BHARATHIDASAN UNIVERSITY
Tiruchirappalli- 620024,
Tamil Nadu, India.

Programme: M.Sc., Marine Biotechnology

Course Title : Marine Resources Assessment

Course Code: 21 CC 4a

Unit-III

Dr. S. Rajakumar
Associate Professor

Methods of surveying the living resources

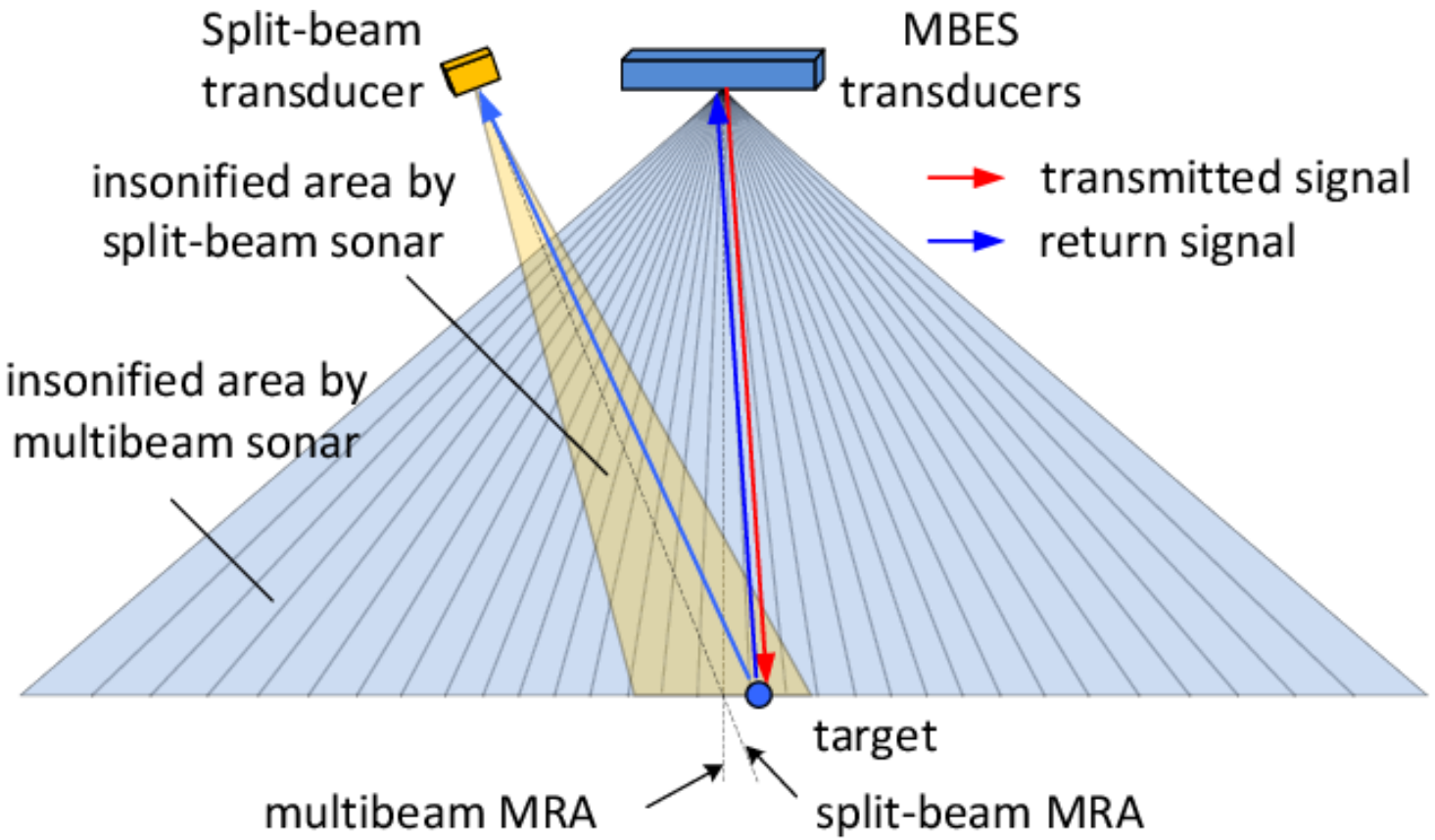
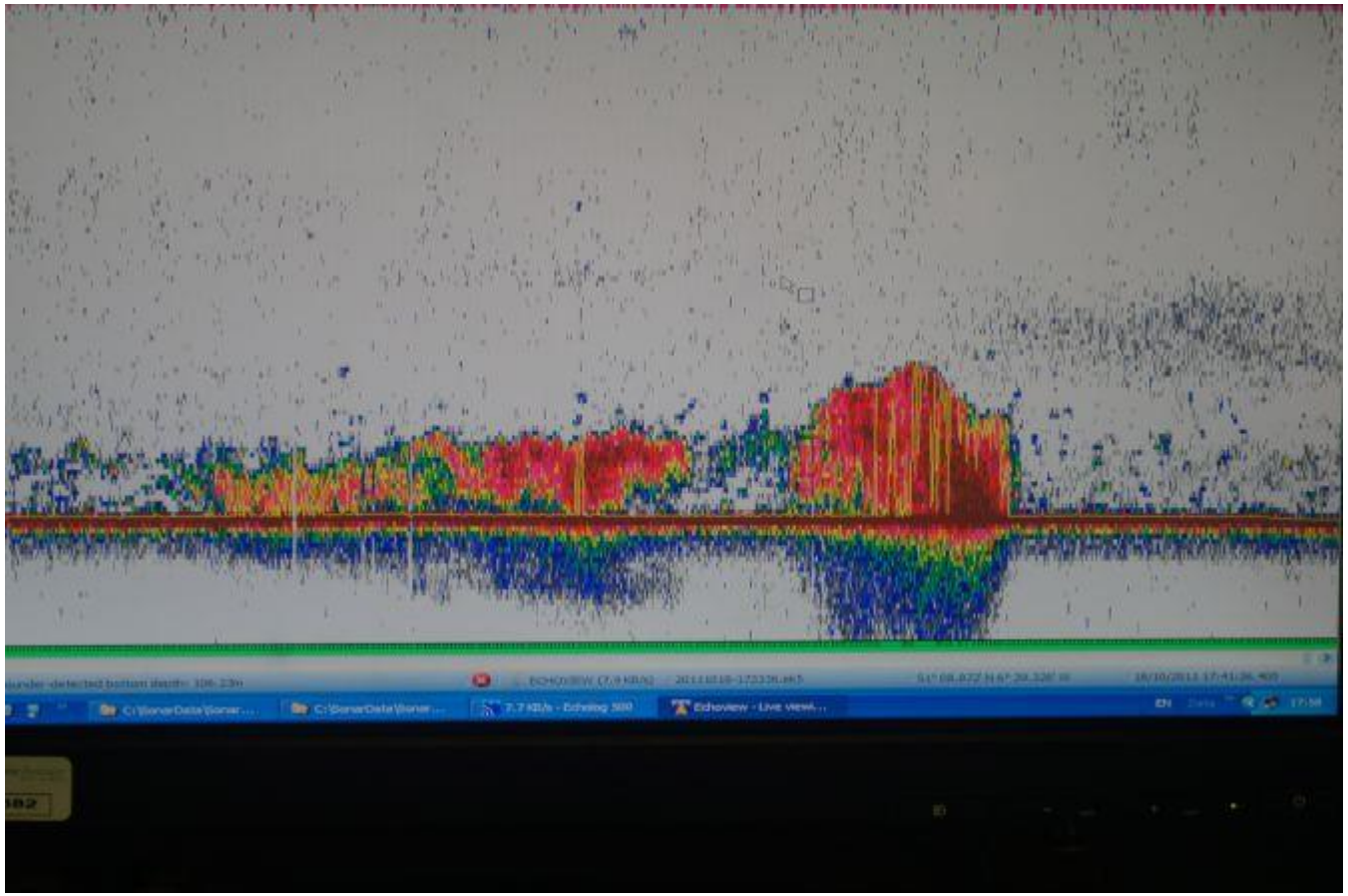


