Fish life history

- Each fish species develops different survival strategy
- Key stages in fish life cycle: egg, hatchling, fry, fingerlings, juvenile, adult
- For some: short or long distant migration; for others more local or sedentary
- Some others: part of their life in inland or sea at different stages
- Typical white fish - different habitats at different stages: adults from Tonle Sap in the flooding season migrate upstream to their spawning ground in the Mekong, they either lay eggs on substrates or broadcast in the water, the eggs and fry drifted downstream to floodplain and Tonle Sap, young fish feed in the floodplain and Tonle Sap, they grow big to become adult and migrate to spawn upstream to complete its cycle in one year.
- Some have longer cycle to several years before they get mature and are able to reproduce.

FEEDING ECOLOGY

- Fish needs: Food, space, depth, flow, quality of water, substrates, seasonality, accessibility…
- Interactions between fish - How species act upon each other (big fish eat little fish / compete for prey)
- Interactions with their environment – what fish need from their environment (shelter, refugial sites, etc.)

Why do we need to know?

- Ensure accessibility to their grounds (feeding / spawning / refugial)
- Food source availability
- Environment suitability

To know which types of habitat are important, which specific locations and when they are important to know when and how to protect the habitats.

How to understand feeding ecology?

- Observation in regular fishing (??) e.g. seeing feeding aggregations?
- Fish diet: stomach content
- Behaviour/habitat: field observation and video documentation

Fish diet determination

- Select 4-5 specimen from catch, any time of the year
- Weighing and measuring
- Open cavity to inspect stomach contents
- Weighing and counting stomach content

Feeding behavior/habitat

- Based on diet, identify feeding location, habitat preference and behavior
- Search for feeing location with info on diet, prey preference…
- Can also set baiting station for verification purpose, distinct feeding habitats.

Use of Info on feeding and habitat preference in management

- Feeding requirements ID sites needing protection
- Trophic interactions b/t species Avoid adverse management actions such as over-stocking of predator, removal of certain feeding habitats, prey items

Interventions to address feeding ecology needs

- Stocking selected prey items
- Ensure a balance by maintaining sufficient predators to keep prey in balance.
- Protection of critical habitats
- Create/improve channels for access by fish to particular habitats
- Maintain dry season ponds
- Maintain/protect rice-field habitats
- Use aggregation devices to attract fish to prime habitats
- Maintain access channels to feeding habitats
- Provide feed
- Create feeding refugia for young and juveniles
  e.g. brush parks, artificial reefs, hyacinth aggregations, etc.

SPAWNING

Why do we need to understand fish life-history and spawning behavior?

- Allow fish to get mature and spawn
- Ensure they are able to access spawning habitats
- Balance between harvesting and spawning stock.
- Understand the differences in spawning behaviour between different species to make sure that management meets the needs of multiple/different species. (Timing, habitat needs, substrates, other environmental conditions (e.g. spawning cues), under spawning aggregations and ensure they are not harvested, movements, etc.)

How to understand spawning biology?

- Use captured or market samples of selected species to see eggs (indicates timing of spawning and spawning type for species – number of eggs indicates LH strategy, etc.)
- Focus on assessing fish during predicted spawning season
- Select 4-5 target species
- Open cavity to count eggs

How to understand spawning behavior

- Field based observation at predicted spawning locations (sandy banks, submerged vegetation, rocky pools, eddies, etc.)
- Look for spawning aggregations (groups of fish 'milling' – can be single or multi-species)
- Swimming/wadding in shallow water
- Provide artificial spawning substrates
- Daily effort (???)

- Target spawning season.

