Collecting data for direct monitoring

fish5101fishsci Introduction to fish population dynamics

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Monitoring a resource

To understand the ecosystem you need to monitor it

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To monitor it you need measurements

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The preferred measurements are catches in numbers at age and survey index. Otherwise use dynamic age-structured production models etc. Can use only a survey index, only CPUE data etc.

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Must have consistent and annual sampling

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Data needs to be stored in a consistent format

Catches (landings): Notation

Notation for landings data:
Y =catch (yield) in tonnes (or 000 t)
y = year (integers, 1985, 1986 etc.)

For example,
Y_{1986} or Y_{85}
Y_y =total landings in year y
Remember:
Only used with other data !
Catches alone say nothing about the state of the stock or trends!!!

Linking data to advice

Short-term catch depends on the

- type of gear, timing, and form of targeting
- spawning vs juvenile components
- large vs small fish
- mesh size or other regulation

Longer-term effect on stock depends on

- typical effort expended
- type of gear/mesh size

Traditional fisheries advice - data flow chart

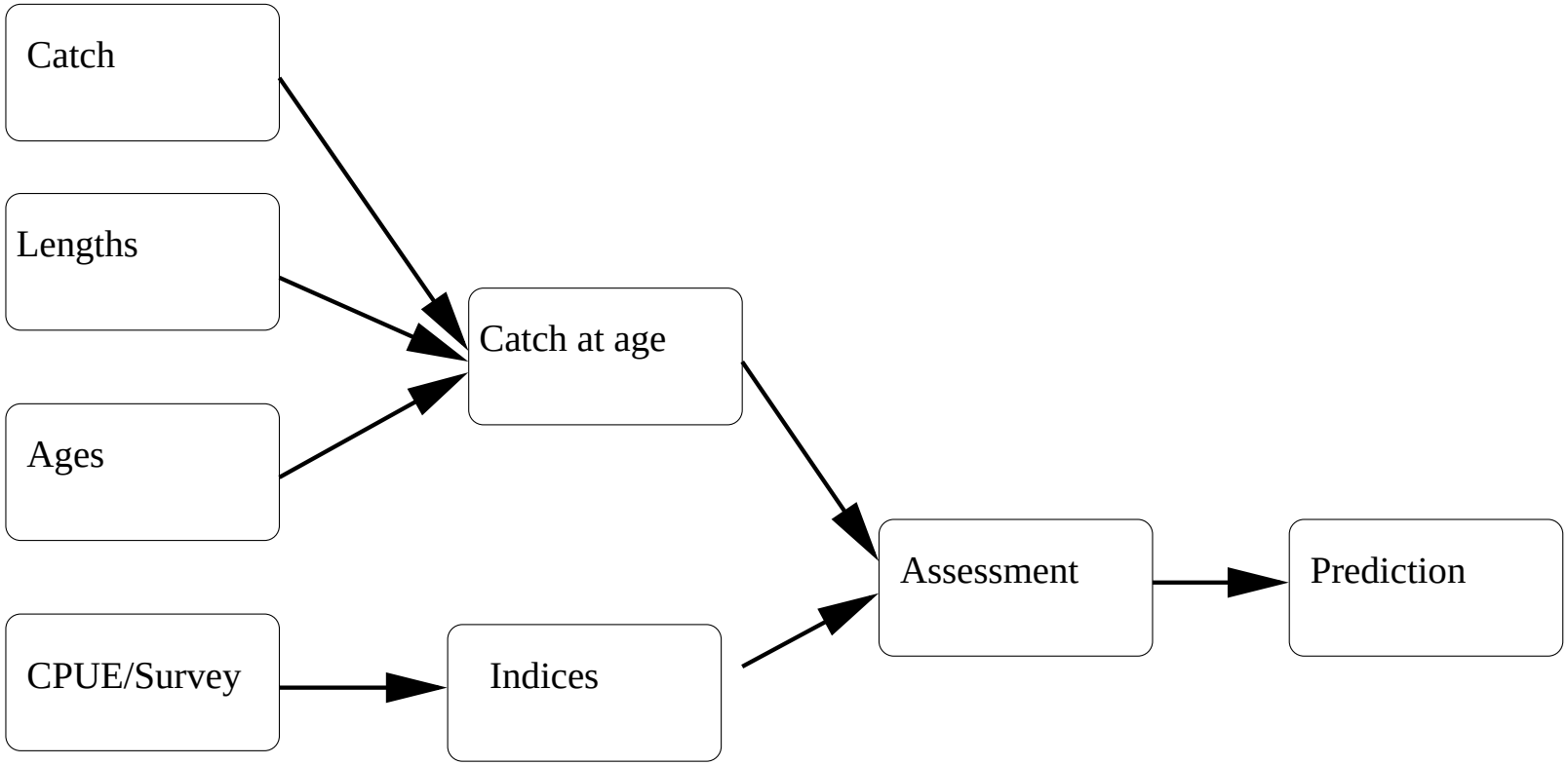


Figure : Traditional data flow chart of fisheries data. One or more data boxes may be missing.

