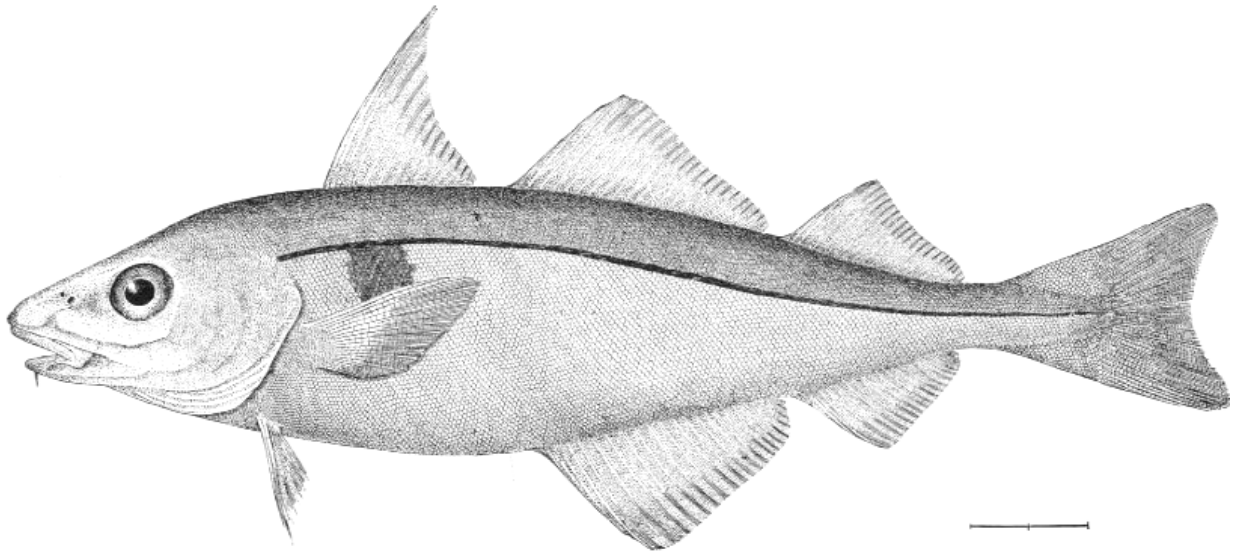
R. Gulf of Maine haddock (*Melanogrammus aeglefinus*)

Presenter: Michael Palmer



THE HADDOCK.

Melanogrammus æglefinus (L.), Gill. (p. 223.)

Drawing by H. L. Todd, from No. 1044. U. S. National Museum, collected at Eastport, Me., 1872, by U. S. Fish Commission.

- Found at depths 45 – 135 m.
- Maximum ages observed in trawl survey range from 10 – 15 years.
- Maximum sizes observed in trawl survey range from 78 – 92 cm.
- Age at 50 % maturity currently between 2 – 3 years.
    - Fecundity between 30,000 (2-year old) – 2,158,000 eggs.
- Spawning occurs in shallower coastal areas in GoM (27 – 36 m) from February to May.