Spawning habitat assessment

- Select 3-4 species on interest
- Map spawning sites: both substrate and broadcast spawning
- Conduct verification at sites, without disturbing the target species
- Use info from interview and other sources
- Predict spawning locations
- For substrate spawners: Wade in shallow potential spawning habitats and observe nests and eggs on substrates, leaves, trees… verify by capture, photograph and release;
- For broadcast spawners: look for aggregates of species at night time, verify using bongo nets to capture eggs and fry from water column

Identification of potential spawning sites and timing for assessment

- Look for spawning indicators in gravid female, use egg counting to guide spawning habitat study,
- Record environmental conditions: flow changes, temp changes…
- Predict when and where spawning will take place for the target species
- Use temperature data logger
- In potential spawning sites, search for fish aggregations by wadding in shallow water, look for substrates and holes where fish likely to spawn;
- Take pictures and create photo documentation of the sites and conditions;
- Report environmental information that is possible to capture.
- Verify using hook and line catch, photograph and release;
- Assess number of fry and eggs with bongo nets to assess broadcast spawning behavior;

Spawning sites

- Look for indications that fish are ready to spawn: female should be gravid, sing of milk or swollen abdomen;
- Fish swim in large aggregation for cyprinids or swimming in circle around each other in rocky bed for catfish are indication of spawning site

Use of the info in management

- Location, habitat requirements for spawning, seasonality, spawning cues and conditions predict seasonal closures from fishing.

Interventions to address spawning management needs

- Enhance and protect spawning habitats with improvement/creation of substrates, setting fishing restrictions, placement of fishing prevention devices, seasonal closures, size restrictions.

Stomach Content analysis
Step 1: Cut open fish and remove stomach

1) Cut open the fish (using either scissors or a very sharp fine knife) by inserting scissors into the anal hole of the fish and cut very shallow (close to the surface of the fish) along the belly towards the mouth.
2) CAREFULLY pull the 'innards' out of the fish and locate the stomach bag and the long tube that leads to the anus.
3) Locate the 'throat' of the fish – a long tube that leads to the mouth above the top of the stomach bag and carefully cut and pinch to make sure the contents does not come out.
4) Then cut the tube at the anal hole and lift the tubes and stomach in to a bowl.

Step 2: Open up stomach bag and remove contents

1) Weigh the stomach and guts (tubes)
2) Either gently squeeze the contents out of the stomach through the anal tube
3) OR CAREFULLY cut the side of the bag and empty the stomach contents into a bowl.

Step 3: Weigh all stomach contents clean and sort

1) Weigh all the contents and record the weight before removing liquid or seperating
2) Record any observations about color and items in the stomach content
3) Place the guts in a sieve and gently rinse with water to remove 'goo' and separate the items
4) Place the stomach contents in a dish and sort through the different items
5) Record what you observe about the contents and the fish diet.

Identification of gravid development stage

Stage 1: Virgin	Sexual organs very small, situated close to vertebral column. Testis and ovary transparent, colourless or grey. Eggs not visible to naked eye.
Stage 2: Maturing virgin	Testis and ovary translucent, grey- red. Length of gonads 1/2, or slightly more, of length of ventral cavity. Individual eggs can be seen with magnifying glass
Stage 3: Developing	Testis and ovary opaque, reddish with blood capillaries. Occupy about 1/2 of ventral cavity. Eggs visible to naked eye as whitish granular material.
Stage 4: Developed	Testis reddish-white, no milt produced under pressure. Ovary orange-red. Eggs clearly discernible, opaque. Testis and ovary occupy about 2/3rds of ventral cavity.
Stage 5: Gravid	Sexual organs fill ventral cavity. Testis white. Drops of milt produced under pressure. Eggs completely round, some already translucent and ripe.
Stage 6: Spawning	Roe and milt run under slight pressure. Most eggs translucent with few opaque eggs left in ovary.
Stage 7: Spent	Not completely empty, no opaque eggs left in ovary.
Stage 8: Resting	Testis and ovary red and empty. A few eggs in state of resorption

Examples of species that are long life-history, pangasius, cyclo, etc. and then examples of 1-year maturation…
? Ask Les for his guesstimates…
1-year sexual maturity