An Introduction to Electric Fishing

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Introduction

This presentation will cover:

- An overview of electric fishing
- The equipment used
- The main factors influencing the effectiveness of electric fishing
- Health & Safety
- Fish welfare & electric fishing

Guidelines for Electric Fishing Best Practice

- Due to wide variety of equipment in use, and water bodies in which they are used, it is not easy to state exactly what settings to use and where.

More complex equipment

- Equipment used for Electric fishing has become much more technically advanced over the past 20 years

1974

2020

Guidelines for Electric Fishing Best Practice

- A good understanding of equipment and basic theory behind the method will allow operators to set equipment output according to circumstances.

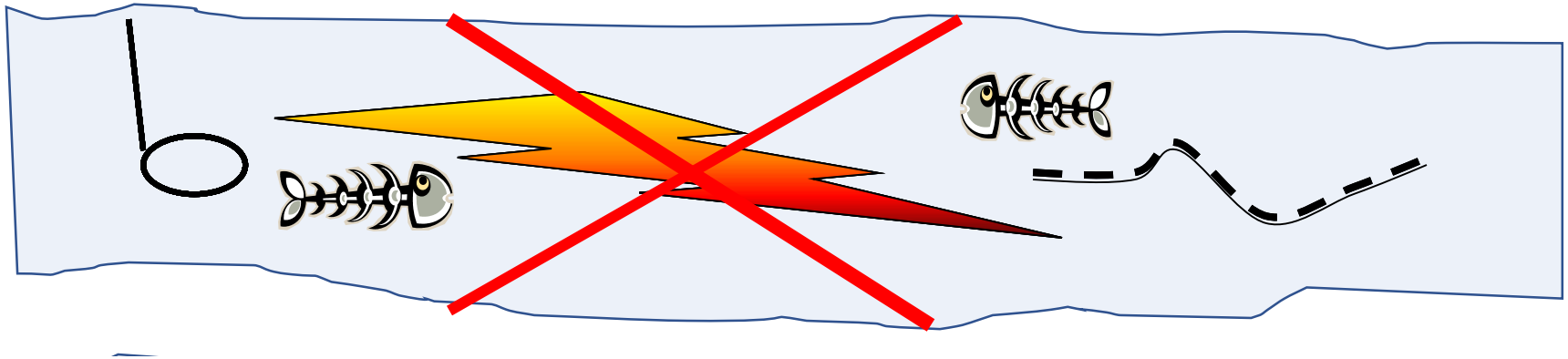
Training needed!

What Is Electric Fishing?

- “The application of an electric field into water in order to incapacitate fish: thus rendering them easier to catch”

Not electrocuting the fish!!

Basic idea



+ve (Anode)

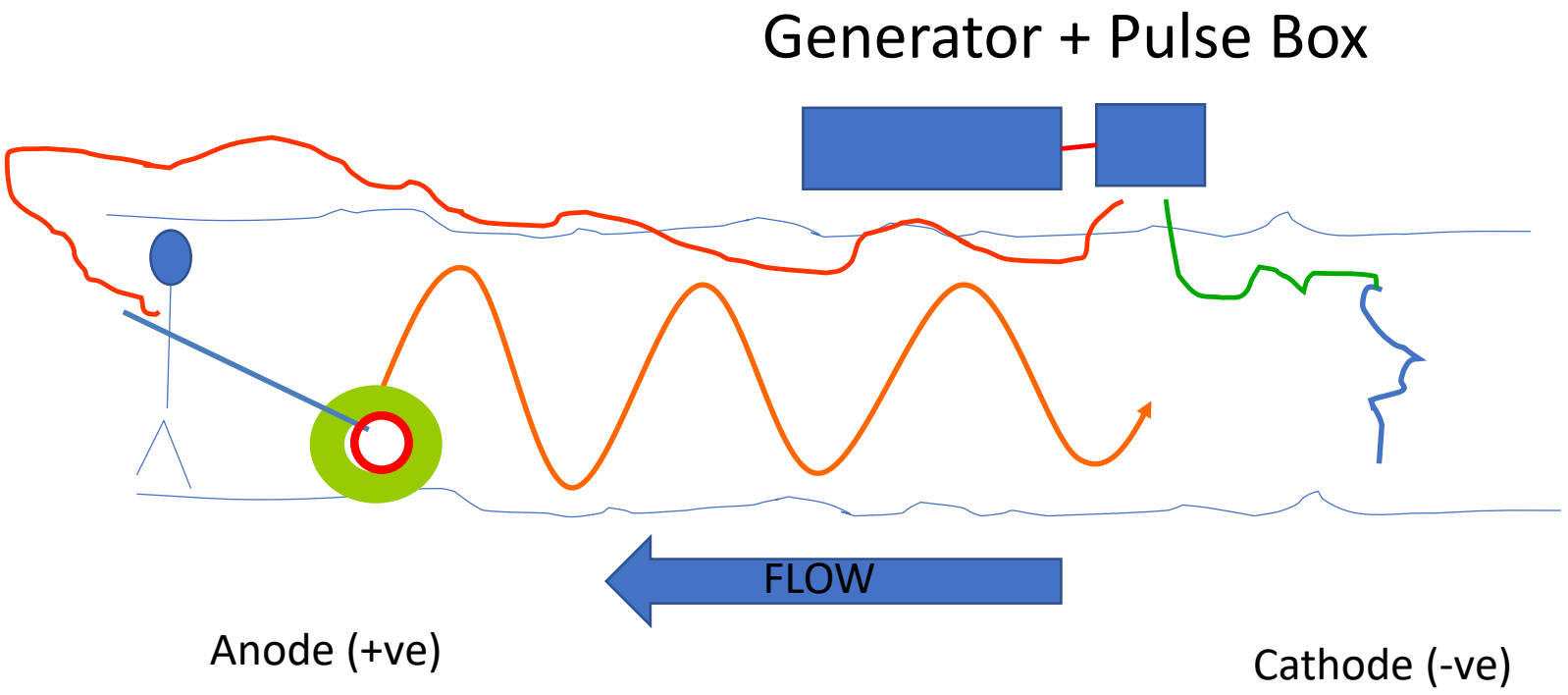
-ve (Cathode)

