Module 23

Welfare of Wild-Caught and Farmed Fish (Fish Welfare Part 1)

This lecture was first developed for **World Animal Protection** in 2006 with extensive contributions from by Dr Larry Hammell of the Atlantic Veterinary College, Canada. It was revised by **World Animal Protection** scientific advisors in 2012 using updates provided by Dr Caroline Hewson.

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This module will enable you

To understand the basics of

- Fish diversity
- Fish biology
- Fish husbandry

To assess the welfare of fish

To identify the main welfare concerns in fish that we eat

Credit: Dr. L. Hammell, AVC/UPEI

Context 1
(Huntingford & Kadri, 2009)

Welfare issues

- Commercial fisheries: stress of catching and slaughter, including for escaping fish/invertebrates, unintentional catch – effect on ecosystem
- Aquaculture (farmed fish and invertebrates): stress of housing, handling, feeding regimen, transport, slaughter – effect on individuals
- Ornamental fish and recreational angling – effect on individuals

Context 2
(Mood, 2010)

Farmed terrestrial animals killed for food each year, globally

- **Mammals: ~3 billion**
- **Poultry: ~57 billion**

Fish killed each year, globally, for food and other uses

- **Farmed fish (= 'aquaculture'): ~7–115 billion**
- **Wild fish (= 'commercial fisheries' or 'wild-capture fisheries'): between ~970 billion and ~2.7 trillion**
- Estimates based on weight as individuals are not counted – range from ~10 g to 50 kg or more (e.g. tuna)

Fish biology 1

Bony fish (teleosts)

- One of the five main groups of vertebrates
- >30,000 species
- Bony skeleton, swim bladder
- Many sub-groups

Cartilaginous fish

- Sharks, etc.

Example: salmonids

Atlantic salmon (*Salmo salar*)

Credit: Dr. L. Hammell, AVC/UPEI

Example: cichlids

Tilapia (*Tilapia rendalii*)

Credit: Dr. L. Hammell, AVC/UPEI

Fish biology 2

Respiration

- Gills: covered by opercula
- Carp can breathe air orally
- Being out of water is very stressful

Stress response (Conte, 2004; Ashley, 2007)

- Physiological: similar to mammals
- Behavioural: many different responses possible, depending on stressor
- Individual variation

Fish biology: sentience 1

Increasingly recognised
(e.g. OIE, 2011)

Criteria for pain perception
(Braithwaite & Huntingford, 2004; Elwood, 2012)

- **Can they perceive adverse stimuli?**
- No neocortex, but nociceptors and nociceptive nerves (A- delta, C) (Sneddon et al., 2003)
- **Do they respond physiologically and behaviourally?**
- Injection of acetic acid into lips of trout ⇨ protective behaviour changes (rubbed lips, rocked, did not eat) and physiological (e.g. increased opercular rate)
- **Can they learn to avoid the stimuli?**

Trout avoided light paired with threat, and remembered that association 7 days later (Yue et al., 2004)

Fish biology: sentience 2

(Chandroo et al., 2004; Huntingford et al., 2006)

Lack of neocortex does not mean fish cannot suffer

- **Neural processing is more important**

More research needed

Welfare of wild-caught fish

Context of commercial fisheries (Kaiser & Huntingford, 2009)

Fish: most die in the process of capture, storage and processing (gutting, filleting, chilling, freezing) (Mood, 2010)

Fishers have high costs: fuel, boats, chilling, gear, export to market

Better welfare ⇨ better meat quality ⇨ better prices

Credit: Digital Visions

Welfare of fish in commercial fisheries
(Metcalfe, 2009; Mood, 2010)

Capture and landing, followed by either

- **Slaughter / death**
- **Discarded**

Escape

Capture and landing 1
(Metcalfe, 2009; Mood, 2010)

Methods ('gear')

- **Nets – trawled or set**
- **Hooks and lines – trawled or static**

Animals' experience

- **Pursued to exhaustion**
- **Decompression when raised from depth ⇨ swim bladder bursts, etc.**

