19.1 Introduction

- Monitor locations, behavior, physiology of aquatic animals
- Involves attaching to aquatic organism a device that relays biological information
- Relayed via radio signals
Monitors animals not visible

- Collect data with minimal disturbance
- Means to solve biological problems
Devices

- Transmitter - device attached emits signal
- Transponder - returns a signal in response
  - Active
  - Passive
Transmitter

- Electronic oscillator circuit produces signal
- Measure of frequency is hertz
Factors to consider for telemetry

- Compile testable yes or no questions
- Can the problem be solved using another method?

Yes … Don’t do telemetry
19.2 Telemetry Systems

- Origin in late 1950's
- Modified to work underwater in the 1960's
Features Common to Ultrasonic and Radio Systems

• Transmitter signals
  – Continuous wave or pulsing signal
• Continuous more easily detected and recorded
• Pulsing signals use less energy and increase transmitter life
Transmitter encapsulation

- Encapsulated (for compactness) with
  - Epoxy
  - Wax
  - Urethane
  - Silicone
  - Dental acrylic
Transmitter encapsulation (cont.)

- Done by
  - pouring material over components
  - dipping component into material
- Density of should be similar to water
Batteries

- Choice is critical (size)
- Largely determined by battery energy per unit volume/weight
- Other considerations include cost, shelf life and availability
Five types of batteries are used

- Lithium
  - Highest voltage/unit weight and volume
  - Excellent low temperature performance
  - Good high temperature performance
  - Long shelf life
  - Good efficiency
  - Low cost
Five types of batteries are used (cont.)

- Mercury oxide
  - Possible health hazard
- Silver oxide
- Alkaline
- Rechargeable nickel-cadmium
Receivers

- Filters input signals, amplifies, and converts to usable form
- Must have good sensitivity
- Must have narrow frequency

- Portable receiver should have rechargeable batteries
- Should have water proof switches and be moisture resistant
Advantages/disadvantages of Ultrasonic & Radio Systems

- With respect to characteristics
  - Depth: 45-100 ft.
  - Water conductivity: high
  - Current speed: 3mph
  - Habitat size: 300 square mi.
- Plant densities: low
- Temperature gradients: 50 - 85
Ultrasonic telemetry

- Salt and fresh with high conductivity
- Deep water
- Adversely affected by (reduce signal range)
  - Macrophytes
  - Algae
  - Thermoclines
  - Water turbulence
  - Rain drops and boat motors
Radiotelemetry

- Shallow water
- Low conductivity fresh water
- Turbulent water
- Can be used for large areas
- Can be used from shore
- Cannot be used in salt water
- Deflected by objects
Coded and sensing transmitters

- Provide information on
  - Animals identity
  - Physiological variables
  - Behavior
  - Environment
- Often used to identify tagged individuals
Selection of a supplier

- Review literature for names of researchers
- Ask for a reliable manufacturer
- Do not reinvent the wheel
Selection of a supplier (cont.)

- A firm should
  - Fill orders quickly
  - Repair equipment quickly
  - Loan replacement equipment
  - Offer advice
  - Visit site to solve a problem
19.3 Methods of attaching transmitters

- Depends on
  - Morphology and behavior of species
  - Nature of aquatic ecosystem
  - Objectives of project
External Transmitters

- Easier and quicker than surgical implantation
- Used for fish spawning and feeding
- Necessary for sensing environmental factors
- Increase drag on swimming organisms
Widest application

- Attaches transmitter alongside dorsal fin
- Surgical needle can be used
- Neoprene placed between fish and plate
- Attach radio transmitter
Stomach Inserted Transmitters

- Do not cause drag
- Cannot become snagged
- Less likely to be abrasive
- Can use heavier package
- Can be done quickly
- Short habituation time for fish

ATTENTION ANGLERS

REWARD

FOR RADIO TRANSMITTERS

$100 REWARD
$25 REWARD
Disadvantages

- Difficult to get in fish's mouth
- May be regurgitated
- May rupture the esophagus or stomach
- External variables are difficult to monitor
Surgically implanted transmitters

- Excellent for physiological transmitters
- Best for long term attachment
- External factors difficult to monitor
- Takes long to perform
- Long recovery period
- More likely to cause infection
19.4 Methods of tracking - Boat

- Stop at specific locations
- Listen for transmitter signals
- Engine off or at low revolutions
- By signal position boat above animal
- Locate animal on map
- Measurements taken
Airplane

- Highly mobile tagged animals
- Greatest detection range for signals
- Very high cost
- Easy to miss animal due to speed
- Locations determined within 100 m
Triangulation

• Bearings from two or more locations

Aerial Tracking

✓ Special case of homing
✓ Particularly useful for animals that move long distances or are “lost”
✓ Fast and efficient
✓ Accuracy? Generally within 100-200 m
✓ Mapping errors
✓ Difficulties in observing animal

• Move receiving unit between locations

• Great error by moving animals
Appearance at fixed locations

- Receivers set at certain locations
- Record presence or absence of transmitter
Automatic tracking system

- Measure time taken by signal to travel through water
- Very accurate
- Must have strong signal
- Animals must be in home range
Satellite telemetry

- By satellite
- Track remote, wide ranging animals
- Usually used on larger animals
Automatic Data Recording

- Automatically decoded and recorded
- Absence or presence of signal on strip chart
- Manual - one animal at a time
- Timers may be used
- More elaborate
  - Electronic data sheets
  - Data collection computers
  - Microcomputers
19.5 Sampling and processing - Field Considerations

- Have spare for everything
- Store transmitters in padded boxes
- Store in refrigerator if not used for long (batteries)
- Activate transmitters days before testing
Field Considerations (cont.)

- Test transmitter before attaching to animal
- Cover receivers with plastic bags
- Dry out receivers after use
- Discharge nicad battery before recharging
Sampling size considerations

- Number tagged depends on
  - Cost
  - Labor
  - Availability of animals
  - Type of data desired
  - Method of analysis
Methods of Searching

- Use equally spaced transects
- Vary starting point each day
Sampling time

- Do not sample same time every day
- All hours sampled equally
- Choose days and time randomly
Data Plots

- Draw bearings on plot board
- Each animal gets a x and y coordinate
- Statistical programs can plot scattergrams

Temporal Independence: Problems II

☑ If animals are migrating for instance, problems may arise (McNay et al. 1994)
  - A few long distance moves stretches range
  - The result is a bimodal point distribution
Data analysis

- Usually done with computer
- Define biotelemetry
Population of interest

- Experimental unit
- Hypothesis to be tested
- Present in appropriate units