M1.2 Patterns of exploitation
Industrial vs. small-scale fisheries

Assessing the status of fish stock for management: the collection and use of basic fisheries data and statistics

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University of the South Pacific,
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Patterns of exploitation

Content

• Overview of industrialised fisheries
• Overview of small-scale fisheries
• Management implications
Patterns of exploitation

Industrial versus Small scale fisheries
Patterns of exploitation

• Depends on several societal and biological factors (often co-related):
  – Habitat
  – Availability/proximity of resources
  – Communities/infrastructure
  – Technological development
  – Economic development
  – Alternative incomes
  – Demand/supply - Markets
Coastal Zone: beach seines, diving, traps, nets, lines, lift nets, boat seines, pots.

Continental shelf: trawls, purse seines, traps, gillnets, long lines.

High seas: pelagic trawls, driftnets, long-lines, purse seines, jiggers.
Industrial fisheries

- Capital-intensive fisheries.
- Relatively large vessels with a high degree of mechanization and specialized gear.
- Long ranging - advanced fish finding and navigational equipment.
- High production capacity and high catch per unit effort.
- High fuel consumption.
- International market oriented.
Industrial fisheries

• High value stocks, large stocks or highly migratory species.
  – About 50% of landings for human consumption.
  – Majority of landings for meal and oil reduction
• Few concentrated landing places
• National fleets on offshore demersal or pelagic stocks
• Distant water fleets on high seas or contracting national quotas.
• In some areas industrial fisheries is synonymous with fisheries for species that are used for reduction to fishmeal and fish oil
EC and distant water fleets

Accumulated catches (1950-1994) by distant water fishing nations in FAO statistical areas

http://www.fisheries.ubc.ca/publications/reports/6-6a.pdf
Industrial fisheries

• Important for national economies (GDP), easily taxed
• Monitored, reasonably good statistics, lots of data, time-series
• Lots of research and lots of scientists (particularly in Northern hemisphere)
• Single species stock assessment on regular basis
• Dominates the paradigmatic thinking of fisheries research and management regulations
Landing of the 5 marine species that have dominated global landings since 1950. These are all from industrial fisheries. After Jennings et al. (2001)
Capture fisheries production – top 10 species in 2002

Anchoveta: 9.7 million tonnes
Alaska pollock: 2.7 million tonnes
Skipjack tuna: 2.0 million tonnes
Capelin: 2.0 million tonnes
Atlantic herring: 1.9 million tonnes
Japanese anchovy: 1.9 million tonnes
Chilean jack mackerel: 1.8 million tonnes
Blue whiting: 1.6 million tonnes
Chub mackerel: 1.5 million tonnes
Largehead hairtail: 1.5 million tonnes

P/B ratio:
- High
- Medium
- Low

n = rank in 1997

(modified from SOFIA 2004)
World’s fishing grounds

Watson & Pauly (2001), based on FAO statistics
Fisheries takes 1.2% of global fuel consumption

Distribution and intensity of fuel consumption by marine fisheries in 2000. Total fuel inputs amount to 50 billion L, with most of this being expended in nearshore fishing grounds of the Northern Hemisphere. Tyedmers et al. 2005
Expansion of the fishing grounds

Fraction of the sea bottom and adjacent waters contributing to the world fisheries from 1950 to 2000 and projected to 2050 by depth (logarithmic scale).

Pauly et al. (2003)
Status and trends

• None of the 20-top major fish stock have collapsed (with one major exception!), although most display high fluctuations
• Increased control and surveillance
• Increased international cooperation
• Gross tonnage (GT) declining
• Discards declining
• Distant water fleets + landings declining
• Developed world fisheries fully exploited, developing world fisheries still increasing
Global fleet of vessels above 100 GT

After SOFIA (2004)
Discards decreasing?

Zeller & Pauly (2005)

Global marine landings

Global discards

Peruvian anchoveta
Landings by distant water fishing nations (high sea fleets)

[Graph showing the trend of landings and percentage of global total from 1950 to 2000, with peaks in the 1970s and a decline by the late 1990s, after FAO (1999).]
Marine landing by developing or developed countries

After Jennings et al. (2001)
Small-scale Fisheries
or
Artisanal Fisheries
Artisanal fisheries are characterised by:

- Integrated, informal occupation
- Within geographically limited community
- Dependent on local resources
- Relatively low capital investment
- Numerous actors, high gear diversity = high
  - adaptability
  - seasonality
  - fluctuations
  - migrations
  - (also fishers fluctuate, are seasonal and migrate)
Artisanal or small-scale fisheries

