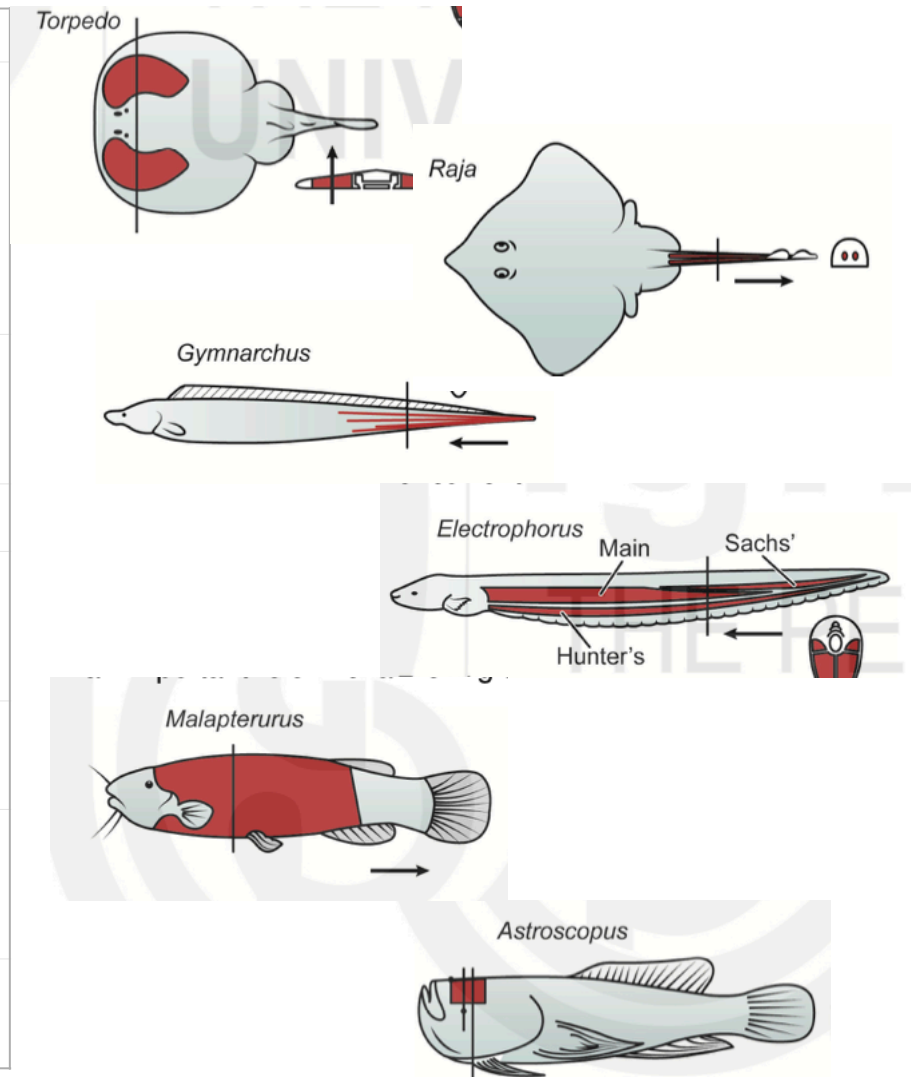


ELECTRIC ORGANS

- Fishes are unique in the animal kingdom in being capable of generating electric current. About 250 species of fish, both Chondrichthyes and Osteichthyes, are reported to possess electric organs.
- The following are the important fishes that are known to possess electric organs:

Elasmobranchii			
Electric rays	<i>Torpedo</i> <i>Narcine</i>	bronchial muscles adjacent to the gill arch	located on both sides of the head along the front edge of the gills and thoracic fins and is connected to the brain through nerves
Skates	<i>Raia/Raja</i>	Tail muscles	confined to the tail region and is nerved from the spinal cord
Teleost			
Mormyridae	<i>Gymnarchus</i> <i>Mormyrus</i>	Tail muscles	confined to the tail region and is nerved from the spinal cord
Gymnotidae	<i>Electrophorus electricus</i>	Tail muscles	located laterally from the stem to the end of the tail
Siluridae	<i>Malapterurus</i>	body muscle	located on the skin and muscles along the whole body
Uranoscopidae	<i>Uranoscopus</i> , <i>Astroscopus</i>	eye muscle	located behind the both eyes





Torpedo



Narcine



Raia/Raja



Gymnarchus (African knife fish)