Basic idea

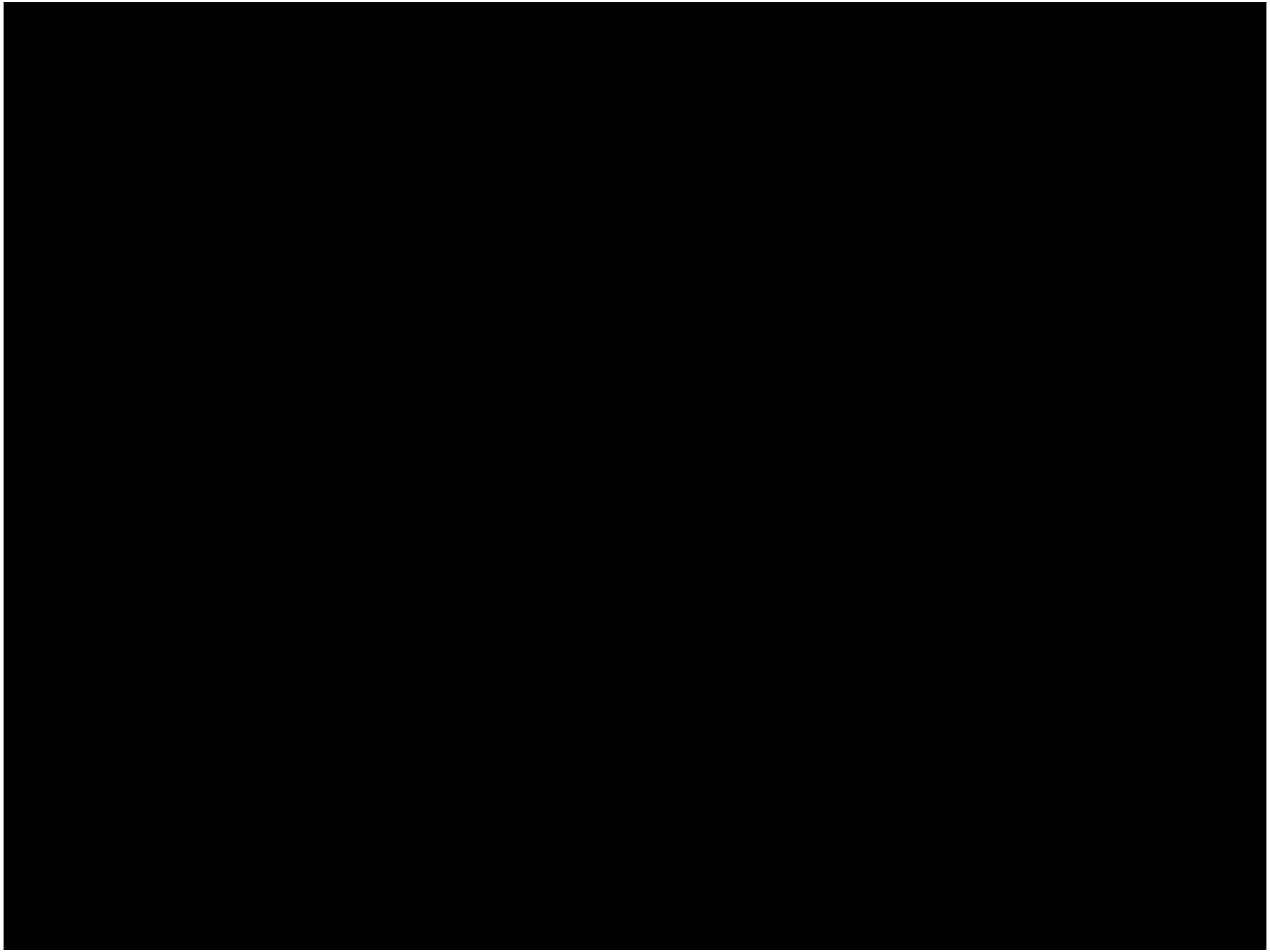
Capture area

Basic equipment

Basic method



Basic idea - film



Uses for fish assessment

- Qualitative sampling
  - e.g. Presence/Absence
    - Single pass
- Semi-Quantitative sampling (no assessment of error)
  - Standardised single pass/timed fishing
    - Same equipment, comparative output settings, same staff …
- Quantitative sampling (Data plus error estimate)
  - e.g. Population density
    - Catch depletion ≥ 2 runs (Seber & LeCren; Zippin)
    - Catch /mark / recapture

Factors affecting the effectiveness of electric fishing.

- Electrical output
  - Waveform type
  - Voltage
- Electrode design
- Water conductivity
- Time of day
- Water clarity
- Water depth & width

- **Operator skill**

Equipment

Equipment – generator based

Pros:

- High power available (for high conductivity sites).
- Refueling easy so long running times available.
- Modular design

Cons:

- Heavy, 2-3 people needed to transport

Price: GB£ 9-12,000

Control Box – EAES *Easyfisher*

Price:
GB£ 6,000

Equipment – Backpack

Pros:

- Easy to transport
- Reduced manpower needed

Cons:

- Challenging to set up for high conductivity sites.
- Repair
- Carrying in rocky streams

Price: GB£ 10,000

Equipment – Backpack

Price: GB£ 5,600

+ long-lead anode

Equipment – Backpack Batteries

Batteries: <u>Non-spill</u>

- Lead/Acid gel type
  - Cheap
  - Robust
  - Ready availability

SRI:
GB£ 300

Amazon:
GB£ 20 (x2 = £40)

- Lithium Iron Phosphate (LiFePO4)
  - Expensive
  - Light weight
  - Difficult to get

SRI:
GB£ 700

Equipment – Anode (positive electrode)

Equipment – Anode (positive electrode)

- Insulating handle – Fibreglass, GRP not wood (or Carbon Fibre)
- Deadmans switch
- NOT used as net

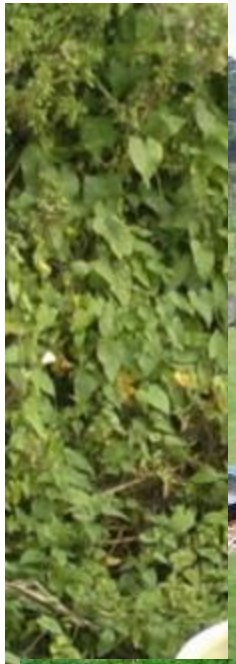
Anodes – bad design!

Equipment – Anode (positive electrode)

- In wide rivers (>5metres) more than one anode will be needed for accurate population estimates.

Cathode

Equipment - Nets



Handle:
Wood / Bamboo
Fibreglass / GRP

Equipment – Nets

Insulated metal or non-metallic net ring

Electric Fishing - Methods

- Classical (wading) fishing - Upstream

Electric Fishing - Methods

- Classical (wading) fishing - Downstream

Electric Fishing - Methods

- Gear in boat wading (twin anode) towing boat

Electric Fishing - Methods

- Small inflatable boat fishing

Electric Fishing - Methods

- Boom-raft

E-Cat Light-Duty C

Electric Fishing - Methods

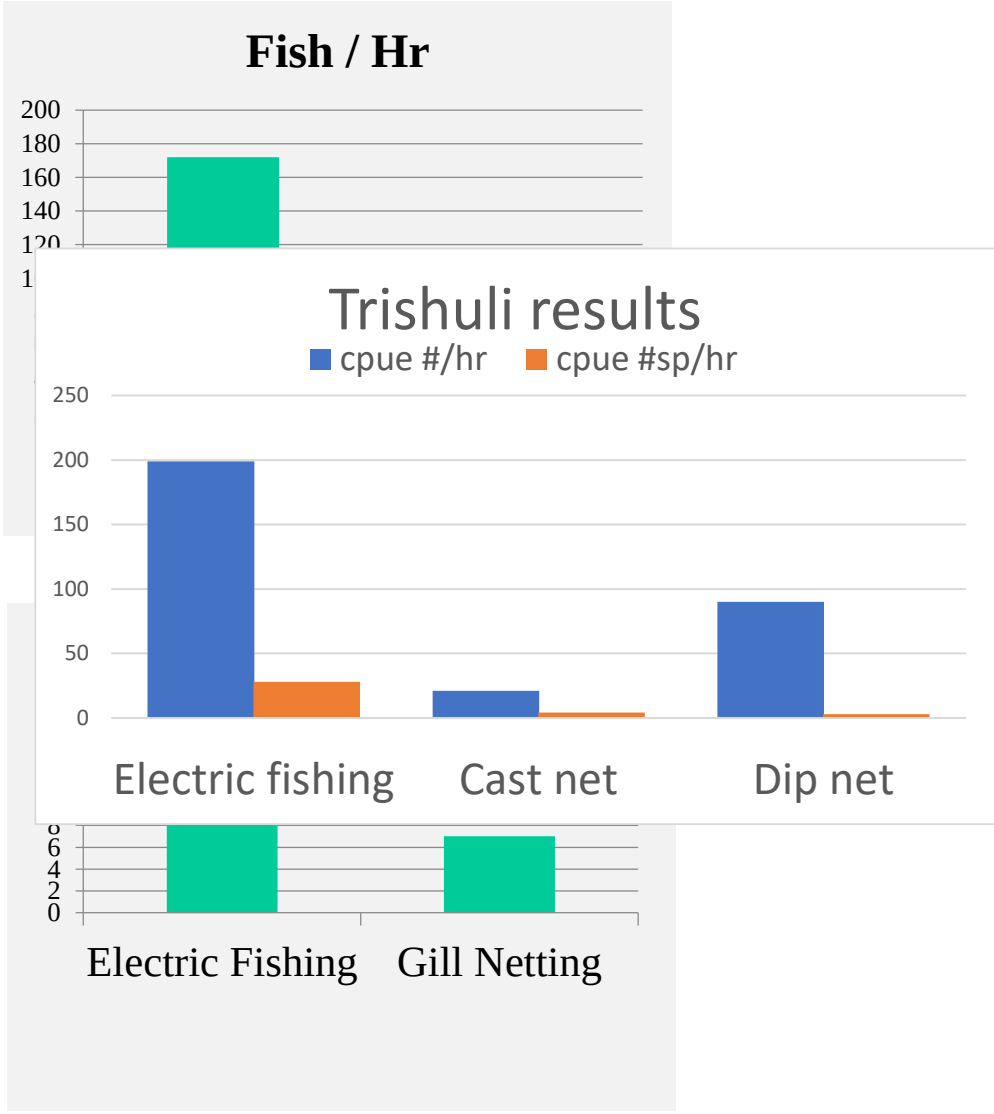
- Mini-Boom-Boat

Electric Fishing - Methods

- Boom-Boat

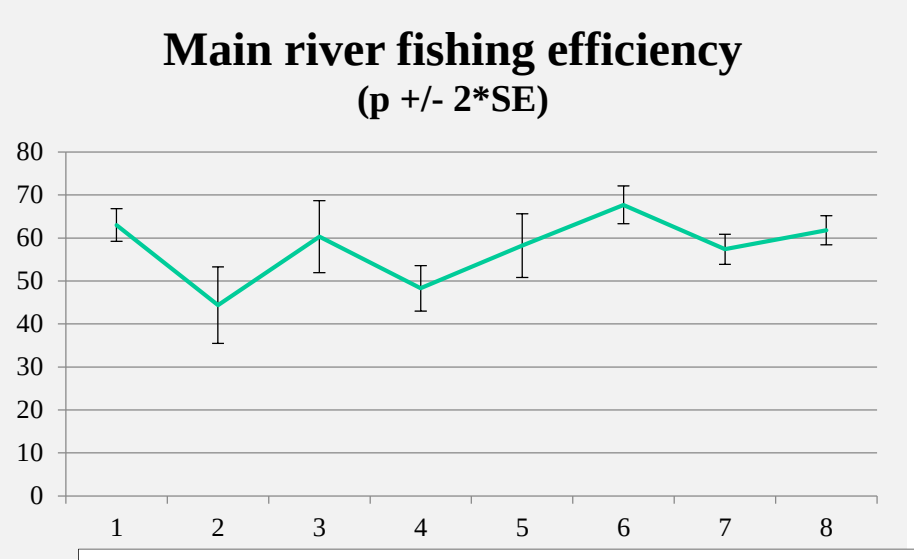
Advantages over other methods

- High capture rate
  - 30x that of gill nets
- Better species composition
  - 2x as many species