R. Survey indices

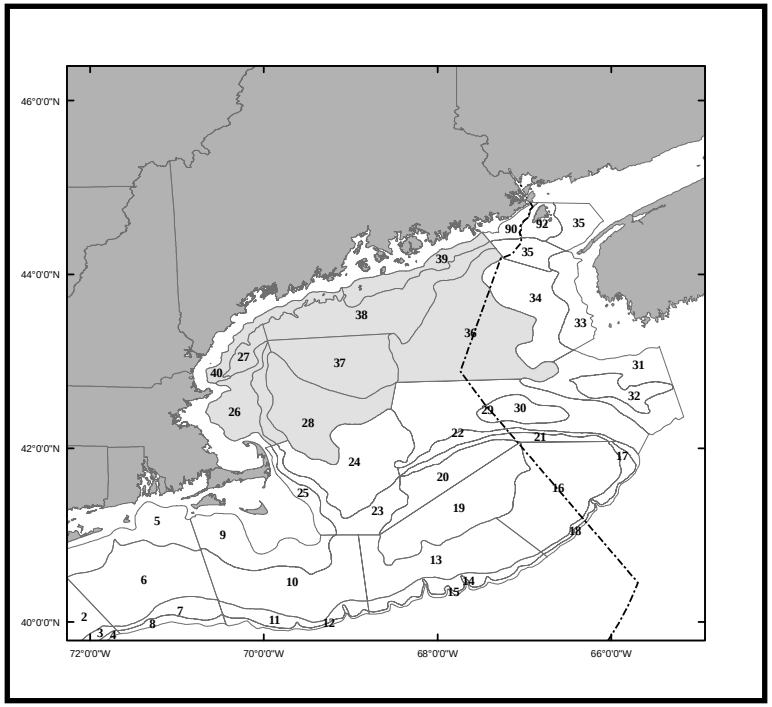


Fig. R.2. Northeast Fisheries Science Center (NEFSC) bottom trawl survey strata used to calculate Gulf of Maine haddock survey indices.

