Data Processing and Analysis: Literature Update

FISH 538

Emma DeWitt Cotter
Echo data

Abundance estimations for a site

Fig. 9.3  Echogram (EK500, 38 kHz) from the North Sea displayed in greyscale (original in colour) showing three types of marks at different depths: a near-surface plankton layer (10–40 m), young-of-the-year haddock in small diffuse schools (50–100 m) and 3–4-year-old herring near the seabed (110–130 m). In this case partitioning is achieved by appropriate choice of depth layers for the integration.

Fig. 9.8  Contour map of the fish density from an acoustic survey off Borneo, showing higher densities on the continental shelf than in the deeper water.
Big Changes in the Last 10 Years

• More data!
  • Longer deployments enabled by ocean observatories
  • Use of multi-frequency and broadband devices

• Faster computers
Classification of Coexisting Species

- **Mean Volume Backscatter (MVBS)**
- More accurate, objective information about more species using multiple frequencies
- More widely used for classification

Classification of Coexisting Species

Fig. 8. Composite echogram of 18, 38, and 120 kHz data collected along a transect conducted during 21 September 2003 (0950–2010 GMT). The transect is oriented north to south (left to right). In the composite echogram, volume backscatter cells are color-coded based on the frequency combinations, where “1”, “2”, or “3” denotes the presence of 18, 38, or 120 kHz $S_v$ values, and “−” denotes the absence of a frequency. The grey band at the surface designates the upper 10 m of the water column, which was not used in the analyses. The image is vertically distorted to highlight details of the backscattering patterns. The purple “streaks” throughout the water column are 18 kHz noise, most likely caused by cavitation at the transducer. nmi, nautical miles.

1 – 18 kHz
2 – 28 kHz
3 – 120 kHz

Classification of Coexisting Species

Automated Target Classification

• Applies an established statistical method (probabilistic clustering) to acoustic data
  • Widespread uses including insurance, biology, and meteorology
• Determine the intrinsic grouping in a set of unlabeled data

Automated Target Classification

- Each sample is assigned probabilities of membership to each cluster group
- Determined optimum number of clusters for two data sets
  - Gulf of Alaska: low-diversity, well known system
  - Mid-Atlantic Ridge: high diversity, less well known system
- Cluster number dependent on site and survey goals
- Able to capture biological features of data
Automated Target Classification

- Large Fish
- Small Fish
- Background
- Gulf of Alaska
- Saturation
- Fish
- Bottom + Intense Schools
- Zooplankton
- Low Saturation
- Zooplankton
- Background
- Large Fish
- Gulf of Alaska
- Saturation
- Top + Intense Schools
Automated Target Classification

• Mid-Atlantic Ridge
  • 2 Clusters: Non noise vs intense noise features
  • 3 Clusters – saturation, bubbles, non-noise features
  • 13 Clusters – fish tracks, biota, bubbles, saturation, dropped pings
Spatially and Temporally Resolved Data

• First example – Jiang et al 2007
  • Net-based studies do not provide high temporal resolution and are difficult to execute over long periods of time

• ADCP backscatter data used to observe diel and annual trends in migration (1996-2000)

• Abundance data shown as a function of time of year, time of day, and depth

Spatially and Temporally Resolved Data


Fig. 3. Contours of zooplankton biomass estimated from ADCP backscatter intensity (using 1-h averaged data) during Deployment 6–14 (1996–2000). The black line is the maximum depth where biomass values remain at least 3 mg dw m⁻³ (using 24-h averaged data).
Spatially and Temporally Resolved Data

• Sato et al 2013
• VENUS Cabled observatory in British Columbia
• 2 years of echosounder data
• Observed diel vertical migration of euphausiids (krill)

Spatially and Temporally Resolved Data