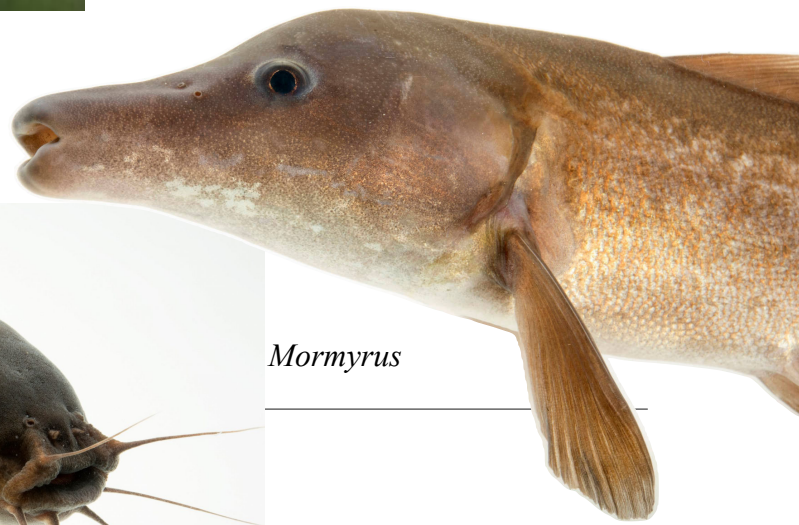
Electrophorus electricus (Electric eel)



Uranoscopus (Stargazer)



Malapterurus

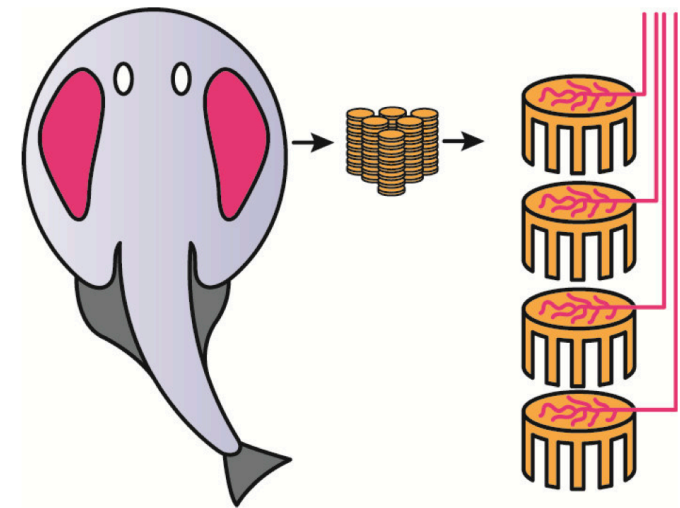


Mormyrus

Definition: Electric organs are specialized structures found in certain species of fish that generate electric fields or electric discharges. These organs are composed of *electrocytes*, which are modified muscle or nerve cells that have evolved to produce electricity. The electric organ discharge (EOD) can range from weak to strong, depending on the species and its ecological needs.

Structure: Electric organs vary in shape, size and histological features. Each organ is made up of large number of disc-like cells called electrocytes, electroplaxes or electroplates.

- Electrocytes are the functional units of electric organs.
- They are modified cells derived from muscle tissue (myogenic) or nerve tissue (neurogenic).
- Each electrocyte acts like a tiny battery, capable of generating a small voltage (typically around 50–150 millivolts).
- Electrocytes are stacked in series so as to face the same direction to increase the total voltage of the electric discharge.. They are also arranged in parallel to increase the current.
- The electroplates are embedded in a jelly-like extra-cellular material, and are bound together by connective tissue. The connective tissue plays an important role in channelling the flow of current.
- One face of each electroplate is supplied by nerve fibres (motor neurons) and the jelly receives blood capillaries.
- The electroplate may show characteristic foldings and convolutions of one or both its surfaces. Generally, the nervous end is smooth while the non-nervous end bears large papillae.



Electric Organ Discharge (EOD):

The collective activity of electrocytes produces an **electric organ discharge (EOD)**, which can be:

1. **Weak:** Used for navigation and communication (e.g., mormyrids, gymnotiformes).
2. **Strong:** Used for predation or defense (e.g., electric eels, electric rays).