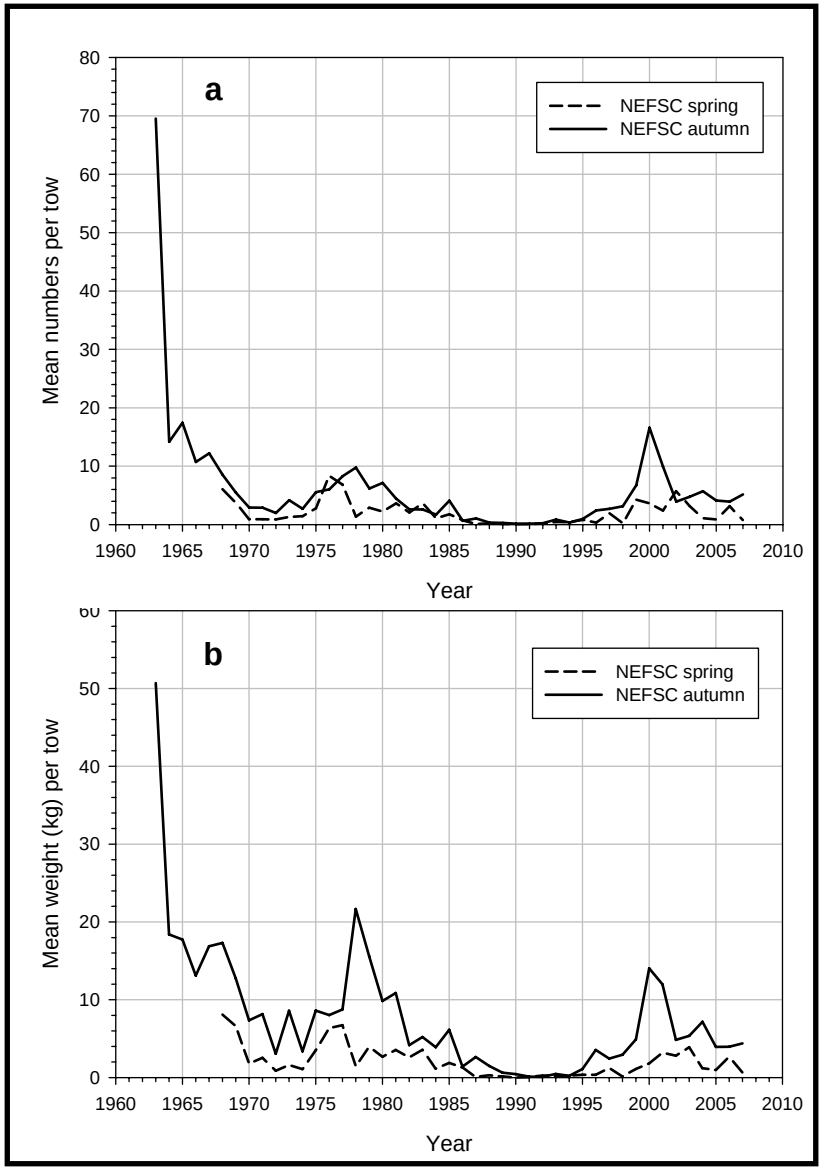
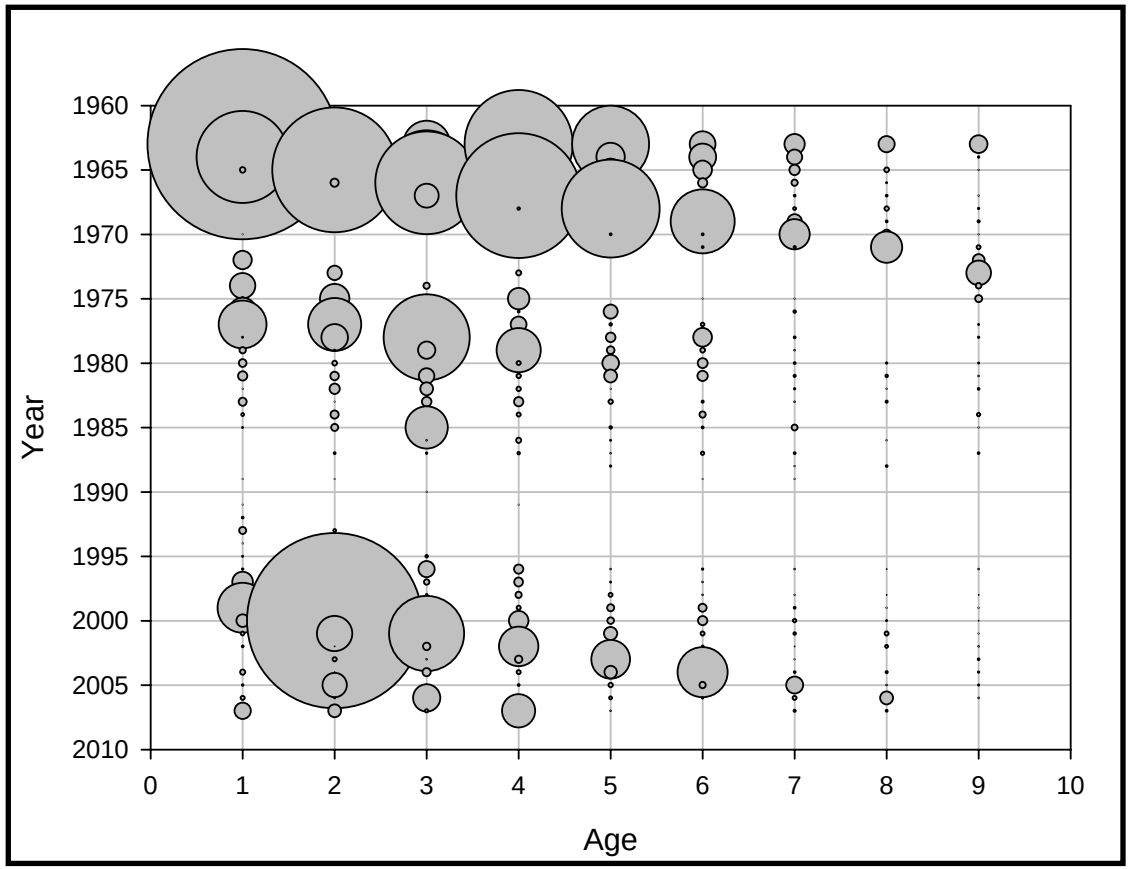


Fig. R.4. Northeast Fisheries Science Center (NEFSC) bottom trawl survey abundance (stratified mean numbers per tow) (a), and biomass (stratified mean weight (kg) per tow) (b) for Gulf of Maine haddock, 1963 – 2007.

R. Survey indices

- Abundance has been driven primarily by 3 periods of strong recruitment.
  - 1962/63, 1975/76, 1998, 2003(?)
- Truncation of older age classes during periods of low abundance.



