EOSC 478

Final Exam Study Guide

1. Marine ecosystems and fishery systems. Fishery management as a problem in system control

- Global fish harvest, contribution of capture fisheries versus aquaculture
- State of fish stocks
- What is the realm of fisheries science?
- Know major subsystems of marine fishery system
- System view approach: boundaries, communication types, feedback concept
- Characterization of natural, human and management subsystems
- Importance of spatial scale in fishery systems
- Overview of fished species/groups
- Fish population versus fish stock: definitions

2. Basic fishery science

- Life types definitions, metamorphosis
- Effect temperature on basic biology
- Basic trophodynamics, growth, mortality and fish population dynamics
- Density dependent processes
- Fishery management concerns

3. Variation in fish numbers. Causes of variation. Geographic and temporal scales of variation

- Phenomenon of fish number fluctuations: uncertainty, amplitude, temporal and spatial scales
- What might cause fluctuation?
- Overfishing versus other causes
- Regional, reciprocal and cyclic fluctuations

4. Population level models of fisheries

- Know the recursive model
- What might force the population to stop growing?
- Surplus production concept
- Maximum sustainable yield concept
- How can we assess the population status and surplus production using catch data?

5. Bioenergetics and marine fish production

- Know how we can use bioenergetic and food web structure models to estimate fish production?
- Transfer efficiency concept (revised)
- Estimates of global fish production: Ryther versus Pauly/Christensen approaches
- How sustainable harvest rate can be estimated: sustainable catch, fish yield efficiency concepts

- Importance of basin differences in productivity: large shelves, upwelling systems, retention areas

6. Variation in distribution and its association with abundance

- Importance of abundance and distribution and links between them
- Ecological significance of distribution
- Is the distribution dynamic? Examples: (a) Pacific hake; (b) Northern anchovy; (c) Sardine
- Habitat value hypothesis
- Density dependent habitat selection hypothesis
- "Basin" and "Expansion-contraction" models

7. Anadromy and Catadromy: Salmon and Eels

- Know types of fish migratory behaviors. Distinguish between anadromy, catadromy and amphidromy
- Life cycle of eels
- Spatial distribution of anadromy, catadromy and amphidromy
- Know potential reasons for anadromy and catadromy to evolve: food availability hypothesis

8. Marine community dynamics, implications for production

- Bottom-up control: revised
- Top-down control: predation, competition
- Trophic cascades, keystone species
- Wasp-waist control
- Implication to fisheries

9. Recruitment mechanisms, explanations for variation in abundance

- Strong year classes. Recruitment definition and spatio-temporal scales in recruitment
- General processes and theories governing recruitment
    - Physical dispersal
    - Starvation
        - Critical period hypothesis
        - Match-mismatch hypothesis
        - Stable ocean hypothesis
    - Predation
    - Synthesis processes

10. Ecologically based fishery management models

- Principles of the single-species management
- Stock assessment
- Gordon-Schaefer diagram
- Regulatory approaches
    - Regulate effort
    - Regulate catch
    - Escapement limitations

    - Indirect economic instruments
- Monitoring effects
- Precautionary principle
- Principles of the ecosystem based management
- Marine protected areas

11. Restoration Fishery Ecology: 'Back to the Future'

- Know about the possibility of adopting ecosystem rebuilding as the goal of fisheries management: large no take reserves, reinstitution of high-value species, whole ecosystem simulation modeling

12. Species at Risk Act

- Canada Species at Risk Act
- Approaches to recovery planning
    - Recovery strategy
    - Critical habitat
    - Compensation
    - Prohibition
    - Penalties
    - Exemptions
    - Public participation

13. Marine aquaculture as an alternative to capture fisheries

- Importance of aquaculture as an alternative to capture fisheries
- Challenges and most recent advances in salmon farming aquaculture

14. Management of new and developing fisheries

- Knowledge on general concept and major phase-steps of the framework for new and developing fisheries developed by the DFO in British Columbia
- Understand benefits and drawbacks of this framework and be prepared to provide a few local examples of its use

15. Effects of fisheries on marine communities

- To be able to elaborate on the topic whether fisheries may cause the collapse or extinction of commercial fisheries
    - Predatory fish decline
    - Slow fish stock recovery
    - Fish species replacement
    - Compensation in exploited fish communities
- Can fisheries cause trophic cascades? Is it a general phenomenon?
    - Fishing down marine food webs
    - Fishing through marine food webs
- Do fishing activities damage habitat so that fish production capacity is reduced?
    - Changes in species interactions
    - Changes in habitat. Biota response to habitat destruction. Timing of recovery.