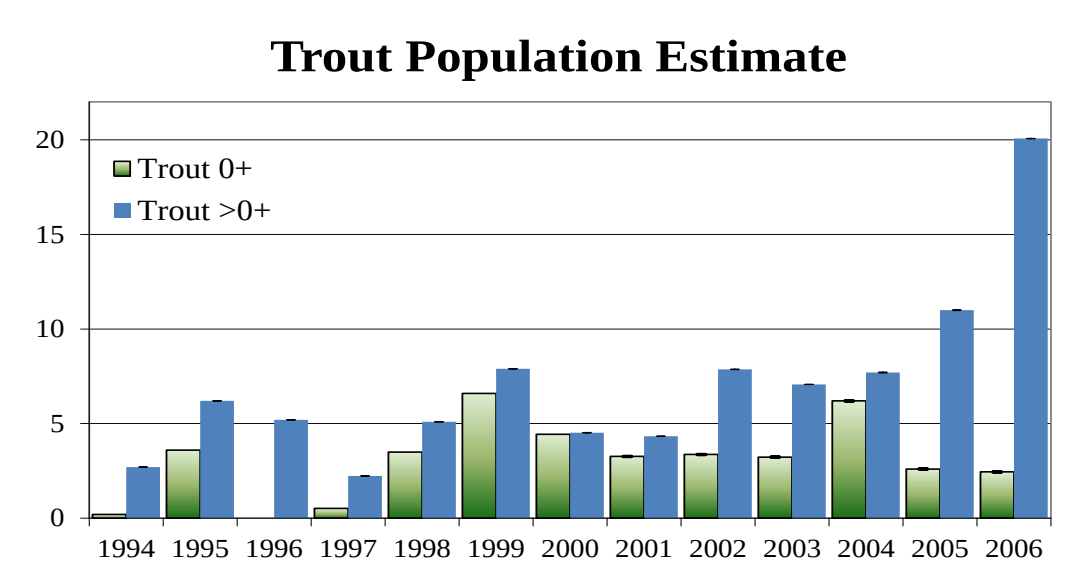


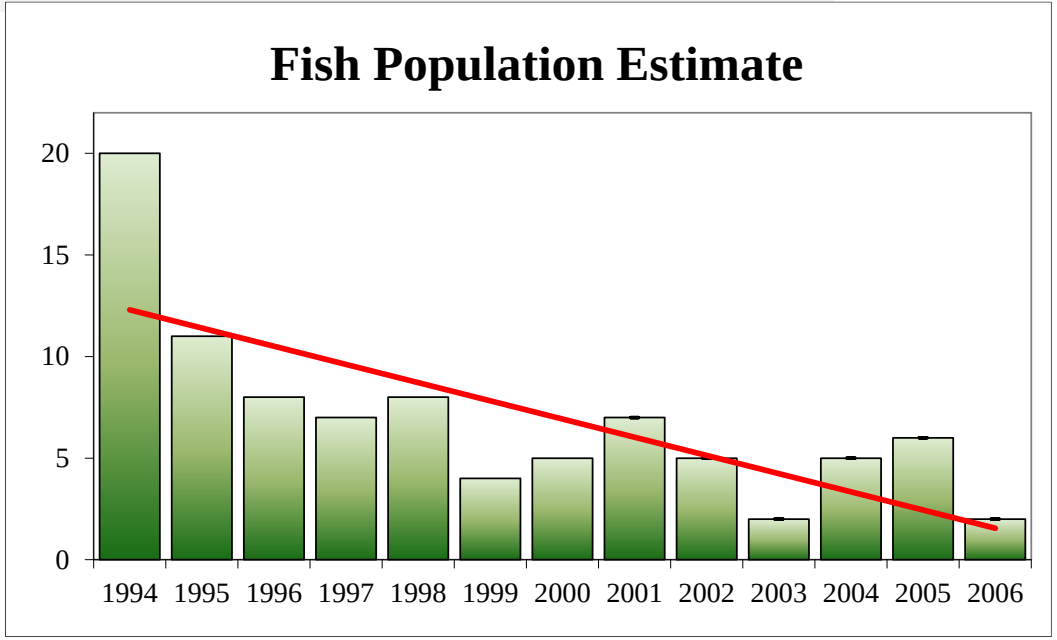
Advantages over other methods

- More consistent results



- Quantifiable results





Advantages over other methods

- Cost effective – less manpower needed
    - Two persons minimum team for backpack fishing
    - Three for generator fishing
- No prior site preparation required
- Less physical injury to fish than some other methods

Limitations

Limitations

Limitations

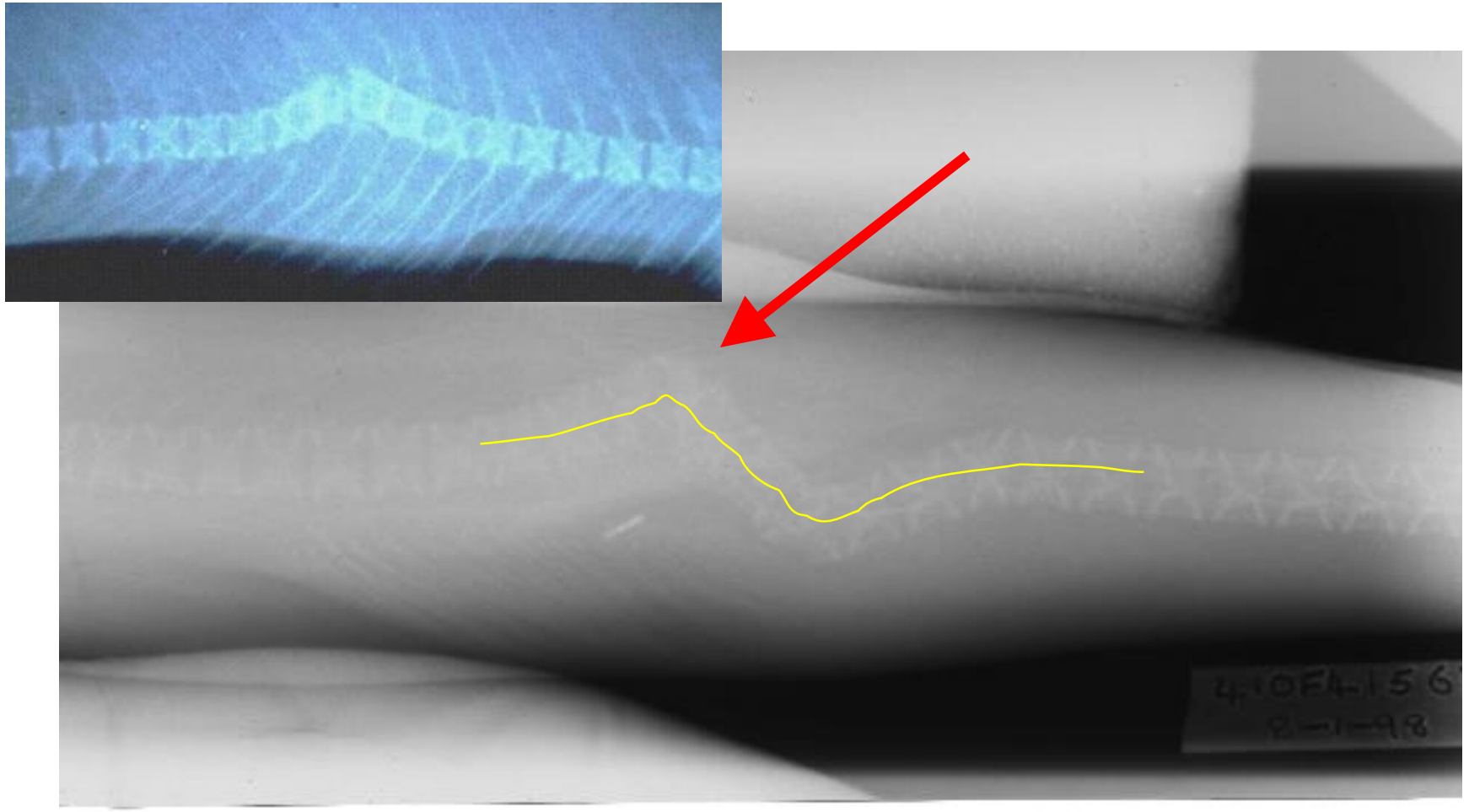
E-Cat Light-Duty Cataraft

Disadvantages over other methods

- Different sizes and species of catchability:
- Influenced by:
  - Surface area of fish
  - Scale size
  - Conductivity of fish
  - Permits?
- Potentially damaging to fish

Fish Damage

Fish Damage



Electric fishing mortality

- Fish injury is usually caused by inappropriate output settings (too high voltage, high frequency pulses).
- However, some injury can occur at “correct” settings.