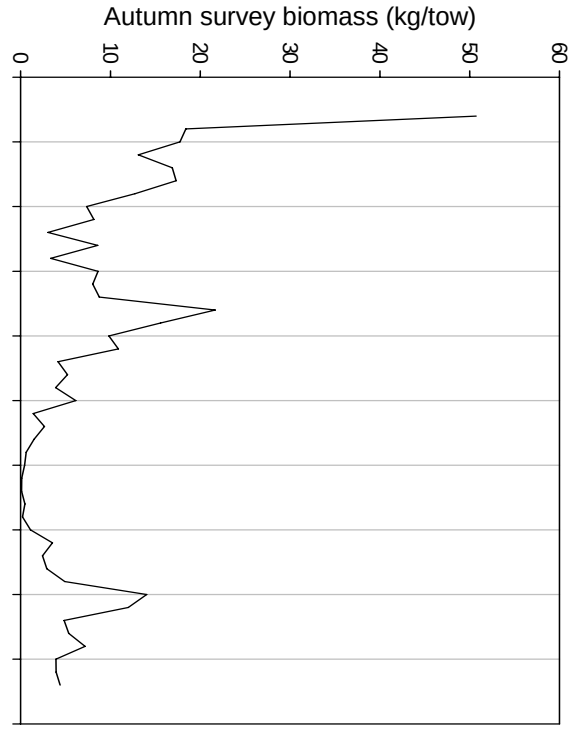


Fig. R.8. Age structure pf the Gulf of Maine haddock population as indicated by the NEFSC autumn bottom trawl survey indices of abundance, 1963 – 2007.

R. Fishery removals

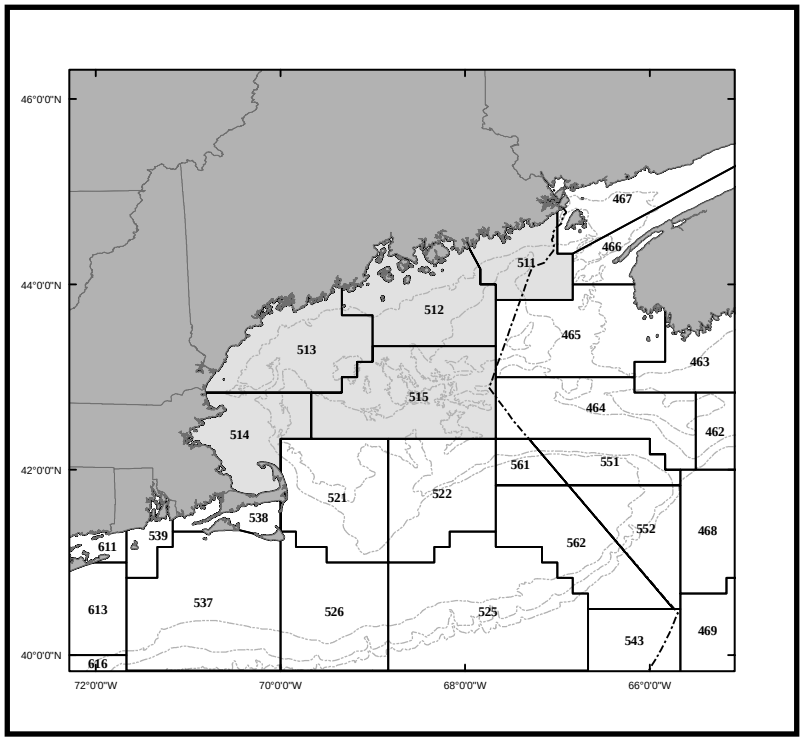


Fig. R.1. Statistical areas included in the Gulf of Maine haddock management unit (light grey). Northeast Atlantic Fisheries Organization (NAFO) division 5Y is comprised Of United States statistical areas 511 – 515.

