grown to be the largest female will change sexes and become the male, in turn enjoying a much greater reproductive success than if she did not switch
- ❖ **Simultaneous hermaphroditism** is found in some deep sea fish that inhabit areas of low light. Often food supplies are limited, population density is low, and the opportunities to meet mates are rare. In this poor condition only hermaphrodites are able to spawn with any individual they encounter—be it male or be it female

nourishment for developing embryo

viviparity

- **viviparous fishes nourish developing embryos through a variety of adaptations**
- **in placental species, the developing embryo subsist exclusively on the yolk for a time and eventually the yolk is supplemented or supplanted by secretions (uterine milk) of the female**
- **in several species of the nutritive secretions are taken in through the mouth or the spiracles and swallowed**
- **in some fishes the villi (trophonemata) that secrete the nutrient fluid are elongate and extend through the spiracles of the embryo to the gut**



Intestinal villi



intestinal villi

placentae



- yolk sac placentae are present in *Mustelus canis*, *Carcharinus falciformis*, *Sphyrna* spp., and few others