The traditional flow of information and data when an annual assessment is conducted using high-quality data sets can be presented in a flow diagram.
Measurements to be undertaken and data to be collected relates to how this flow diagram is constructed. As seen from the diagram, the following basic data is typically collected each year:

- Catch statistics

Fisheries advice using generic data sets

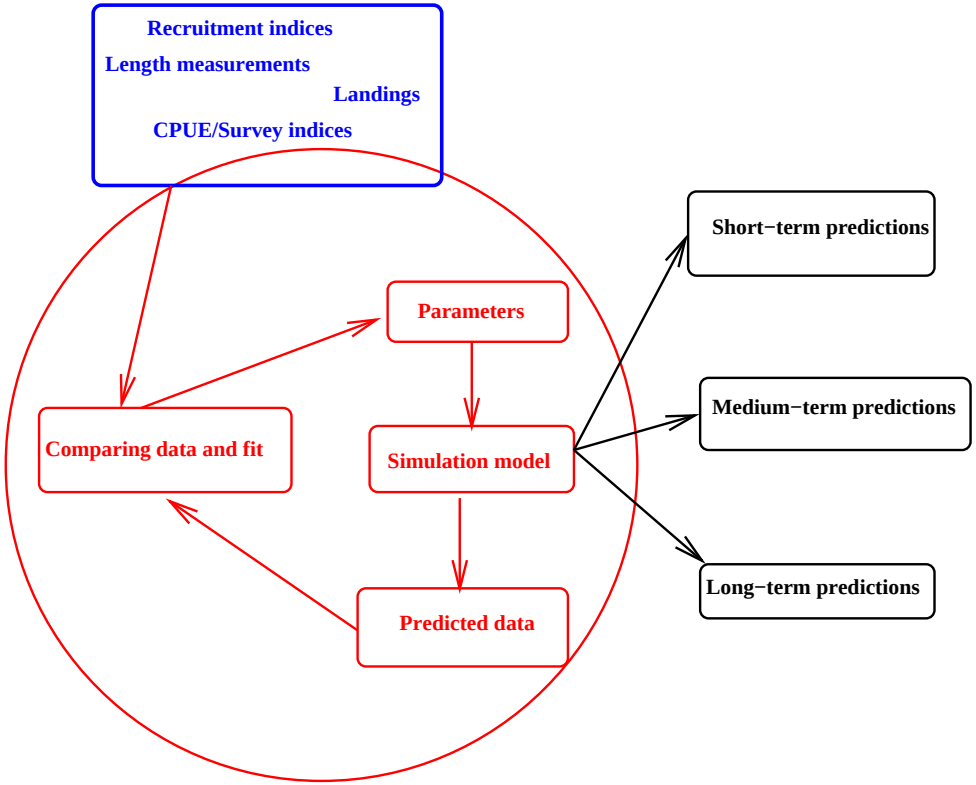


Figure : Data collection, stock assessment and predictions. Blue denotes data collection, red the assessment phase, and black the prediction phase.

A statistical approach - for any combination of data sets

- For effect of fishing need data on catches
- For stock size/trend data which give some stock trend
- For prediction would like something on recruitment

Catches or landings

- Knowledge of landings is essential in most cases
- Census is the "accepted practice"
- Can also (randomly) sample from chosen vessels (cheaper and sometimes better)
- Difficult to do any monitoring or control without knowledge of catches

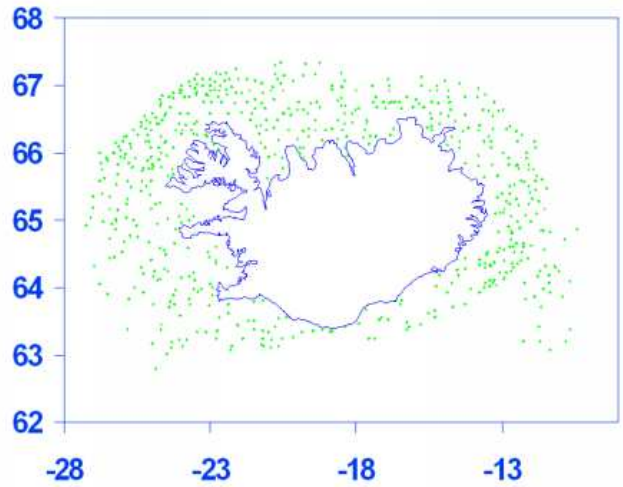
More on catches

Figure : Catches of pandalid shrimp in Icelandic waters, separated into offshore and near-shore (inshore) catches.

It is important to sample components of the fishery.

Research surveys

- Research vessels or other CONSISTENT and ANNUAL abundance measurements
- Usually designed to give time series of abundance, to be related to population trend
- Typically selects more age groups than commercial catches - e.g. catch younger fish than fishermen
- Need to cover stock distribution
- Want to be able to predict future recruitment
- Design is important! Define fishing gear and timing based on biology of the species



Survey indices

Bottom-trawl surveys: Obtain standardized catch-per-unit effort

Abundance indices: Should reflect trends in stock size

Figure : An Icelandic research vessel

Data storage

- Must use consistent data storage "rectangular tables"
- Standardized for all species
- On an institutional level not the individual researcher level
- Easy extraction of all years into one file
- Easy combination e.g. of length and abundance information
- Formal data base (e.g. MySQL or PostgreSQL - both free)
- Not Excel, not Access

Basic design issues

Common design criteria include:

- The distance between $\bar{x}$ and μ should be no greater than δ,
- The confidence interval width should be no more than δ.
- The standard error of $\bar{x}$ should be no more than δ.

Fisheries data rarely satisfy the assumptions!

If simple random sampling applies, n data points come from a Gaussian distribution, and the variance (σ^2) is known, a confidence interval is obtained with

$$\bar{x} \pm z_{1-\alpha/2}\sigma/\sqrt{n}$$

The width of the confidence interval is

$$2z_{1-\alpha/2}\sigma/\sqrt{n}$$

Commonly, $\alpha = 0.05$ is used and then $z_{1-\alpha/2} = 1.96$.
The standard error of the mean is $\sigma/\sqrt{n}$.

References