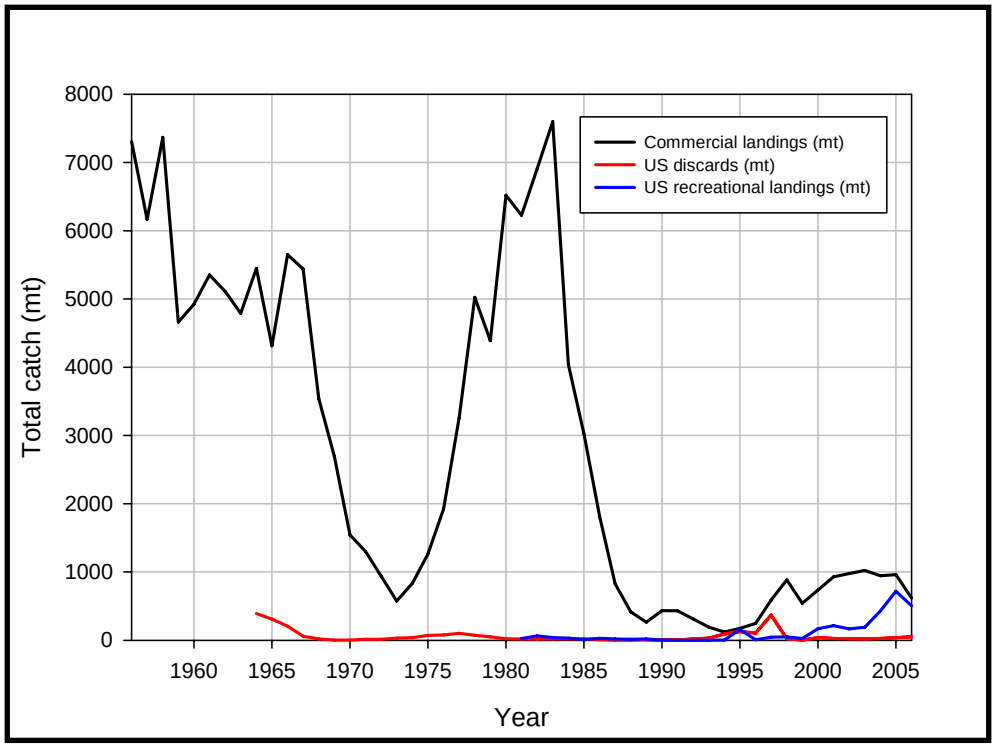
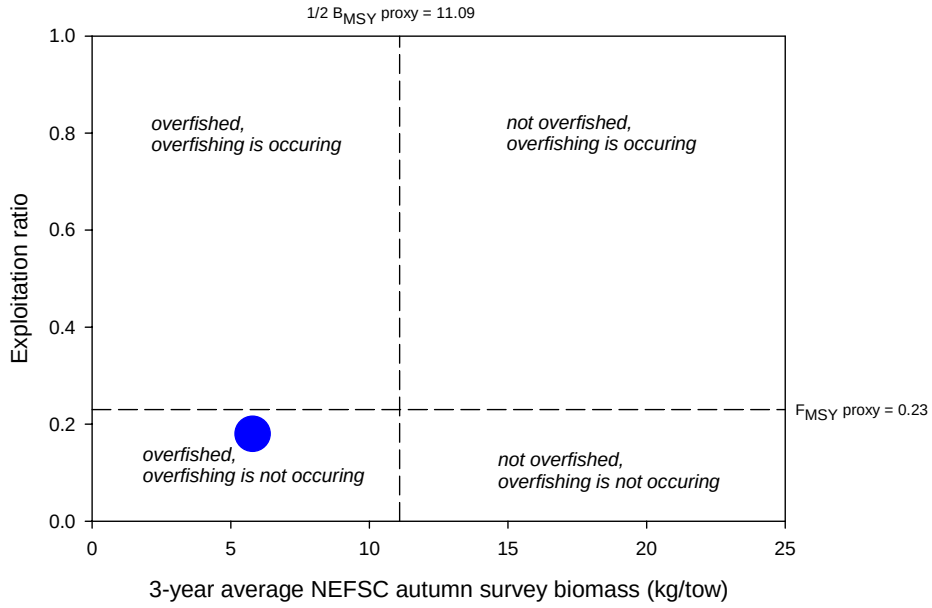


Fig. R.3. Total catch of Gulf of Maine haddock, 1956 – 2006.