- GWCT salmon parr survey
- 10,000 juvenile salmon caught and PIT tagged
- < 2% e/f mortality

But!...

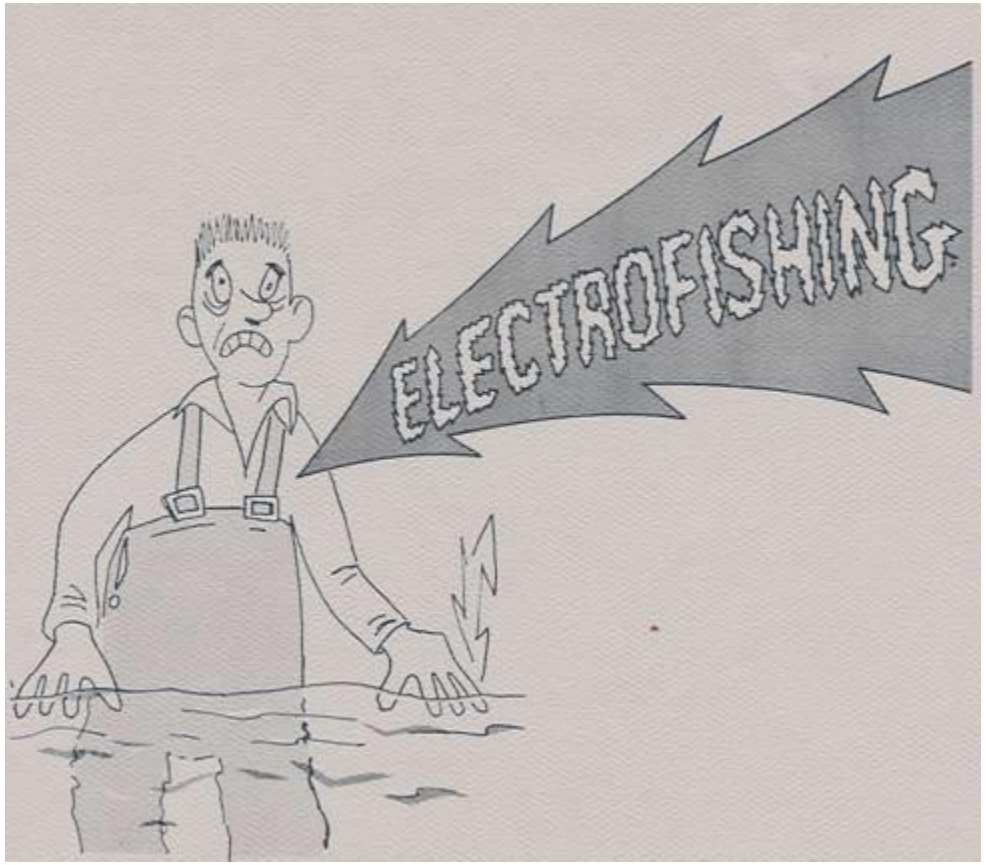
- Be pragmatic! *(Schill, D.J. & Beland, K.F. (1995) Electrofishing injury studies - a call for population perspective. Fisheries 20:)*
- E/F may survey 10%-15% of stream (max)
- Worst case e/f mortality 25%
- E/F effect on population = 3%-4%
  - Below detectable values
- Natural mortality of some fish (salmonids) can be high (30%-60%)
- Fish can heal themselves

Alternative methods??

- ALL fish *capture* methods have some drawbacks regarding fish welfare.
- Netting
  - Damage to gills, physical damage
- Trapping
  - Physical damage

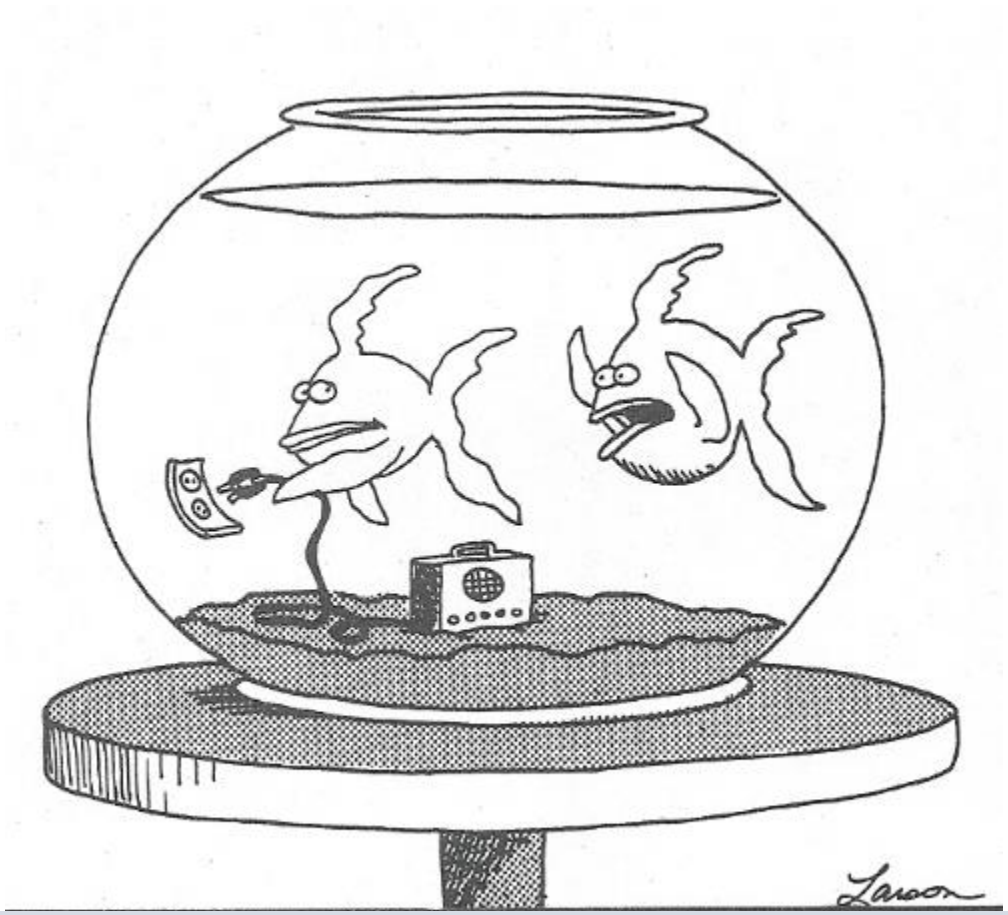
Disadvantages over other methods

- Electric fishing can be dangerous to humans!
- Safe Working Practice can make the risks very low



Health & Safety risks

Principle Electrical Dangers



"Bob! You fool ... Don't plug that thing in!"

Health & Safety risks

Principle Electrical Dangers

- Direct contact with AC power (Source contact)
- Direct contact with DC/PDC power from out-of-water contact with electrodes (Dry contact)
- Contact with water within electrical field (Wet contact)
- Electrical shock due to faulty equipment (Fault contact)

Health & Safety risks

Principle Electrical Dangers

Dry contact: direct contact with power from ‘dry contact’ with electrodes

- NEVER energise an electrode out of the water
- Always assume electrode is “live”
- European regulation states: ‘Nothing shall be taken from the electrode by hand’