Figure 5. Field calibration methodology overview.

Acoustic Survey Techniques

- Acoustic surveys are generally carried out on spawning and pre-spawning aggregations of fish. Outside of the spawning season many pelagic species are generally very scattered over a large geographical area and difficult to detect using acoustic methods.
- The aim of an acoustic survey is to determine the relative abundance of the target species.



How Acoustic Surveys Work

These surveys use sound waves emitted from a "transducer" to estimate the density of plankton and fish shoals.

The survey vessel tows the transducer under water, which is linked to an echo sounder in the vessel which records the shoals of fish as "marks" on a screen or paper trace.

The species composition of each mark is then identified by taking trawl samples.

The density and number of marks are then converted into biomass (weight) of the different species. Acoustic surveys are particularly effective on shoaling species that have a large swim bladder, such as herring and blue whiting.

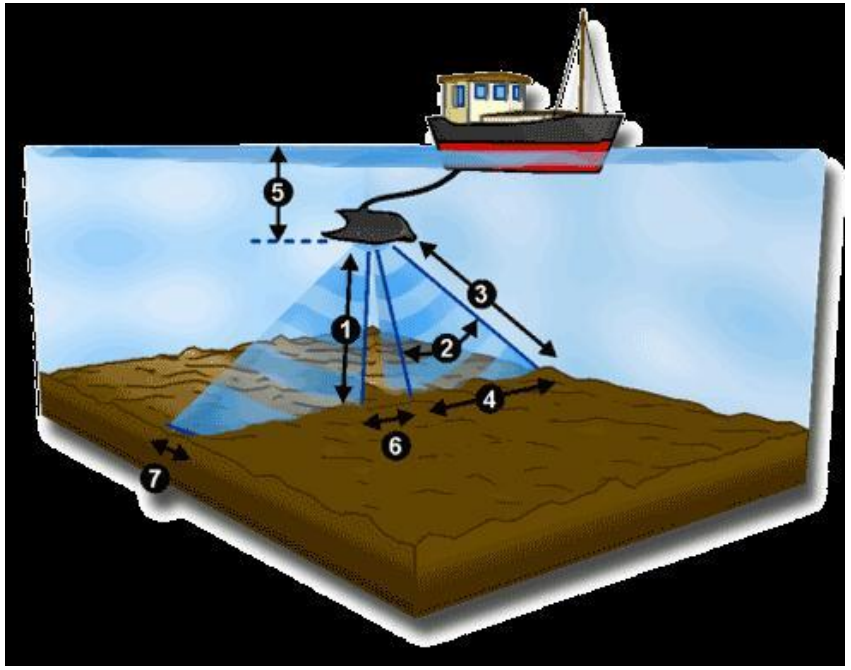
- Acoustic surveys are used extensively to survey pelagic species that form monospecific schools.
- Acoustic backscatter is proportional to abundance when the scattering properties of the target species are known.

1.Multi-Beam Echo Sounders

- Multibeam echosounders (MBES) provide detailed information on water depth and seabed morphology (form and structure) by focusing pulses of acoustic energy directly beneath the ship's hull in a fan-shaped coverage of the seabed.
- Transducers then record the strength, direction and elapsed time of the acoustic reflection from the seabed and these digital signals are decoded to determine seabed depths (bathymetry) and features from a wide area under the survey vessel.