R. Current stock status

- Based on 2005 assessment, stock status was determined to be **overfished, but overfishing was not occurring**.
  - Included survey indices and commercial landings through 2004 (NEFSC 2005).
    - Exploitation ratio (relative F)= 0.18
    - 3-year average survey biomass = 5.79 kg/tow
    - *Note: The exploitation ratio did not include estimates of commercial discards or recreational landings.
  - Biological reference points based on AIM model run (NEFSC 2002a)
    - ½ B_{MSY} = 11.09 kg/tow
    - F_{MSY} proxy = 0.23

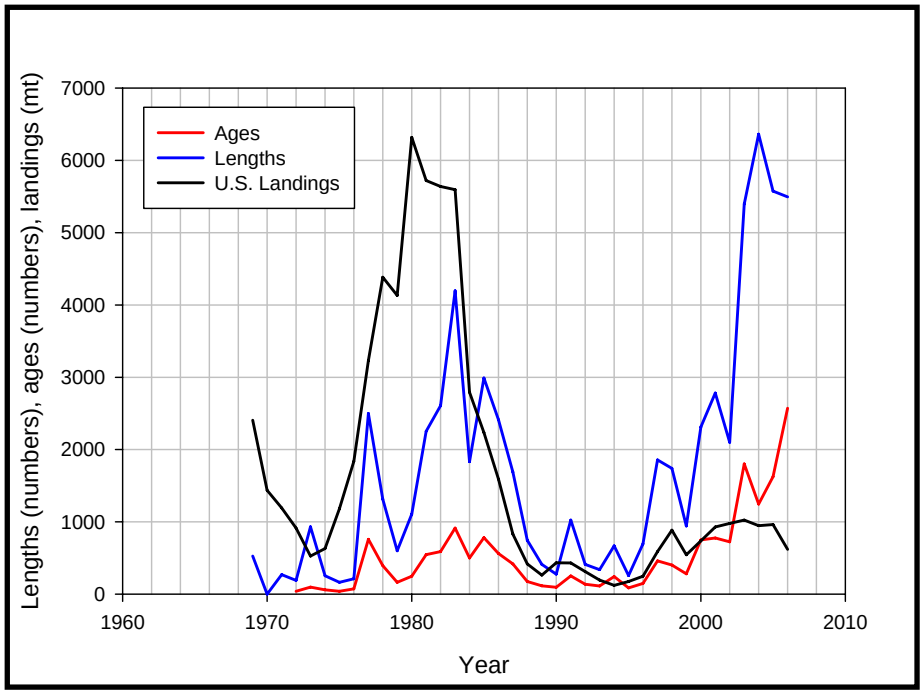


R. Recent assessment history

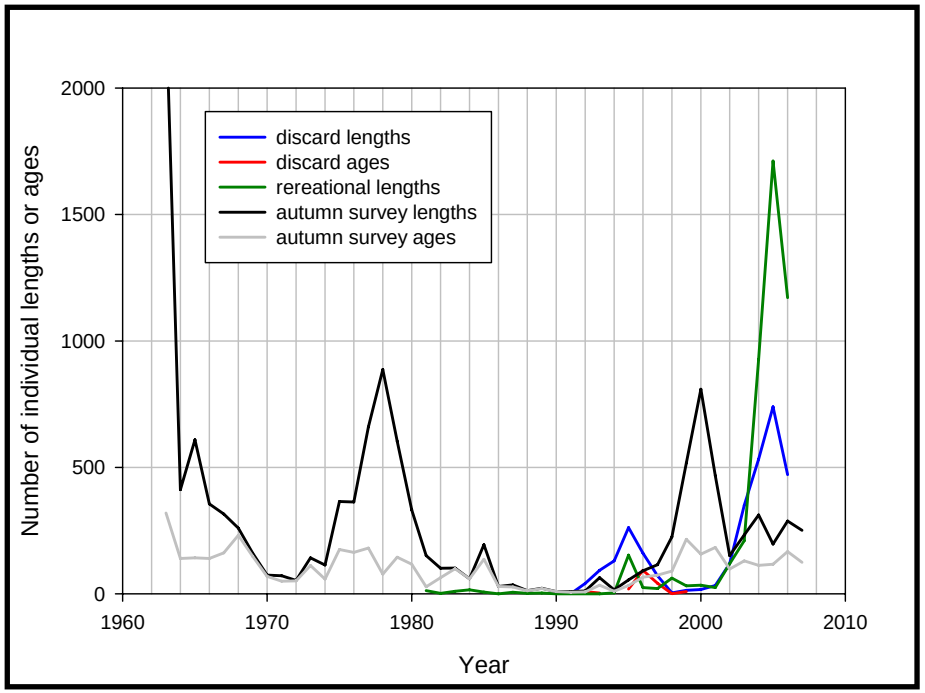
- 1986 – SAW 2 – No formal analysis of fishing mortality was attempted
- 2001 – SAW 32 – Availability of biological samples insufficient to reliably estimate parameters needed to support a full analytic assessment. ASPIC model was attempted for reference points, not accepted.
- 2002 – GARM – Index-based assessment based on exploitation rate, reference points estimated using AIM.
- 2005 – GARM II – Index-based assessment based on exploitation rate, reference points estimated using AIM.

R. Biological sampling

- Limited availability of length and age data.
  - Commercial landings (Tables R.3 and R.2, 1989 – 1996).
  - Commercial discards (Table R.6, < 100 lengths before 1994, 1997 – 2001, no ages beyond 1999).
  - Recreational landings (Table R.7, limited length samples prior to 2002).
  - Survey (Table R.11, 1986 – 1996).



R. Number of Gulf of Maine haddock lengths and ages sampled from commercial landings by year, relative to total U.S. landings.



R. Number of Gulf of Maine haddock lengths and ages sampled from the autumn survey, recreational fishery and from commercial discards by year.

R. Current model approach

- Index-based method
  - Current biomass is computed from a 3-year average of annual NEFSC autumn survey biomass.