Play
15.24 / 29.00

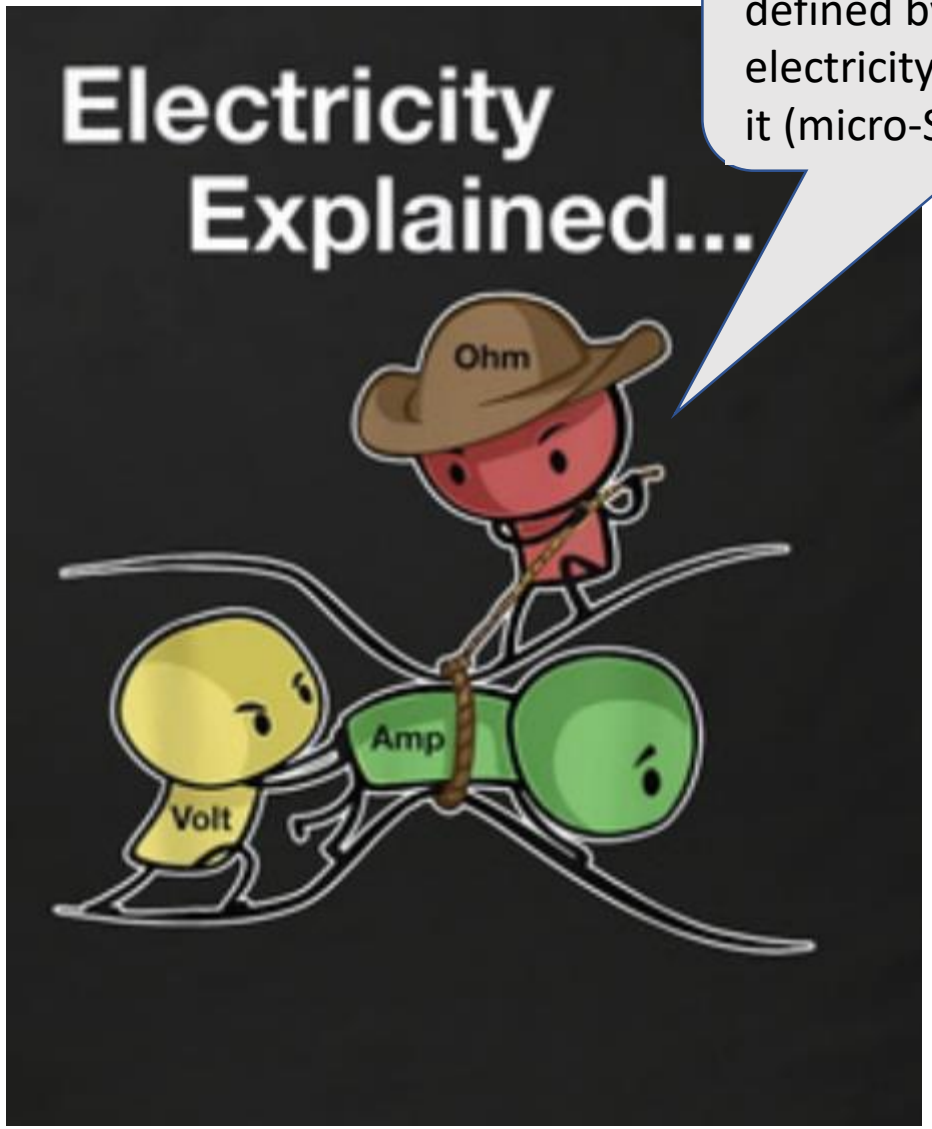
Health & Safety risks

- Other risks
  - Drowning
  - Tripping / falling
  - Lifting heavy equipment
  - Burns from contact with generator exhaust or shorting-out battery
  - Trauma from being hit by net poles
  - Hypothermia / Hyperthermia
  - Driving to the site – esp. in Nepal!

Definition of Electrical Terms

Definition of electrical terms

Note: water resistance is defined by how easily the electricity can pass through it (micro-Siemens =1/Ω)



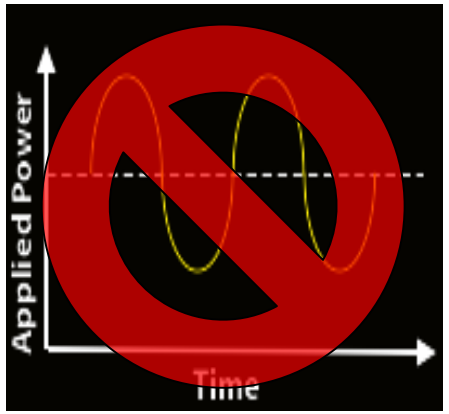
Ohms (Ω), the resistance to the transmission of the electricity

Volts (V), the pressure of the electricity

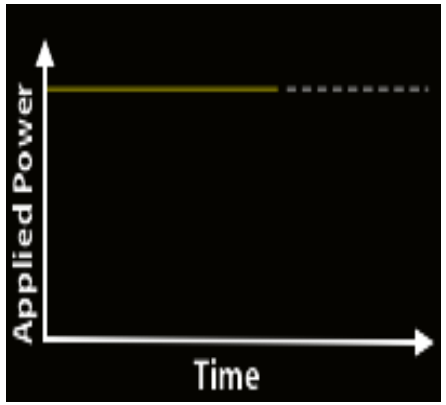
Amps (I), the volume of the electricity

Types of Electrical Waveforms

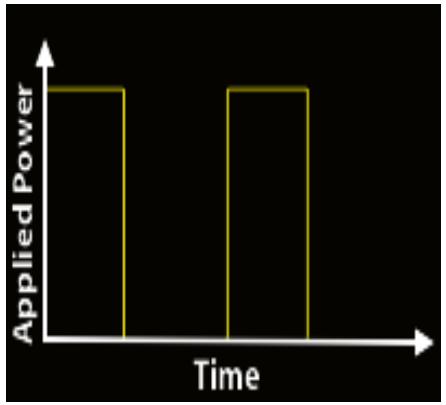
AC



DC



Pulsed DC



Pros and Cons (for a fixed voltage)

- Catches a lot of fish
- Easy to produce
- Moderate power demand
- High level of injury

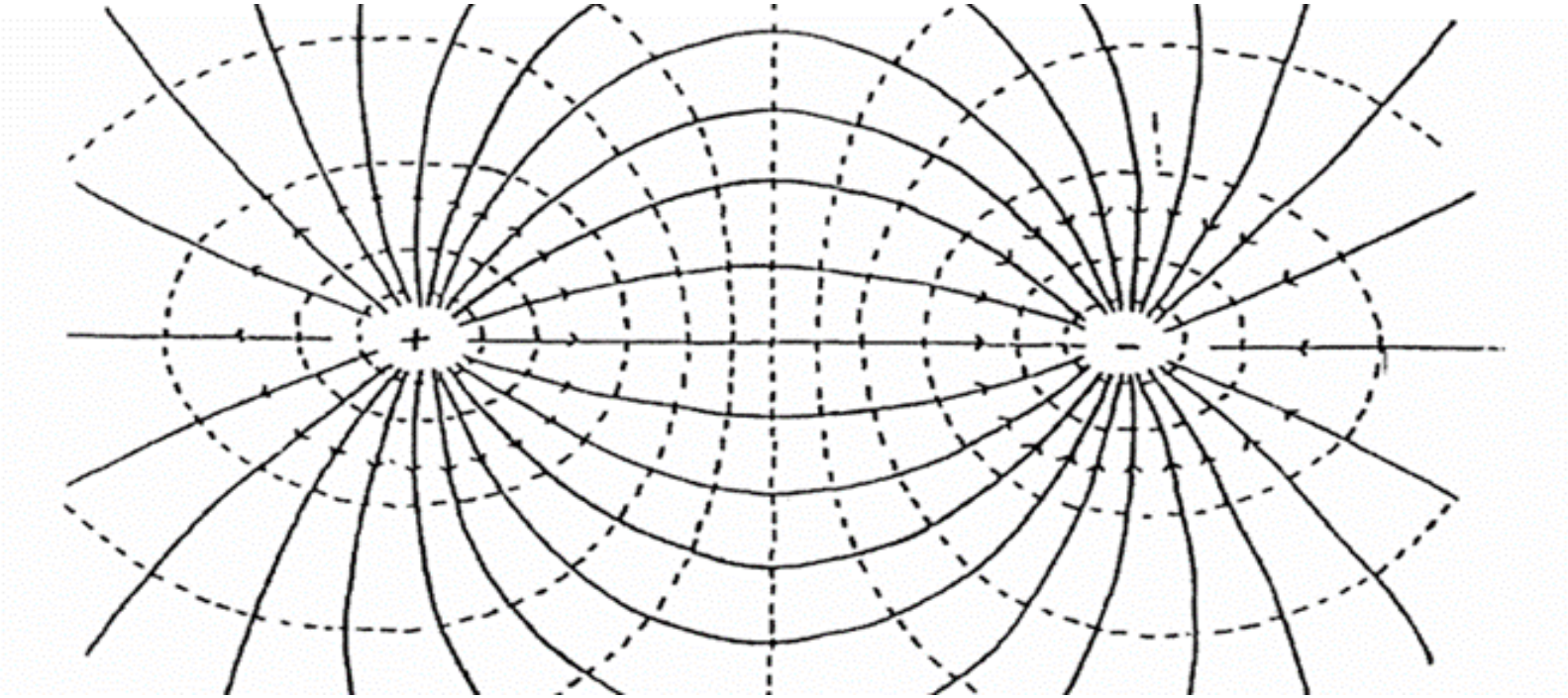
- Catches fewer fish
- Easy to produce
- High power demand
- Low level of injury

- Catches many fish
- Hard to produce
- Moderate power demand
- Intermediate level of injury

Definition of terms – Voltage gradient

Voltage gradient.

- Measurement of volts per linear unit (V/cm).



