

Introduction to Fisheries Science

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Course?level overview – suitable for undergraduate or introductory graduate study

1. What Is Fisheries Science?

Aspect	Description
Definition	The interdisciplinary study of fish populations, their habitats, and the management of aquatic resources for sustainable use.
Core Disciplines	• Biology – fish anatomy, physiology, behavior • Ecology – food webs, habitat dynamics, ecosystem services • Oceanography / Limnology – physical and chemical environment of freshwater and marine systems • Economics & Social Science – market analysis, community livelihoods, policy
Goal	Balance the exploitation of fish (food, recreation, industry) with conservation of biodiversity and ecosystem health.

2. Historical Context

Period	Milestones
Pre?20th?c.	Traditional fisheries based on local knowledge; over?exploitation rarely documented.
Early 1900s	First scientific surveys (e.g., International Council for the Exploration of the Sea – ICES, 1902).
Mid?20th?c.	Development of stock assessment methods; introduction of Maximum Sustainable Yield (MSY) concept.
1970s–80s	Recognition of ecosystem impacts (bycatch, habitat loss); birth of ecosystem?based fisheries management (EBFM) .
1990s–2000s	Advances in genetics , remote sensing , and bio?economic modeling .
Current	Integrated approaches: climate change adaptation, marine protected areas (MPAs), and data?rich management (e?DNA, AI?driven monitoring).

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3. Fundamental Concepts

3.1 Fish Biology & Life History

- **Morphology** – external (scales, fins) & internal (gastrointestinal, reproductive) structures.
- **Physiology** – osmoregulation, metabolism, growth patterns (von Bertalanffy growth model).
- **Reproduction** – spawning strategies (broadcast, nest?building), fecundity, early life stages.
- **Behavior** – schooling, migration (anadromous, catadromous), habitat selection.

3.2 Population Dynamics

- **Key Parameters**
 - **N** – population size (abundance)
 - **r** – intrinsic rate of increase
 - **K** – carrying capacity
 - **F** – fishing mortality
 - **M** – natural mortality
- **Models**
 - **Logistic growth**: $dN/dt = rN(1 - N/K)$
 - **Cohort models**: age?structured (e.g., Leslie matrix)
 - **Yield?per?recruit** and **spawning?stock?recruit (SSR)** relationships.

3.3 Stock Assessment

1. **Data collection** – catch statistics, effort, survey indices, tagging, acoustic surveys.
2. **Model selection** – surplus production, statistical catch?at?age, integrated assessment models (e.g., Stock Synthesis).
3. **Reference points** – MSY , B_{MSY} (biomass at MSY), F_{MSY} (fishing mortality at MSY).
4. **Uncertainty analysis** – confidence intervals, sensitivity testing, Bayesian approaches.

3.4 Ecosystem?Based Fisheries Management (EBFM)

- **Principles** –