2.Side scan sonar

- side scan sonar also uses acoustic signals to detect underwater objects and features.
- The angle at which the acoustic beams are transmitted results in distinctive ‘shadows’ being cast behind objects and features, helping scientists build a picture of what the seabed looks like.
- The strength of the returned acoustic signal varies with the characteristics of the seabed being surveyed, which helps differentiate between hard and soft sediments.
- To collect these data, a torpedo-shaped 'towfish' containing the sensors is towed behind the survey vessel. Signals are transmitted via the tow cable to a ship-based processing unit where the acoustic data are interpreted.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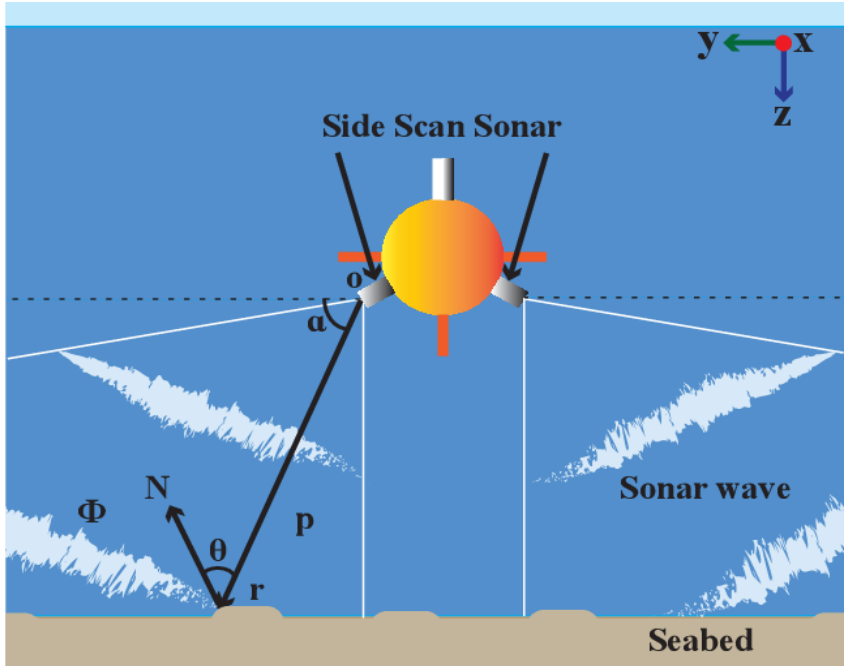
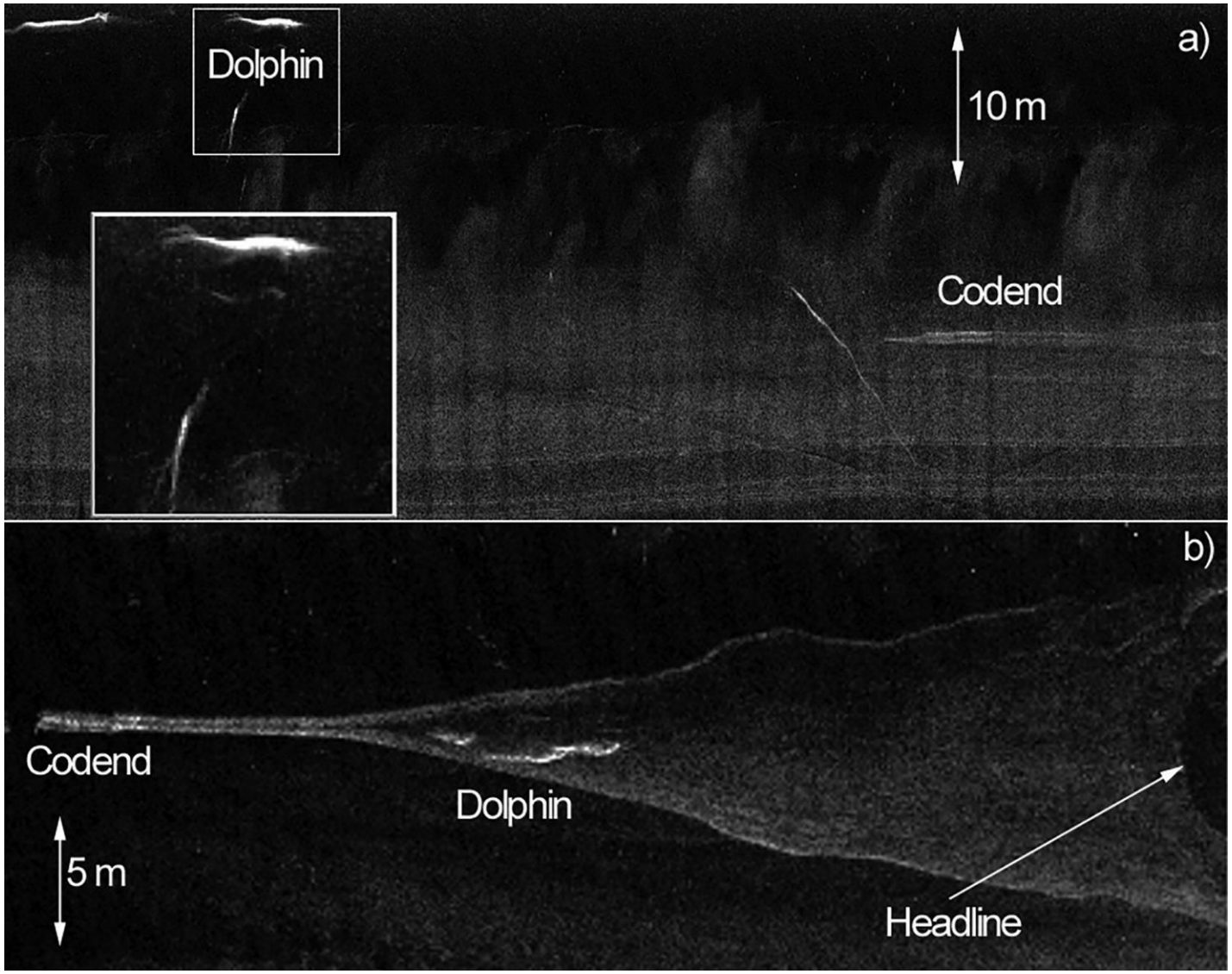