- Voltage (dashed line) & current (solid line) fields

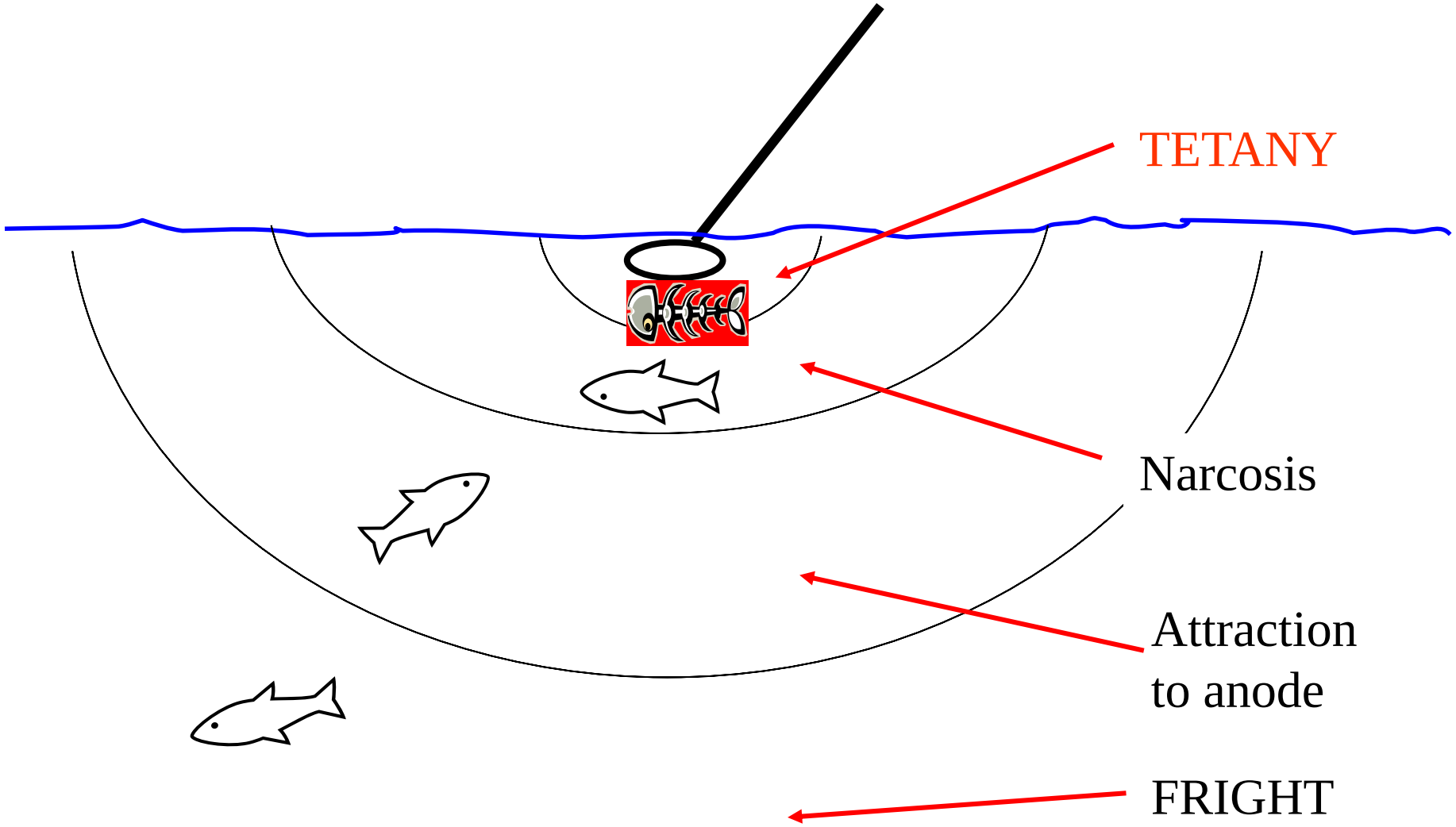
Voltage gradient

Threshold (of effect) values will vary with differing waveforms (DC, PDC).

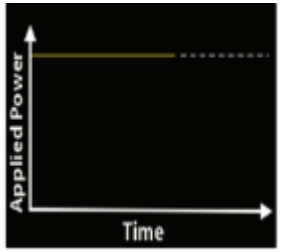
For pdc, attraction threshold = 0.1 - 0.2V.cm

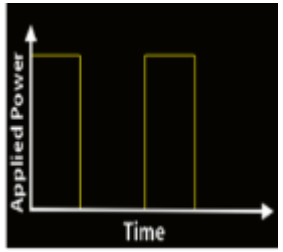
For dc, attraction threshold = 0.2 - 0.3 V.cm

Effects of DC/PDC electric field on fish



Effects of DC *vs* PDC waveforms





Direct Current

- Least damaging waveform
- High fish attraction
- Needs high voltages for effect
- Very power hungry, so difficult to use in high conductivity (>350µS.cm^{-1}) or using battery gear

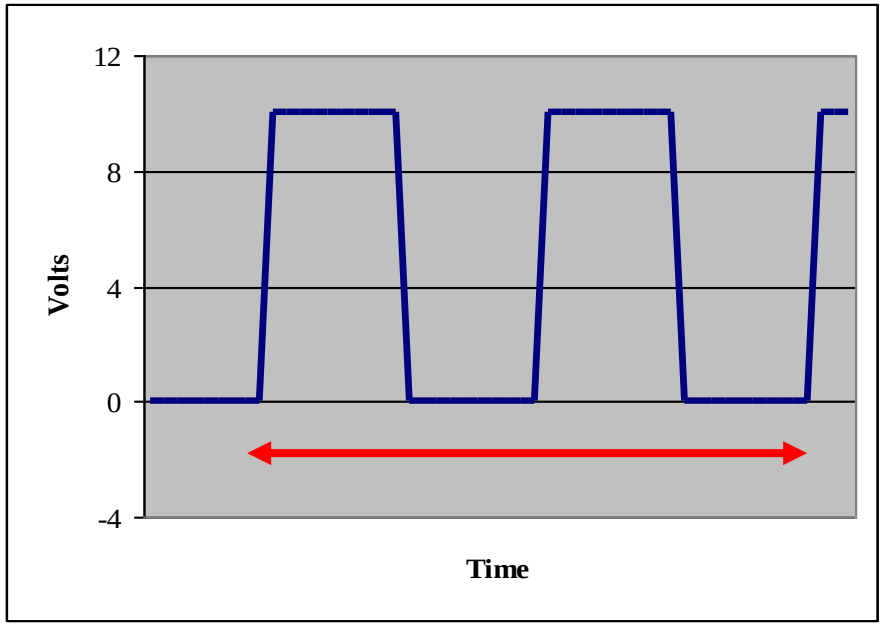
Pulsed Direct Current

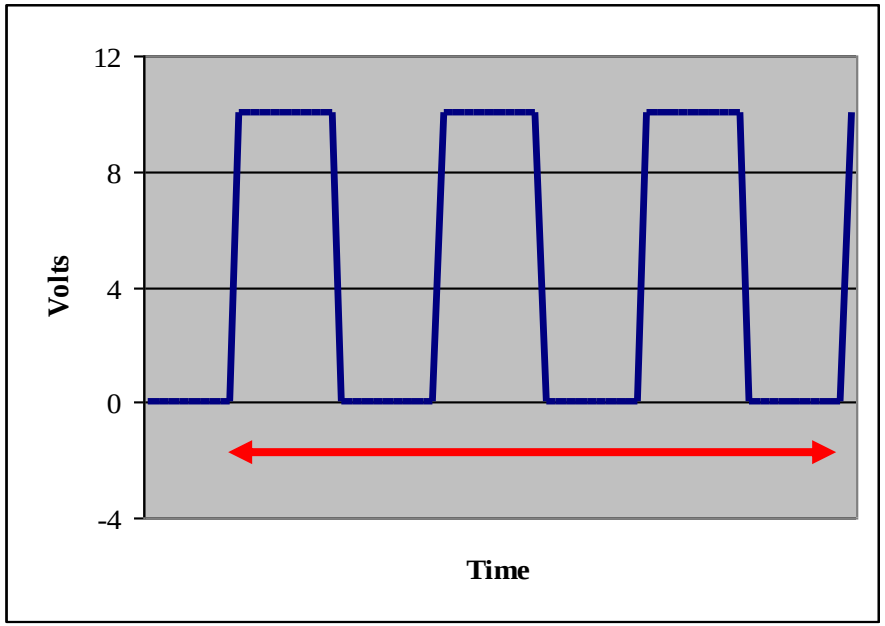
- Higher damage – particularly at high pulse frequency (see later)
- Uses lower voltage than DC for effect
- Very power efficient, can be used in most water conductivities

Definition of terms

Pulse Frequency (Hertz - Hz)