    - Discard problem. Bycatch mortality. Provision of discards to scavengers.
    - Reduction of the abundance of slow growing, late maturing species
- Selective effects of fishing. Can fisheries be important for evolutionary change in harvestable population?

16. Fishery economics

- Basics of Resource Economics
    - Natural capital. Fish as natural capital in a broad sense
    - Fish as common property resource
    - Externalities vs Private property
- Bionomic equilibrium and economic efficiency
    - Economic efficiency
    - Maximum economic yield
    - Bionomic equilibrium
    - Relationship between maximum sustainable yield, bionomic equilibrium and maximum economic yield

17. Economic instruments for fishery management

- Incentive Blocking Approaches to Management
- Limited entry programs and their problems
- Incentive Adjusting Approach
- Shift between Incentive Blocking and Incentive Adjusting resource management schemes
- "Common pool" fisheries
- Private property rights
    - fishers enjoy some of benefits of resource investment
    - fishers expect to suffer from consequences of resource overexploitation
- Alternatives to creating Private Property Rights
    - Individual transferable harvest quotas (ITQs). Ideal ITQs.
    - Fishers' cooperatives
    - Community based fisheries management
    - Combinations of the above

18. Economics of recreational fisheries

- Significance of recreational fishery
- Problems to economics
- Major approaches to value recreational fisheries
    - Ownership rights assignment
    - Approaches (description and downsides) to estimate "willingness to pay" by the society for the recreational resource
        - Contingent valuation (user opinion surveys)
        - Gross expenditure method
        - Travel cost method

19. Economics of enforcement

- To be able to elaborate about general shift away from Incentive Blocking to Incentive Adjusting resource management schemes
- Know about the incentive blocking approaches to management
    - gear restrictions
    - total allowable catch
    - regulated open access
    - limited entry programs
        - limit the number of vessels
- Incentive adjusting approaches to management
    - "Common pool" fisheries
    - private property rights - an incentive for fishers to invest in resources
    - individual transferable harvest quotas
        - ideal ITQs
        - drawbacks to ITQs
    - community based fisheries management

20. Community based fishery management

- Role of the Marine Protected Areas in the framework of community based fishery management
- To be able to discuss challenges for declining fisheries in a very impoverished region and what would need to be considered in implementing a no-take reserve as a marine conservation measure

21. Fraser River sockeye salmon management case study

- Pacific salmon: biology of five major species, distribution, life history
- Pacific salmon migrations in a dynamics ocean. Phases of migration:
    - direct coastal migration
    - open ocean migration
    - directed migration to the coast
    - directed coastal migration to natal stream
- Migrations of sockeye: problems to fishery ecologists
- Early commercial fisheries: historic catches; effects of habitat degradation
- Modern fisheries
- Salmon management
    - Davis Plan
    - Introduction of Optimal Yield Policy
    - Salmonid Enhancement Program
    - Pearce Commission
    - Canada/US Salmon Interception Agreement
    - Salmon sport fishery: management
    - First Nations domestic fishery: management
    - Skeena River Sockeye Fishery: management

22. Antarctic fishery management case study

- Generalized characteristics of major fishery-target Antarctic species
- Brief history of Southern Ocean fisheries and conservation

- Establishment of a “new generation” agreement, e.g. Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)
    - rationale
    - structure
    - decision making
    - management regime
        - precautionary approach
        - ecosystem based approach
        - krill yield model
    - conservation measures: examples
        - regulation of new and exploratory fisheries
        - minimizing seabird bycatch in longline fisheries
        - trade-related measures to combat unregulated fishing
            - Catch Documentation Scheme

23. Current issues in Pacific salmon conservation: early return of sockeye problem

- To be able to discuss the early return of sockey salmon phenomenon: implications to biology
    - abnormal migration-high mortality issue
    - role of river temperature hypotheses
    - mechanisms of mortality
- To be able to discuss implications early return of sockeye problem for the fisheries management

24. Ocean Climate Change and salmon migration and biology

- Effects of recent warming on freshwater adult migrations
- Effects of ocean conditions on salmon survival, growth, and energy levels
- Future climate projections: impact scenarios for Fraser sockeye salmon