y
x
z
Side Scan Sonar
α
N
Φ
θ
p
r
Sonar wave
Seabed


Dolphin
a)
10 m
Codend
b)
Codend
Dolphin
5 m
Headline

3. Sub Bottom Acoustic Profiler

- These instruments are generally towed behind the vessel and are used for the collection of information on the shallow geology and sedimentary structure of the seabed.
- Like side scan sonar and MBES they emit an acoustic wave, however the frequency used is low and the wave is able to penetrate the seabed and reveal shallow reflecting layers within the seabed.

Remote Sensing

- RS systems can be generally divided into two groups of passive and active.
- Passive RS systems record reflected electromagnetic energy in the visible, Near-Infrared (NIR), and Shortwave Infrared (SWIR) bands, as well as emitted electromagnetic energy in the Thermal Infrared (TIR) bands.
- Active RS systems (e.g., microwave systems) measure the backscattering radiation from different objects on the Earth at higher wavelengths compared to passive systems.

Remote sensing involves using satellite-based sensors and other technologies to gather data about various aspects of oceans, including temperature, pollution, and marine life. This data helps researchers and authorities manage and protect marine resources effectively.

- Coastal ecosystems are rapidly changing due to human-caused global warming, rising sea level, changing circulation patterns, sea ice loss, and acidification that in turn alter the productivity and composition of marine biological communities.
- In addition, regional pressures associated with growing human populations and economies result in changes in infrastructure, land use, and other development; greater extraction of fisheries and other natural resources; alteration of benthic seascapes; increased pollution; and eutrophication.
- Understanding biodiversity is fundamental to assessing and managing human activities that sustain ecosystem health and services and mitigate humankind’s indiscretions.

Method 1. Phytoplankton Community Composition Derived from Remote-Sensing Reflectance

Method 3. Pelagic Seascape Ecology: Tracking Dynamic Features and Habitats

- Method 4. Species Distribution and Semi-Analytical Models

Method 2. Remote Sensing of Foundation Species

- Foundation species create locally stabilized environments (Lamy et al., 2020) that provide refuges (Castorani et al., 2018) or isolated patches of different, more-complex habitats that can result in increased local or regional biodiversity.
- In marine environments, these species include primary producers such as mangroves, kelps, and seagrasses as well as reef-forming groups such as corals and bivalves.
- Foundation species may also provide critical habitats for reproduction and population growth of ecologically and economically important fish species.

S.No.	Parameters	Satellite and their data used	Uses
1	Sea surface temperature(SST)	MODIS, AMSRE, TMI	Helps in the study of climate change and weather forecasting
2	Total suspended solids (TSSs)	DEIMOS-1, LANDSAT, ASTER	Provides information of hydrodynamic modelling of coast
3	Chlorophyll content	SeaWiFS, IKONOS, IRS P4 OCM	Indicates the concentration of phytoplankton
4	Potential fishing zone	NOAA AVHRR, IRS OCM	Indicates highly potentials of fishing
5	Wave height and spectra	GEOSAT, ASAR (ENVISAT)	Provides information for navigation
6	Sea surface height, wind speed	Topex /Poseidon, ERS-1, ERS-2	Detection of mid-scale sea surface, importance variables in ocean mixtures
7	Surface current, front, circulation	POES/AVHRR, GOES/IMAGER, JASON-1	Wave and current modelling

- The Nimbus-7 satellite, launched in 1978, carried the first sensor, the **Coastal Zone Colour Scanner (CZCS)**, specifically intended for monitoring the Earth's oceans and water bodies.

- The first Marine Observation Satellite (MOS-1) was launched by Japan in February, 1987 and was followed by its successor, MOS-1b, in February of 1990. These satellites carry three different sensors: a four-channel Multispectral Electronic Self-Scanning Radiometer (MESSR), a four-channel Visible and Thermal Infrared Radiometer (VTIR), and a two-channel Microwave Scanning Radiometer (MSR), in the microwave portion of the spectrum. The characteristics of the two sensors in the visible/infrared are described in the accompanying table.