Pulses per second





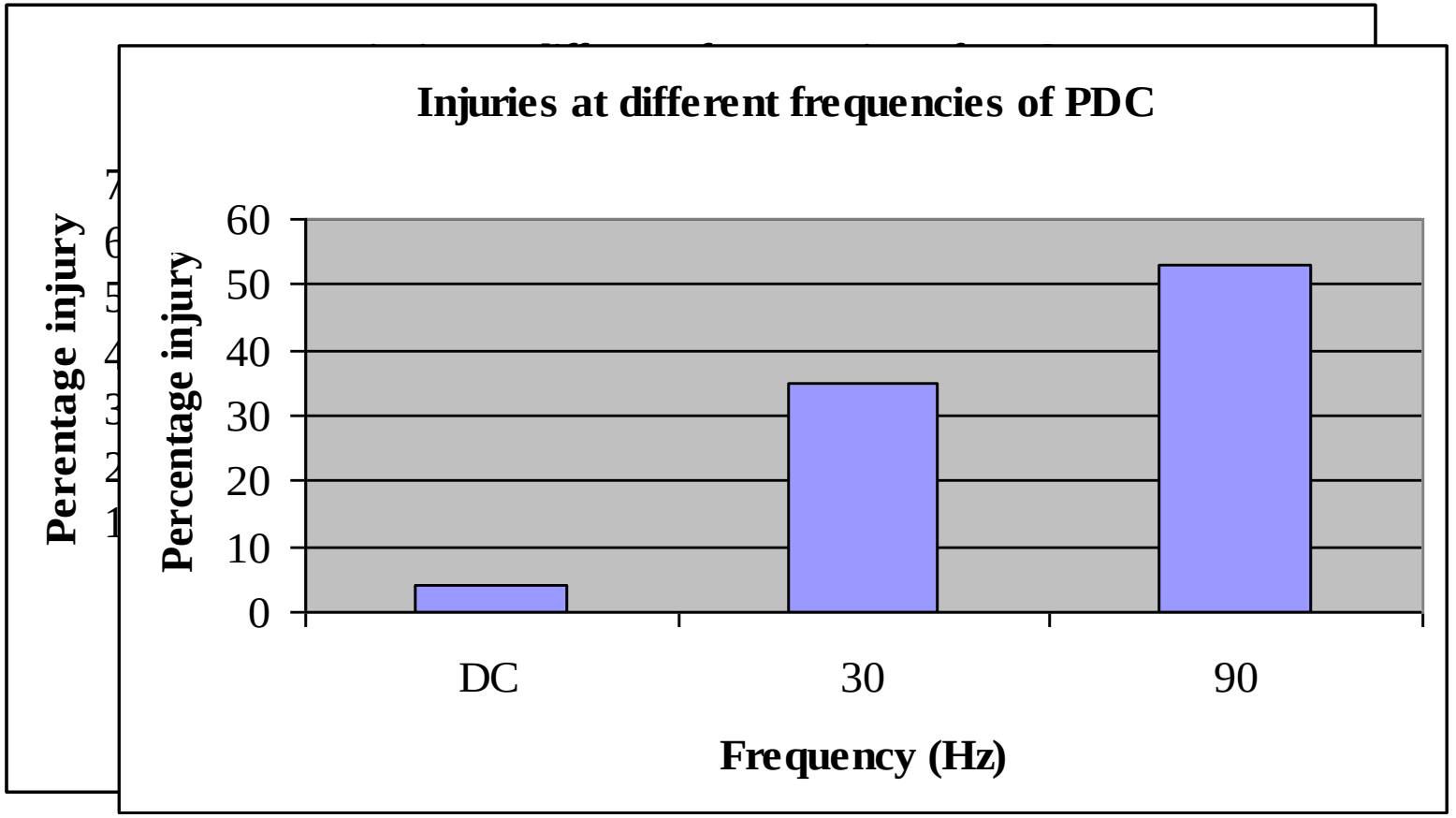
Definition of terms

Pulse Frequency

- Can tailor frequency for target species

Fish Species	Optimal Frequency (Hz)
Trout	60
Carp	30
Eel	20

High frequency harms fish



High frequency harms fish

- High frequency = high injury potential.

The following have been found to be both effective and have minimal / low fish injury for UK species

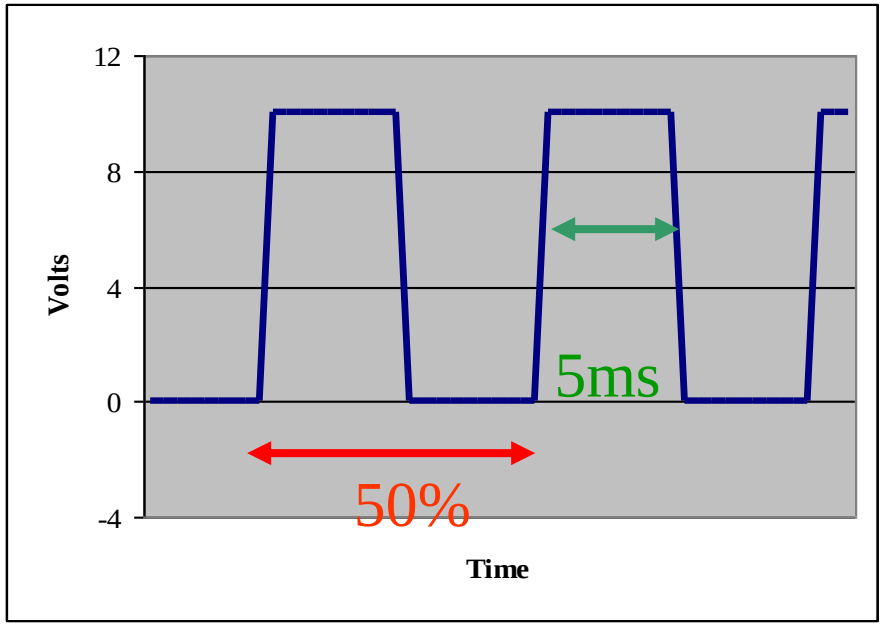
Salmonids	40 – 60 Hz
Cyprinids	30 – 50 Hz
Perch	30 – 40 Hz
Pike	30 – 50 Hz
Eels	10 – 40 Hz