Sometimes separated into:

- **Subsistence** (traditional, “primitive”):
  - Canoes - rafts - wading
  - Barriers, weirs, traps, pots, spears, nets, seines, hook-and-line

- **Commercial** (modern, “sophisticated”):
  - Decked vessels with engine
  - Dredges, automated haulers, jiggers
  - Accessories: GPS, Fish-finders, radios, navigation

- **Intermediate**:
  - Plank boats with sails or engines (outboard)
  - Factory made synthetic materials, hook-and-line

Depending on economy there is a rapid transition
Perhaps most common denominator = small scale
Artisanal fisheries

Economic transition from subsistence to commercial mostly decreases $f$ and increases $q$:

Thus conceptual distinction between:
- *population-driven* ($f$) and
- *investment-driven* ($q$) growth in fishing mortality

\[
C = F \quad \overline{B} = q \cdot f \quad \overline{B}
\]

\[
F = \frac{C}{B} = q \cdot f
\]
No single definition - summary of definitions

<table>
<thead>
<tr>
<th>Boat size</th>
<th>between 5-7m; less than 10, 12 or 15m (2 to 24m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boat GRT</td>
<td>less than 10 GRT (3 to 50 GRT)</td>
</tr>
<tr>
<td>Size of engine</td>
<td>less than 60 HP; between 40-75 HP (15 to 400 HP)</td>
</tr>
<tr>
<td>Boat type</td>
<td>none, canoe, dinghy, non-motorized boat, wooden boat, boat with no deck, traditional boat</td>
</tr>
<tr>
<td>Gear type</td>
<td>coastal gathering, fishing on foot, beach seine, small ring net, gillnets, hand-line, dive, traps</td>
</tr>
<tr>
<td>Distance from shore</td>
<td>between 5-9 km; within 13 km; up to 22 km</td>
</tr>
<tr>
<td>Water depth</td>
<td>less than 10, 50 or 100m depth</td>
</tr>
<tr>
<td>Nature of activity</td>
<td>subsistence, ethnic group, traditional, local, artisanal</td>
</tr>
<tr>
<td>Number of crew</td>
<td>2-3; 5-6</td>
</tr>
<tr>
<td>Travel time</td>
<td>2-3 hours from landing sites</td>
</tr>
</tbody>
</table>

Chuenpagdee et al. (2006)
Comparison between large scale industrial and small scale artisanal fisheries

Misund et al. (2002)
Marine and inland capture fisheries – top 10 producers 2002

China, India and Indonesia have populations of nearly 1 billion people living below the UNDP poverty line of US$ 1 per day (Staples et al. 2004)
Importance of fish for people

The richer the less dependent on fish

Relationship between the proportion of fish protein in human diets and the relative wealth (measured as GPD) of the nations they live in. From Kent (1998)
Small-scale fisheries comprise:

- > 30 % of total world captures
- > 50 % of total landings for human consumption
- > 90 % of all fishermen
- ≈ 80 % live in Asia

Many ecosystems only exploitable on small-scale
- Coastal lagoons
- Tidal flats, shallow shores
- Estuaries
- Coral reefs
- Most freshwaters
Small-scale fisheries

- Small-scale fisheries are an important source of employment, food security and income, particularly in the developing world.
- An estimated 90 per cent of the 38 million people recorded by the FAO as fishers and fish farmers are small-scale.
- An additional more than 100 million people are estimated to be employed in other fisheries associated occupations.
Small-scale fisheries

However:

- Research generally very, very small (mostly socio-economic)
- Most fisheries biologist are dealing with large scale industrialized fisheries
- Quantitative data limited or nil
- Problems and management? copied from industrial fisheries (the ruling paradigm)
Small-scale fisheries

Problems:

- *Competition - marginalisation - vs. industrial*
- *Conversion - semi-industrial or recreational*
- *Those remaining are mostly associated with developing countries*
  - traditional - antiquated - primitive
  - poor - needs development
  - unmanaged - resource depleting
  - overfished
  - “Tragedy of the commons”
Small-scale fisheries

Resulting in **negative** image:

- *Illegal and destructive gears*
- *Ignore regulations and legislation*
- *Unruly members of society*
- *Subject to “Maltusian” overfishing*
- *Artisanal fisheries are a “poverty trap”*
- *Unselective, indiscriminate fishing methods*
Dynamite fishing, for example
Small-scale fisheries

Thus, plenty of arguments for:

They need to be managed!