- **SeaWiFS**
- The SeaWiFS (Sea-viewing Wide-Field-of View Sensor) on board the SeaStar spacecraft is an advanced sensor designed for ocean monitoring. It consists of eight spectral bands of very narrow wavelength ranges (see accompanying table) tailored for very specific detection and monitoring of various ocean phenomena including: ocean primary production and phytoplankton processes, ocean influences on climate processes (heat storage and aerosol formation), and monitoring of the cycles of carbon, sulfur, and nitrogen.
- The orbit altitude is 705 km with a local equatorial crossing time of 12 PM. Two combinations of spatial resolution and swath width are available for each band: a higher resolution mode of 1.1 km (at nadir) over a swath of 2800 km, and a lower resolution mode of 4.5 km (at nadir) over a swath of 1500 km.

- https://secwww.jhuapl.edu/techdigest/Content/techdigest/pdf/V06-N04/06-04-McGoldrick.pdf

- Remote sensing has a wide range of applications in many different fields:
- Coastal applications: Monitor shoreline changes, track sediment transport, and map coastal features. Data can be used for coastal mapping and erosion prevention.
- Ocean applications: Monitor ocean circulation and current systems, measure ocean temperature and wave heights, and track sea ice. Data can be used to better understand the oceans and how to best manage ocean resources.
- Hazard assessment: Track hurricanes, earthquakes, erosion, and flooding. Data can be used to assess the impacts of a natural disaster and create preparedness strategies to be used before and after a hazardous event.
- Natural resource management: Monitor land use, map wetlands, and chart wildlife habitats. Data can be used to minimize the damage that urban growth has on the environment and help decide how to best protect natural resources.

Indigenous Crafts and gears

1. Rafts

raft, simplest type of watercraft, made up of logs or planks fastened together to form a floating platform. The earliest were sometimes made of bundles of reeds. Most rafts have been designed simply to float with the current, but they can be equipped with oars or sails or both and can be navigated in the ocean over long distances, as was dramatically demonstrated by Norwegian scientist Thor Heyerdahl in 1947.

2. Coracles

coracle, Irish **curragh**, primitive, light, bowl-shaped boat with a frame of woven grasses, reeds, or saplings covered with hides. Coracles can be effective fishing vessels. When operated skillfully, they hardly disturb the water or the fish. Welsh coracle fishing is performed by two men, each seated in his coracle and with one hand holding the net while with the other he plies his paddle. When a fish is caught, each hauls up his end of the net until the two coracles touch and the fish are secured. Many coracles are so light and portable that they can easily be carried on the fisherman's shoulders.

3. Canoes

Canoe, lightweight boat pointed at both ends and propelled by one or more paddles (not oars). There are two main forms of the canoe. The modern recreational or sport Canadian canoe is open from end to end; it is propelled with a paddle having a single blade. The kayak has a covered deck with a well, or cockpit, into which the paddler snugly fits; it is propelled with a double-bladed paddle. Other boats sometimes called canoes include the dugout (a shaped and hollowed-out log), or pirogue.

3. Propulsion

Before engines became available, boats could be propelled manually or by the wind. Boats could be propelled by the wind by attaching sails to masts set upright in the boat. Manual propulsion could be done in shallow water by punting with a push pole, and in deeper water by paddling with a paddle or rowing with oars. The difference between paddling and rowing is that when rowing the oars have a mechanical connection with the boat, while when paddling the paddles are hand-held with no mechanical connection. Canoes were traditionally paddled, with the paddler facing the bow of the boat. Small boats that use oars are called rowboats, and the rower typically faces the stern.

4. A jangada is an elegant planked fishing boat used in northern Brazil. It has been claimed the jangada dates back to ancient Greek times.[32] It uses a triangular (lateen) sail, which allows it to sail against the wind.

5. A felucca is a traditional wood-planked sailing boat used in protected waters of the Red Sea and eastern Mediterranean including Malta, and particularly along the Nile in Egypt. Its rig consists of one or two lateen sails.