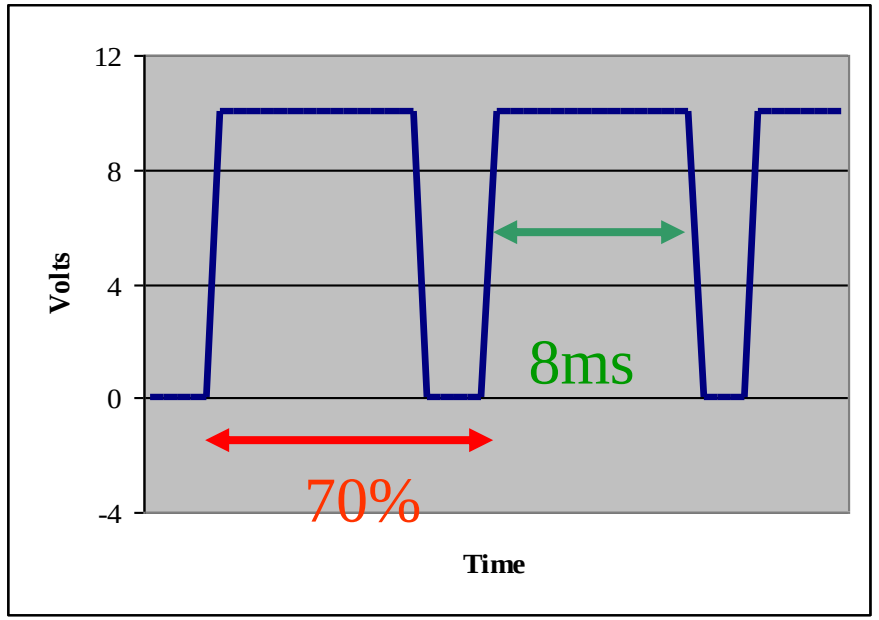
Definition of terms

Pulse width

Percentage duty cycle

Milliseconds





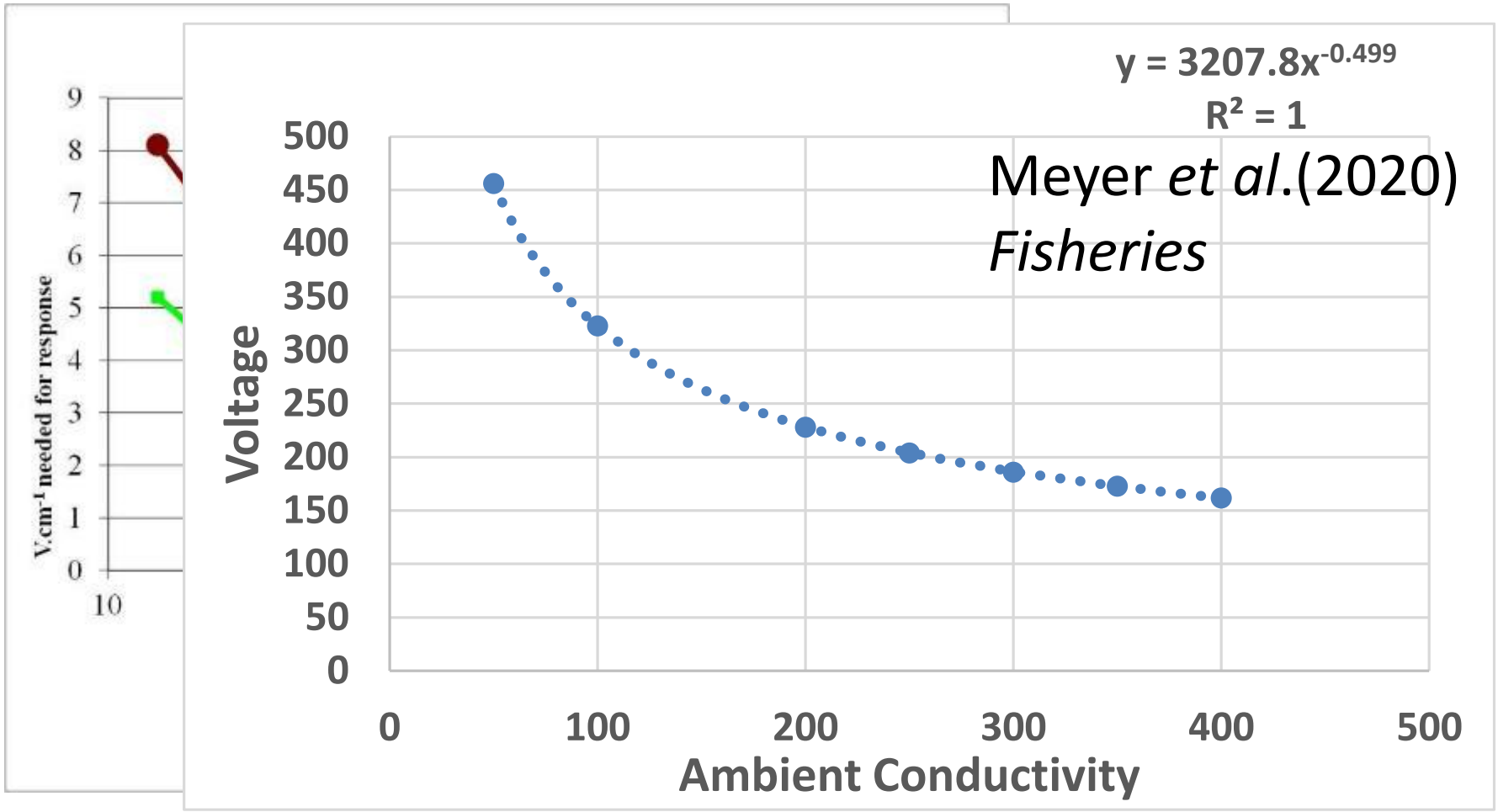
Definition of terms – Conductivity

- A measure of the ability of the water to conduct electric current. Measured in Seimens (S or σ)
- For water usually expressed as microseimens per cm (μScm^{-1})
  - Mountain stream 20 – 150 μScm^{-1}
  - Lowland river 800 – 2500 μScm^{-1}
  - Sea water 30,000 μScm^{-1}

Water : Fish Conductivity Ratio

- Water conductivity will affect the voltage experienced by the fish.

100 Watt method



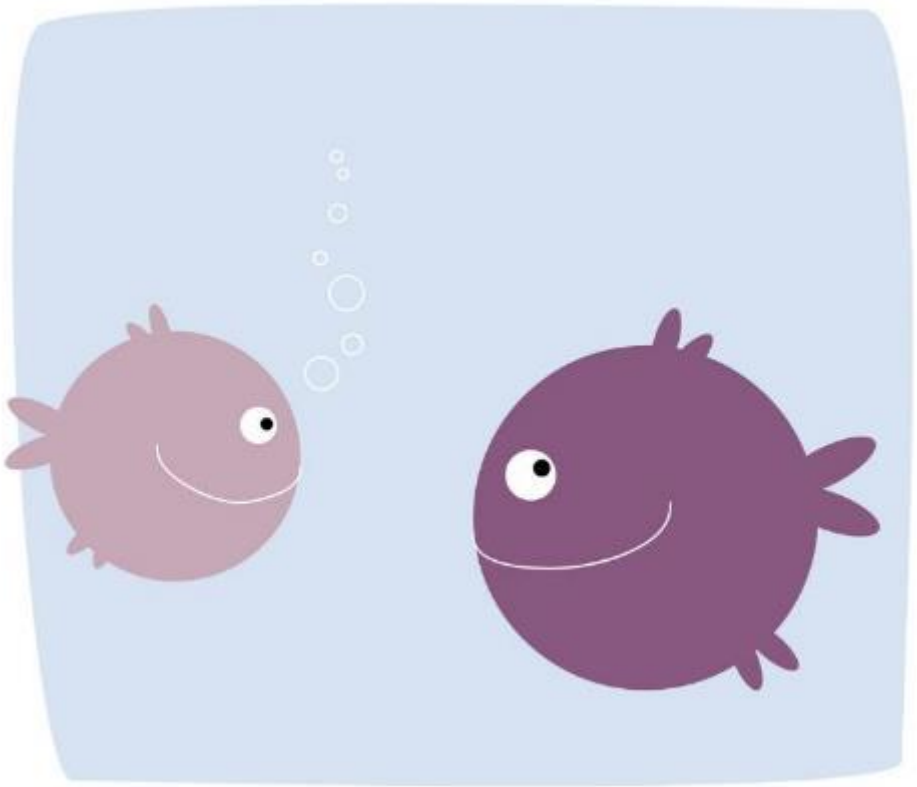
Water : Fish Conductivity Ratio

Keep electric field at the minimum required for efficient fish capture at the conductivity.

The following are recommended as a guide for **PDC**:

•15 – 50 µs/cm	**500 – 1000 Volts**
•50 -100 µs/cm,	**400 – 500 Volts**
•100 - 150 µs/cm,	**300 – 400 Volts**
•150 - 250 µs/cm,	**200 – 300 Volts**
• 250-1000 µs/cm,	**150 – 200 Volts**
• > 1000µs/cm	**50 – 150 Volts**

Fish Welfare



Fish Welfare

- Proper handling of the fish once caught is essential, both to prevent injury and to reduce stress.
- In the past, considerations about a fish's ability to "suffer" have been somewhat overlooked. Present research however has shown clearly that fish can react to stressing actions and some researchers surmise that fish can not only feel pain but also experience fear (Verheijen & Flight 1992).
- Whilst the debate continues regarding this issue, fishery workers must be aware of the fact that they are dealing with sentient organisms and act appropriately.

Fish Welfare

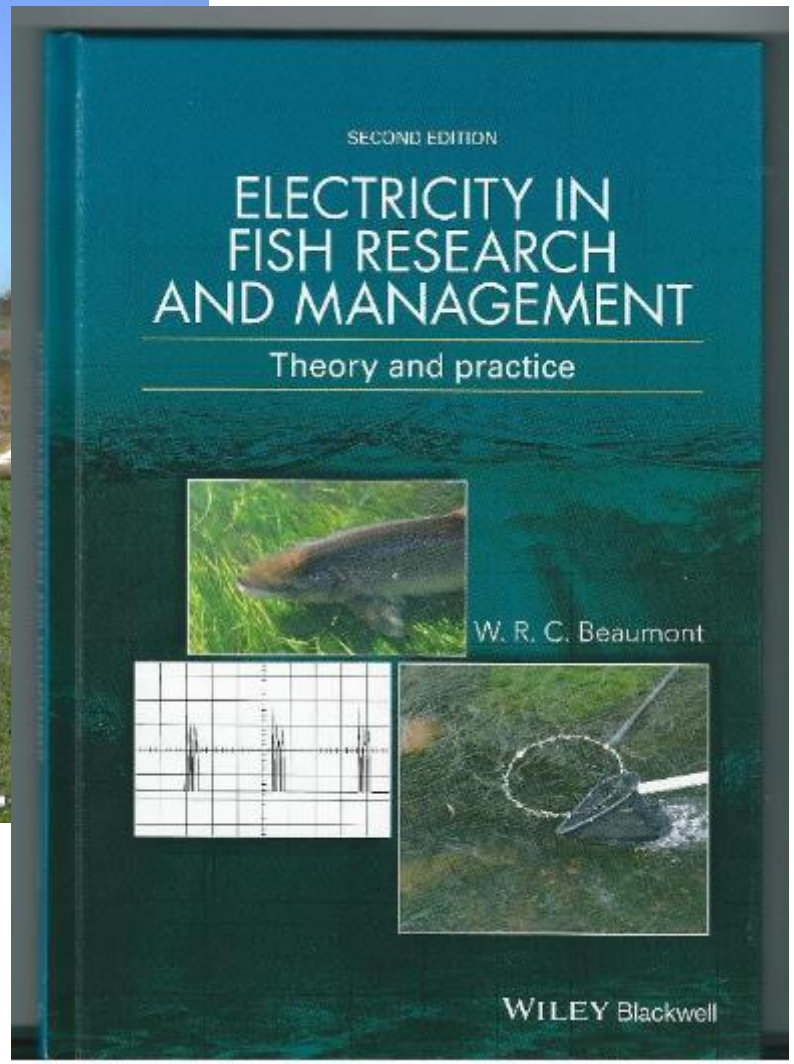
Negative effects on Welfare

- Stress from capture / handling
- Anaesthesia
- Fish density in holding bins
  - Physical damage
  - Oxygen / Carbon Dioxide levels
- Temperature changes

Best Practice guidelines

- Understand basics of theory and adjust according to theory not guesswork!

Thank you!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Theory and practice
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