  - Exploitation ratio (relative F_t) computed from estimate of catch (C_t) divided by 3-year average survey biomass estimate (I):

$$relF_t = \frac{C_t}{\left(\frac{I_{t-1} + I_t + I_{t+1}}{3}\right)}$$

  - Reference points are estimated using an "an index method" model (AIM, NEFSC 2002a).
    - Primary output of the model is a proxy for F_{MSY}
      - F_{MSY} proxy = relative F where the replacement ratio = 1
      - Estimate proxy B_{MSY} from the relationship I_{BMSY} = MSY/relF
        - MSY is derived from a stable period in the landings time series (average of 1959 – 1966 = 5,100 mt)

R. Current model approach

- Strengths
  - Can be used on stocks where age and length information are limited.
  - AIM model is informative (relationship between relF and replacement ratio) (Fig. R.10)
- Weaknesses
  - Sensitive to noise in the landings and survey time series.
  - RelF is not necessarily an adequate proxy for Fmsy – it only indicates the relF value at which the stock can be brought to a stable state.
  - Does not utilize the available age and length information.

R. Proposed model approach

- Past SARC/GARM panels have recommend exploring an age-structured model (NEFSC 2001A, NEFSC 2005).
- The major obstacle is the limited availability of age and length information during the late-80s to mid-90s for many of the time series.
- To date, no age-structured model has been attempted (e.g., VPA or ASAP).
- Recommend an exploratory attempt at a VPA.
  - Biggest limitation is time.
  - There currently are no commercial landings-at-age estimates for any of the years in the time series.
  - There will be uncertainty in numbers at length estimates because of averaging/imputing that will be necessary to fill holes in commercial age-length keys (ALKs).
  - Commercial discards-at-age borrowing from survey ALKs
    - Survey ALKS limited.
  - Recreational landings-at-age will require significant borrowing from commercial age-length keys (were data exist for longline) or survey ALKs.