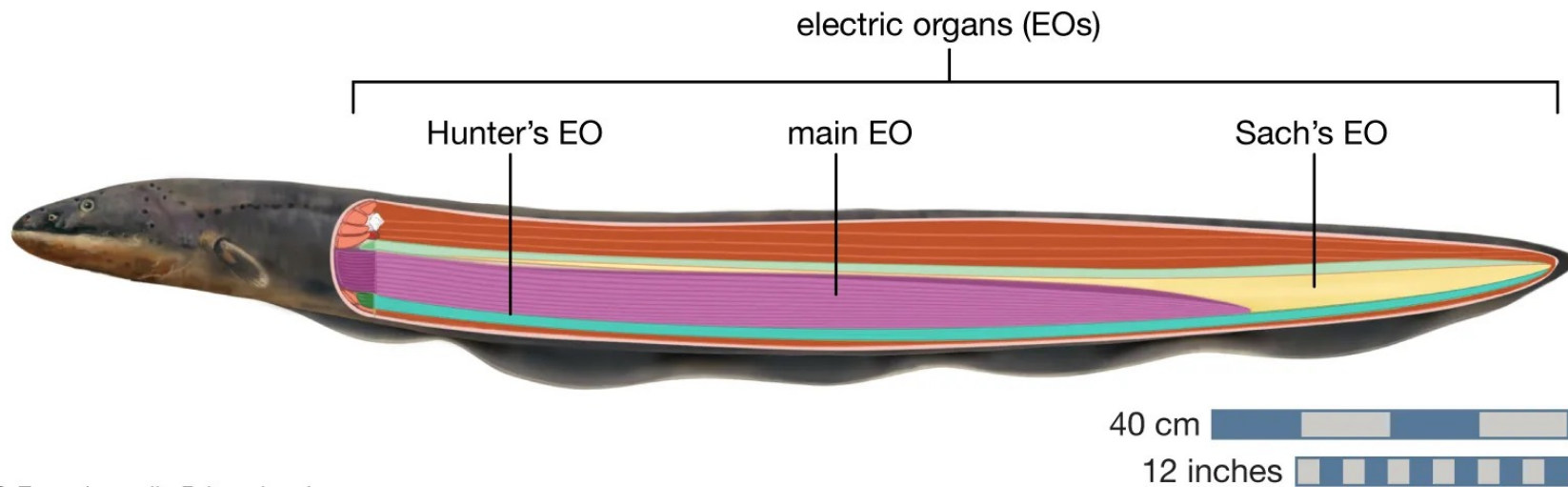
Fig: Stalked electrocytes in *Torpedo*

Electric organs in *Electrophorus electricus*:

- Commonly known as “electric eel”
- The electric organ in *Electrophorus electricus* occupies about **80% of its body**, running almost the entire length of its elongated, cylindrical body. It is divided into **three distinct regions**, each with a specific function:
 - **Main Electric Organ:** The largest section, responsible for generating high-voltage discharges (up to 600 volts).
 - **Hunter’s Organ:** A smaller section (lying on ventral side) that works with the main organ to produce strong electric shocks.
 - **Sachs’ Organ:** Produces low-voltage discharges used for electrolocation and communication.



electric eel
(*Electrophorus electricus*)



FUNCTIONS OF ELECTRIC ORGANS

Electric organs in fish serve a variety of functions, depending on the species and the strength of the electric fields they produce. These functions can be broadly categorized into **weakly electric** and **strongly electric** roles.

1. Weakly Electric Functions:

Weakly electric fish produce low-voltage electric fields (typically less than 1 volt) used for sensory and communication purposes.

a. Electrolocation: Weakly electric fish use their electric organs to generate electric fields around their bodies. Objects in the water distort these fields, and the fish detect these changes using specialized electroreceptors (e.g., **ampullae of Lorenzini**). This helps them navigate, locate prey, and avoid obstacles in dark or murky waters where vision is limited. Examples: Mormyrids (elephantfish) and Gymnotiformes (knifefishes).

b. Communication: Electric signals are used for social interactions, such as:

- **Mating:** Males and females exchange electric signals to identify and attract mates.
- **Territoriality:** Fish use electric discharges to establish and defend territories.
- **Aggression:** Electric signals can signal dominance or aggression during conflicts.

Examples: Mormyrids and some Gymnotiformes.

2. Strongly Electric Functions:

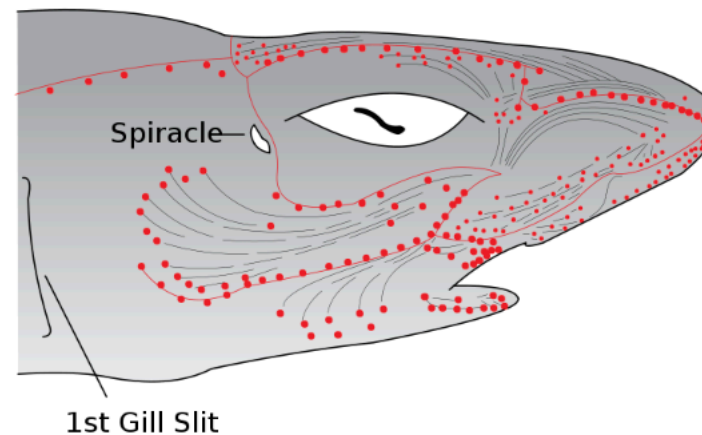
Strongly electric fish produce high-voltage electric discharges (up to 600 volts or more) used for predation and defense.

a. Predation: Strong electric discharges can stun or immobilize prey, making it easier to capture. Example: Electric eels (*Electrophorus electricus*) use high-voltage shocks to stun fish and other prey.

b. Defense: Electric shocks can deter or incapacitate predators, providing a powerful means of self-defense. Example: Electric rays (*Torpediniformes*) and electric catfish (*Malapteruridae*) use strong discharges to ward off threats.

Ampullae of Lorenzini:

- Ampullae of Lorenzini are electro-sensitive organs that, together with the olfactory organs, form the main sensory systems for foraging and navigation in skates, rays, and sharks. They detect weak electric fields, helping them locate prey and navigate.
- The ampullae are a series of symmetrical pores, concentrated around the snout and nose, connected by gel-filled canals.
- They can conduct electrical impulses so small, that chondrichthyes are likely to be more sensitive to electric fields than any other group of animals.



Ampullae of Lorenzini, shown in red, are a electroreceptors that can detect electrical impulses from other organisms in water.