Modern crafts

Fishing gears

Hooks and lines

- It is one of the oldest and widely used fishing methods which are not commercially used and fish caught is consumed by fishermen family itself. Catching of fish in which fishes are caught individually is based on feeding and hunting behaviour of fish species.
- In this technique, fish are caught with the help of baits tied to a metal hook tied with one end of a strong nylon thread and the other end of nylon thread is tied to a bamboo pole of different lengths to dip the metal hook supplied with bait in the water. Earthworms, Grasshoppers, small sized fish and trash fish pieces are commonly used as baits. Attracted to the bait, fish swallow and gets entrapped by the hooks are caught by pulling up the threads. Catfishes and murrel are caught with this technique.

Box trap

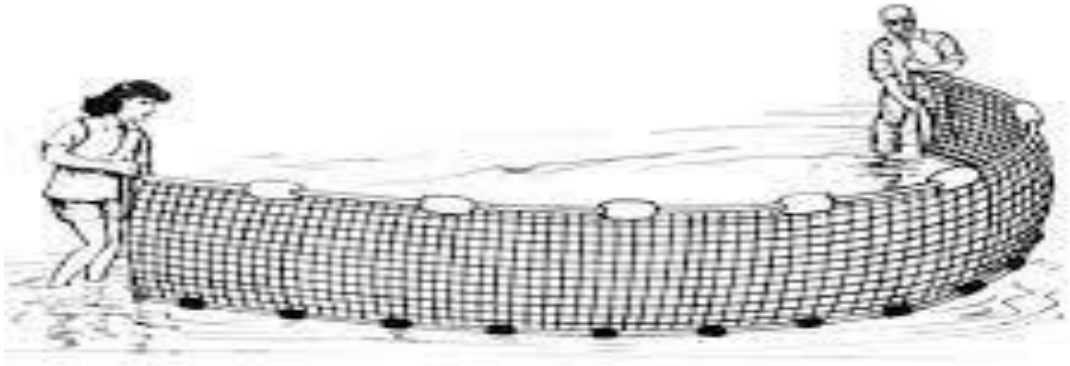
- It is a fishing device in which fish are enticed by enclosures where they are guided to enter the trap. It is the chief gear used for fishing in the lake to catch different species and sizes of fish.
- These are made of split bamboo sticks woven with the long pliable stems of a creeper called Good apala Theega. Catching fish through traps is a passive process. Baits are kept inside the traps sometimes to attract fish.
- The rectangular shape basket trap is the most extensively operated gear and accounts for major part of the catches. It has two vertical openings, one on each long side. Each vertical opening is fixed with a series of inwardly directed, short, pointed bamboo sticks interwoven in such a way that the tips of the two series of splints cross each other.
- This type of arrangement only permits easy entry of the fish but not their exit. Three types of basket traps are regularly used in this area.

Cast net

- The cast net is operated in shallow waters of the lake where depth is about 2 - 3m. It is circular net having umbrella shape made of nylon fibers.
- The cast net is a falling gear and operation of cast net is an active fish catching process. Iron or lead sinkers are fixed along the margin, and a strong rope of 5 - 6m is attached to the apex of the net to haul the net during its operation. Size of the mesh ranges from 20 - 45mm and perimeter range from 10 - 18m based the size of the fishes to be caught.
- These nets can be operated single handedly in which fishermen throw the net conveniently and skillfully over the water either from a boat or the banks of the lake in such a way that it spreads on the water surface fully expanded at its perimeter and cord is held in hand at its apex. Net sinks to the bottom of the lake with closed circumference due to the weight provided by sinkers provided. Small fishes such as carps and catfishes caught with these nets then pulled with the help of th