- **Nets**
  - Crushed under weight of other fish in nets
  - Snared/confined ⇨ panic, scale damage – if escape or are discarded, high mortality
  - Gill nets designed to catch head, by gills – hours or days, and at risk of predation by seals

Capture and landing 2
(Mood, 2010)

Animals' experience (continued)

- **Hooks**
  - May have barbs
  - Caught on hooks through mouth or gills – sometimes for hours and days if 'long-line' baited hooks
  - Spiked to pick them up
  - Used as live bait, on the hook, to catch other fish – humane for the target fish but not the bait fish
- **By-catch**
  - Long-lines catch sea birds, turtles, sharks and non-target fish species
  - Nets catch dolphins; 'dolphin-friendly' nets catch high numbers of sharks, turtles and juvenile fish
  - Sharks may have fins removed while alive

Capture and landing 3

The main welfare questions are

Is the gear specific to the target species, given the range in size, depth, etc.?

Can any distress be reduced?

Once fish have been landed onto the boat, are they killed in a humane way?

Are non-target species, or any fish who escape from the gear, harmed by it?

Can the discarding of fish ('by-catch') be reduced?

Slaughter
(Mood, 2010)

Animals' experience

- Mass catch – no formal slaughter process / method
- Asphyxiation – 55–250 minutes
- Gutted while still alive – average 25–65 minutes

Welfare of fish in commercial fisheries
(Metcalfe, 2009; Mood, 2010)

Escape / discarded

- **Damaged – poor survival**
- **Undamaged – good survival; hardy species may disrupt local balance because relatively more survive?**

Ethics of commercial fisheries

Wild animals – form of hunting (Evans, 2009)

- **Suffering, effects on ecosystem, etc.**
- **Should be abolished?**
- **Fair exchange?**

Particular ethical points (Sandøe et al., 2009; Metcalfe, 2009; Mood, 2010)

- Sustainability; depletion of stocks for local communities who may be vulnerable, low-income communities
- Global employment and food supply
- Use as livestock feed
- Transport to markets worldwide – environmental costs
- Sentience and welfare of individuals
- Ecological impact – effect of unwanted catch

Welfare targets
(Metcalfe, 2009; Mood, 2010)

Refine (minimise suffering)

- **Do not use live fish as bait**
- **Reduce time held in gear and on the deck**
- **Reduce injury and stress during capture and hauling onto the deck:**
  - Type of net
  - Hook design and use
  - Adapt humane slaughter techniques for use on boat (percussive / electrical stunning)

Reduce (catch fewer fish)

- **Modify gear to minimise by-catch / number of juveniles caught**
- **Only catch mature fish – one large vs. several immature small**
- **Consumers: source omega-3 fats from non-fish sources**

Welfare of farmed fish

Credit: Dr. L. Hammell, AVC/UPEI

Credit: Dr. L. Hammell, AVC/UPEI

Fish biology and welfare 1
(Branson, 2008)

Importance of water quality (Conte, 2004)

- Influence of light levels
- Methaemoglobinaemia

Fish biology and welfare 2
(Branson, 2008)

Feeding (Huntingford & Adams, 2005)

- Carnivores (e.g. salmonids) vs. herbivores (e.g. carp)
- Appetite varies with temperature, reproduction, etc.

Fish husbandry 1
(Conte, 2004; Branson, 2008)

Net pens in natural bodies of water

- Little control over water quality

Special facilities

- Ponds – low density ⇨ phytoplankton naturally maintain water quality
- Tanks: require control of quality

Fish husbandry 2
(Branson, 2008)

Stocking density
(Stevenson, 2007; Ashley, 2007; Oppedal et al., 2011)

- **Weight of fish per unit volume of water?**
- **Weight per unit flow of water?**

Fish husbandry 3
(Branson, 2008)

Feeding

- Piscivorous (e.g. salmon, halibut)
- Herbivorous (e.g. carp)

Credit: Dr. L. Hammell, AVC/UPEI

Fish husbandry 4

(Huntingford & Adams, 2005; Stevenson, 2007; Branson, 2008)

