Multi-scale movement of demersal fishes in Alaska

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Thank you!

• Committee:
  – Andrew Seitz (Advisor)
  – Milo Adkison
  – Franz Mueter
  – Tim Loher (IPHC)
  – Susanne McDermott (NOAA AFSC)
Background

- Demersal fish: focal species
  - Pacific halibut
  - Sablefish
  - Pacific cod
- High value
  - Commercial
  - Ecological
  - Cultural
Background

• Current issues
  – Pacific cod
    • Area closures in Aleutians – Steller sea lions
  – Pacific halibut
    • Decreasing allowable catch, local depletion?
  – Sablefish
    • Future issues?
Background

IPHC Management Areas
Background

• Current methods
  – Two points in time only
    • Release and recovery locations

• New movement methods desperately needed!!!
  – Migration timing
  – Spawning locations
  – Migration pathways
Background

Geomagnetic archival tags
Research overview

Multi-scale movement of demersal fishes in Alaska

- Fine-scale movement (Chapter 1)
  - Acoustic telemetry
  - Daily movement characteristics
  - Pacific halibut in Glacier Bay

- Large-scale movement (Chapters 2 & 3)
  - Geomagnetic archival tags
  - Reconstruct migration pathways
  - Pacific halibut, sablefish, Pacific cod (?)
Chapter 1

“Fine-scale movement and environmental correlates for Pacific halibut during summer in Glacier Bay, Alaska”

• Acoustic telemetry data
• Collected 1991 - 1993
• NPS collaboration:
  – Revise
  – Publish
Chapter 1

• Progress
  – On-going data analysis:
    • Characterization of movement patterns
    • Movement rates
    • Habitat associations
      – Kernel density “core areas”
      – Bootstrap method

• Future
  – Draft manuscript and submit for publication
  – Incorporate fine-scale data into movement model (chapter 3)
Chapter 2

“Using geomagnetic tags to examine movement of marine fishes in Alaska”

- Framework for using geomagnetic archival tags in Alaska
- Precision of geolocation estimates
  - Different regions
  - Different movement trajectories
- Resource for designing movement studies
Chapter 2

- Progress:
  - Mapped magnetic fields
Chapter 2

- **Progress:**
  - Deployed stationary and mobile test tags
    - Juneau area
    - Gulf of Alaska (2010 annual sablefish survey)
    - Aleutians (2010 IPHC survey)
Chapter 2

- Progress:
  - Tag measurement resolution
    - Estimated geolocation precision
  - Tag calibration
    - Temperature effects
Chapter 2

• Future:
  – Map magnetic field anomalies
  – Simulate movement trajectories
  – Additional moored test tags
    • Bering Sea
    • Shumagin Islands
Chapter 3

“Multi-scale movement of demersal fishes in Alaska”

• Deploy geomagnetic tags on Pacific halibut, sablefish, and potentially Pacific cod
• Develop model to reconstruct movement paths
  – Combine fine-scale and large-scale information
Chapter 3

Progress: Funded NURP proposal

Desert Star LLC
Pop-up satellite tag

• Magnetic field
• Light levels
• Temperature
• Depth
• Tilt
Chapter 3: Pacific halibut

2011 Pop-up satellite tag deployments:

A (10)  
B (9)  
C (9)  
D (15)  
E (9)  

Additional harvest-recovery geomagnetic tags
Chapter 3: sablefish

- NOAA annual sablefish survey
  - 45 pop-up satellite tags
Chapter 3: Pacific cod

• Laboratory study
  – Satellite tag attachment
  – Barotrauma mitigation research

• Future deployment in Aleutians (?)
Chapter 3

• Reconstructing migration pathways
  – Extend depth-based model – e.g. Seitz 2006
    • Start and end locations
    • Magnetic field, depth, temperature, light
    • Estimated animal swim speed
  – Simulate paths – e.g. Righton and Mills 2008
    • Match environmental conditions of tagged fish
  – State-space or Bayesian models
    • Allows use of other information sources
    • More sophisticated insights on migration parameters
Activity summary

• Coursework
  – Fall 2010
    • Natural Resource Modeling
    • Fish Abundance
    • Statistics with R
  – Spring 2011
    • Population dynamics
  – Future: spatial statistics, fisheries statistics, geomagnetic principles
Activity summary

• Talks
  – AFS Alaska (November 2010)
  – Alaska Marine Science Symposium (January 2011)

• Upcoming talks
  – Biology Graduate Student Symposium (March 2011)
  – UAF Fisheries Seminar (March 2011)

• Posters
  – Models in Population Dynamics and Ecology (September 2010)
Activity summary

• **Timelines:**
  – **2011:**
    • Research Plan
    • Draft/submit for publication Chapter 1
    • Fieldwork: pop-up satellite tags
  – **2012:**
    • Draft Chapter 2
    • Begin analysis of archival tag data
  – **2013:**
    • Develop multi-scale movement model
    • Draft chapter 3
    • Submit for publication Chapter 2
  – **2014:**
    • Complete dissertation and defend
Thank you!
Chapter 3

Contour lines: 200 nT

Magnetic field (nano Tesla)
 Chapter 3

- Magnetic field gradients
- Movement trajectories
- Tag measurement resolution
Release locations, 1991 - 1993

12% not heard after release
14% < 5 positions
Dispersive movement pattern

Capture 7/8/92

7/12

7/18

7/12 – 8/10

8/15

8/18

9/10

9/11

9/18

7/8/92

Depth

0 m

400 m

5 Km
Chapter 1: Fine-scale movement

Locations $\geq$ 1 day apart
Each symbol different animal