Determining the discard mortality of longline-caught skates (Rajidae) in Alaska

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Objectives

• Data-hungry discards
• Mysterious mortality
• Skates in Alaska
• Results so far
Discards

- Total catch – Landings
  - Market driven
  - Regulatory
  - Escape mortality

- FAO global estimate: ~8% of total catch
  - Yearly discards of 7.3 million mt between 1992-2001
  - Significant, despite wide variability in estimates

- Key factor with high uncertainty
  - Recognized data gap
  - Population models/stock assessments
  - Ecosystem-based management
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Sources of mortality

Surface

Depth

Cumulative stress

Gear interaction

Adapted from Davis and Ryer, 2003

Pictures: http://etc.usf.edu/clipart/; ebay.com
Elevated seawater temperature

Salinity

Thermocline

Surface

Depth

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Surface

Air exposure  Air temperature (seasonal)  Light exposure

Depth

Cumulative stress

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Surface

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Cumulative stress

Handling

Sorting time

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Surface Depth

Handling Sorting time

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Surface

Thermocline

Air exposure

Air temperature

Air temperature (seasonal)

Light exposure

Handling

Sorting time

Pressure

Elevated seawater temperature

Salinity

Immediate mortality

Delayed mortality

Gear interaction

Cumulative stress

Adapted from Davis and Ryer, 2003
Assessing mortality

- Mark-recapture
  - Satellite tagging

- *In-situ* holding studies

- Laboratory studies
  - Simulated vs. actual capture

- RAMP – Reflex Action Mortality Predictors
  - Davis *et al.*
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• Categorize injuries

• Influential parameters

• Laboratory study

• Mark-Recapture or PSATs

• Integration and modeling

Skate research

A multi-pronged approach
• Categorize injuries

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Skate research

A multi-pronged approach
Skates in Alaska

- Multiple species
  - Common species managed individually
  - Others grouped into skate complex

- High trophic level predator/scavenger

- $k$ – selected life history
  - Low $M$

- Skates frequently caught and discarded by longline fleet
  - Usually alive with various injuries
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• Skates frequently caught and discarded by longline fleet
  • Usually alive with various injuries
Skates in Alaska

- 27 000 mt caught in 2013
  - Retention typically ~30%
  - 100% assumed mortality

Target Species - Gear Type

- Pacific cod - longline
- Misc. flatfishes - nonpelagic trawl
- Walleye Pollock - pelagic trawl
- Other - longline
- Other - nonpelagic trawl

Observed skate catch 98-08 (Stevenson and Lewis, 2010)
Handling regimes

Typical (commercial)

- No standardization/guidelines
- Gaff use to rip skates off hooks
- “Crucifier”
- Brush-bar

Non-invasive (careful)

- Akin to Pacific halibut handling
- No “crucifier,” gaff entry into body
- Hook twisting, straightening common
- Gangion cutting/breaking
Project overview

- Sampled aboard commercial longline vessels
  - 2 trips in Pacific cod fishery
  - 1 trip during NMFS Sablefish survey
    - Controlled handling

- Categorized injuries into ranks
  - Minor, Moderate, Severe, Critical

- Analyzed with multi-dimensional homogeneity tables
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Surface

Thermocline

Air exposure
Air temperature (seasonal)
Light exposure

Handling

Depth

Gear interaction

Elevated seawater temperature

Pressure

Salinity

Temperature

Buoyancy (-)

Cumulative stress

Adapted from Davis and Ryer, 2003

Pictures: http://etc.usf.edu/clipart/; ebay.com
Parameters

- **Injury rank**
  - **Species**
    - $p < 0.001$, df=9, n=772
  - **Size**
    - $p < 0.001$, df=6, n=911
  - **Handling**
    - $p < 0.001$, df=3, n=293
  - **Release method**
    - $p < 0.001$, df=9, n=772
  - **Depth**
    - $p = 0.030$, df=3, n=772
  - **Crew exp.**
    - $p = 0.055$, df=6, n=772
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Additional note:

p<0.001, df=39, n=911
Parameters

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$p<0.001$, df=24, n=772
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Injury rank

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p<0.001, df=3,
n=293

Release method
p<0.001, df=9,
n=772

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Diagram showing relationships between parameters and injury rank.
Parameters

- Injury rank
- Depth: $p=0.030$, $df=3$, $n=772$
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Trends

Typical (commercial)

• Increased severity rank:
  ▫ Increased depth
  ▫ Smaller size

• Depth and size effects likely confound species effect

• Higher frequency of severe, critical ranks w/ripping removal

Non-invasive (careful)

• Higher frequency of minor injury rank

• Significantly lower critical and severe rank
Injury score by release method

n = 772
Trends

Typical (commercial)

• Increased severity rank:
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  ▫ Smaller size

• Depth and size effects likely confound species effect

• Higher frequency of severe, critical ranks w/ripping removal

Non-invasive (careful)

• Higher frequency of minor injury rank

• Significantly lower critical and severe rank
Injury severity

Normal handling
- Minor: 23%
- Moderate: 49%
- Severe: 15%
- Critical: 13%

n = 138

Careful handling
- Minor: 67%
- Moderate: 29%
- Severe: 3%
- Critical: 1%

n = 155
- Categorize injuries
- Influential parameters
- Laboratory study
- Mark-Recapture or PSATs
- Integration and modeling

Skate research
A multi-pronged approach
Acknowledgments

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- Committee members: Gordon Kruse, Jon Heifetz

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  - Captain and crew of the F/V Ocean Prowler

- Aleutian Spray Fisheries
  - Captain and crew of the F/V US Liberator

- All the faculty, staff, and students at SFOS/UAF
- Family and friends

- Sea grant and symposium organizers
Questions?