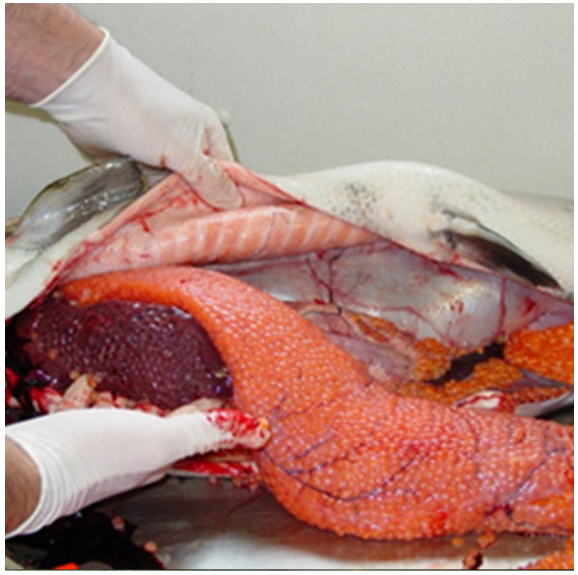
Feeding

- **Genetic manipulation for growth hormone ⇨ very fast growth**
  (Hallerman et al., 2007)
- **Aggression vs. competition**
- **To reduce competition**
- Deliver food according to appetite
- Distribute food widely
- Use cameras
- Keep older, larger fish with juveniles?
- Keep fish of the same size together?

Fish husbandry 5

Reproductive management

Varies with species, e.g. salmon vs. tilapia



Credit: Dr. L. Hammell, AVC/UPEI

Credit: Dr. L. Hammell, AVC/UPEI

Fish husbandry 6 (Branson, 2008)

Reproductive management (Atlantic salmon)

- **Triploidy**
- **All-female stock**
- **Artificial lighting**

Catching, handling and transport
(Stevenson, 2007; Branson, 2008; OIE, 2011)

Reasons

- When moving from pond to pond
- For slaughter
- For vaccination and reproduction assistance
- For grading – to monitor size and weight

Credit: Dr. L. Hammell, AVC/UPEI

Stressful

- Max. time out of water = 15 secs

Transport

- Withhold food ~48 hours

Slaughter methods 1

Slaughter methods

- Slow loss of sensibility
- Immediate loss of sensibility

Credit: Dr. L. Hammell, AVC/UPEI

Slaughter methods 2

(Robb & Kestin, 2002; Stevenson, 2007; OIE, 2011)

Slow loss of sensibility

- Asphyxiation – air, ice
- Exsanguination
- CO_2 narcosis
- Evisceration of live fish
- Decapitation (eels)
- Sedative in water: Aqui-STM used in Chile, New Zealand and Australia to sedate fish pre-stunning
- Salt or ammonia (eels)
- Electrical immobilisation

Slaughter methods 3

(Robb & Kestin, 2002; Stevenson, 2007; OIE, 2011)

Immediate loss of sensibility

- Percussive stunning
- Spiking
- Shooting
- Electrical stunning

Credit: Dr. L. Hammell, AVC/UPEI

Slaughter methods 4

(Robb & Kestin, 2002; Stevenson, 2007; OIE, 2011)

Slaughter methods, from best welfare to worst

1. Electrical stunning; anaesthetics
2. Percussive stunning, spiking, shooting
3. Carbon dioxide; asphyxiation in air or ice
4. Decapitation; evisceration; electro-immobilisation; salt or ammonia bath

Assess effectiveness of stunning (OIE, 2011)

1. Loss of swimming and loss of opercular movement

2. Visual evoked response (EEG)

3. ‘Eye roll’

Do not use righting reflex (Gregory, 2005)

Auditing: five criteria (Grandin, 2010)

% stunned effectively with one application of stunner

% rendered insensible before processing

% with defects (e.g. eroded fins) that occurred in the pens

% with bruised carcass

% with other carcass defects

Summary

Many species of fish

Fish are sentient

Wild-caught fish – capture, landing and slaughter

Aquaculture – husbandry, diseases, handling, slaughter

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