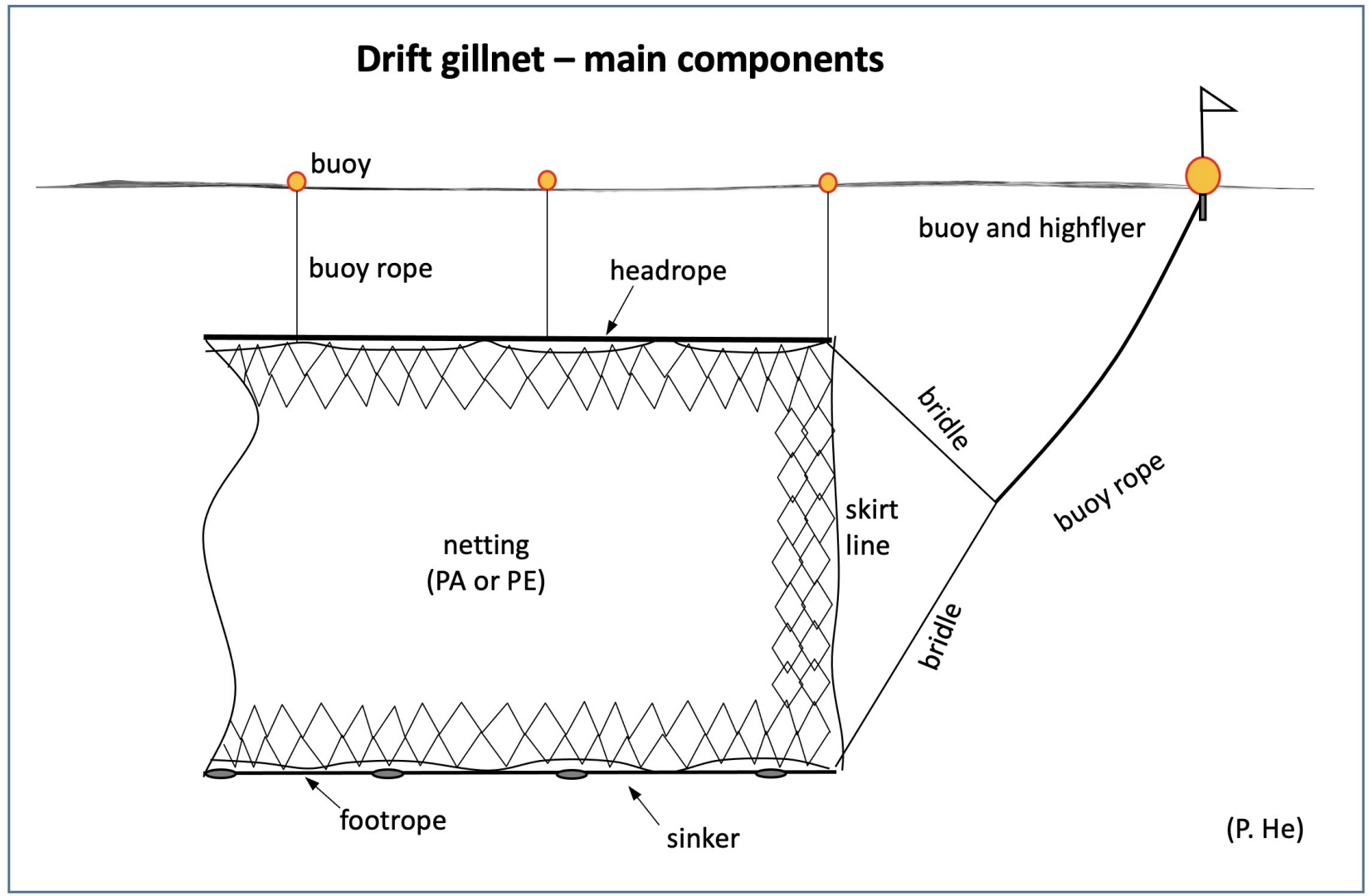
Drag net

- Drag net is used to encircle certain region of the lake to catch a detected fish school by dragging the net or scooping it out with other gears. It is very effective gear to catch the wild fish population and is more suitable for huge water bodies such lake Kolleru.
- During its operation, one end is fixed at the bank of the lake, and the other end is to be towed in an arc around the fish shoal to surround them, and a boat or Dhoni is used to pull the net into a large area before its hauling to the bank of the lake.



Gill net

- Gill net is a passive rectangular gear. This net is erected in water column vertically perpendicular to the movement of fish with the help of head and foot ropes provided with sinkers and floats respectively. As fish attempt to swim through the mesh of the net, they become snagged by their gill operculum, fins or by their scales. Small undersized fish usually can swim through the mesh unharmed, whereas excessively large fish are unable to penetrate the mesh sufficiently to become trapped.
- Characteristics such as simplicity in its operation, design, and construction, low investments attract the fishermen to use it extensively. Nets of smaller size are operated in the shallow regions of the lake depth ranging from 1 - 2m where as large sized ones are relatively used in the deeper areas of the lake at 2 to 4m depth.


Drift gillnet – main components
buoy
buoy rope
headrope
buoy and highflyer
bridle
buoy rope
skirt
line
netting
(PA or PE)
bridle
footrope
sinker
(P. He)

Modern gears

- https://mpeda.gov.in/fishers/?page_id=1784

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