90 % of projects use one or several of the above reasons for justifications

But how to manage them? when:

• Little research = little knowledge
• Multi-species and multi-gear situations
• Negligible monitoring
• Unwillingness to abide
• Costly to enforce

The present answer (panacea) seems to be:

MPAs and Co-management

“They must learn to understand their own good”
Management paradigm

The present mainstream research is focused on:

- Industrial (valuable) fisheries
- Single-species considerations
  - F, TAC, Quotas, size-limits
- Enhanced selective harvesting strategies
- EAF (ecosystem approach to fisheries) is only recent on the agenda (Johannesburg 1992) and only conceptually debated = we don’t know how!

Purpose: A selective kill on targeted species and sizes

Result: Dominate our thinking (paradigm) and forms our perception on small-scale fisheries

We shall get back to EAF later in the course
Artisanal fisheries

Working within a “paradigm” (Kuhn, T.S. 1970. *The Structure of Scientific Revolutions*):

- The problem has a solution
- There are given rules for the procedures
- There are given rules for what is a solution

This means:

*Science is a selective collection of relevant facts, aiming to support or reject the “ruling theories”*
Patterns of exploitation

Selectivity = rooted in all fisheries theory:

- Mesh size regulations
- Gear restrictions
- By-catch
- Destructive methods
  – seining
  – beat fishing
  – barriers, weirs
  – small mesh sizes

In industrial fisheries non-selectivity = BAD

Result: Universally applied - also in co-management!
The selectivity paradigm

• FAO 2003 (Ecosystem Approach to Fisheries): "Selectivity, or lack of it, is central to many biological issues affecting fisheries. Bycatch or incidental capture is responsible for endangering and contributing to extinction of a number of non-target species (such as dolphins or turtles) caught in driftnets or longline fisheries. In addition, the discarding of unwanted catch, which is particularly important in unselective fisheries, is being considered by society not only as wasteful but as unethical. The Code of Conduct dedicates a whole section to the issue (8.5). It promotes the use of more selective gear (7.6.9; 8.4.5) and calls for more international collaboration in better gear development (8.5.1; 8.5.4), as well as for the agreement on gear research standards.”
The selectivity paradigm

• We shall get back to selectivity when we discuss life history theory and ecological concepts in relation to multi-species fisheries.

• For now we can conclude that due to lack of data and knowledge, management of small-scale fisheries are based on assumptions from industrial fisheries.
Management

• **Industrial fisheries are single species fisheries with single species management**

• They are so large and valuable that research and CMS is invested for management decisions

• **Small-scale fisheries are multi-species, multi-gear, too small to warrant research.**

• Our ‘understanding’ and assumptions on which we base our management is directly inherited from large-scale fisheries.
Small-scale fisheries are often "non-selective"!

How much? How? How do we manage a multi-species fishery? What is the right gears and mesh sizes?

Management questions

Can we fish everything proportionally?

A non-selective harvesting pattern is what they are criticised for

But a non-selective harvesting pattern is ecosystem conserving.

The system remains unchanged, except everything is less.
Conclusions (1)

• There is room (and need) for both industrial and small-scale fisheries
• But most small-scale fisheries have been ignored and marginalized over the years and very little is known about the actual status (except their importance)
• This is mainly a result of policies to “modernize” fisheries and which favoured commercial and industrial fleets
• It has also resulted in conflicts between small and commercial sectors
Conclusions (2)

• Exploitation patterns are different and thus management should be different
• Management of small-scale fisheries requires a different way of thinking (biological, social, economic, institutional) to deal with the complexities of the fishery
• Blind transfers of approach and regulations from single species industrial problems to multi-species small-scale problems have not proven useful or viable
Conclusions (3)

• Fisheries management based on the methods from industrialised fisheries is costly (research, MCS).

• Emphasis is on single species approaches and improving selectivity.

• Problems, methods, and thinking is applied universally (especially when no data).

• But new solutions are gaining focus, which include common sense approaches, stakeholder information, consensus
Conclusions (4)

• A new ‘green’ paradigm is rapidly spreading which will affect both industrial and small-scale fisheries

• This paradigm is based on a universal belief that our fisheries are for the most part already destroyed or collapsing due to over exploitation

• The solution has already to a large extend been devised: EAF, MPAs, TURFs, co-management
Conclusions (5)

• The questions that will face fisheries biologists are:
  – What shall be our future patterns of exploitation?
  – Are small-scale fisheries (in general) overfished and using destructive methods?
  – Is the current fisheries paradigm correct?
  – Can conservation and production be reconciled?

• The answer is:
  – Data, monitoring, stock assessment