

Figure 28. Age frequencies of female and male sea mullet sampled from NSW ocean landings between April and June, 1995 to 2000. (No ages available in 1997; in parentheses – number of fish aged; arrow denotes 1990 year class)

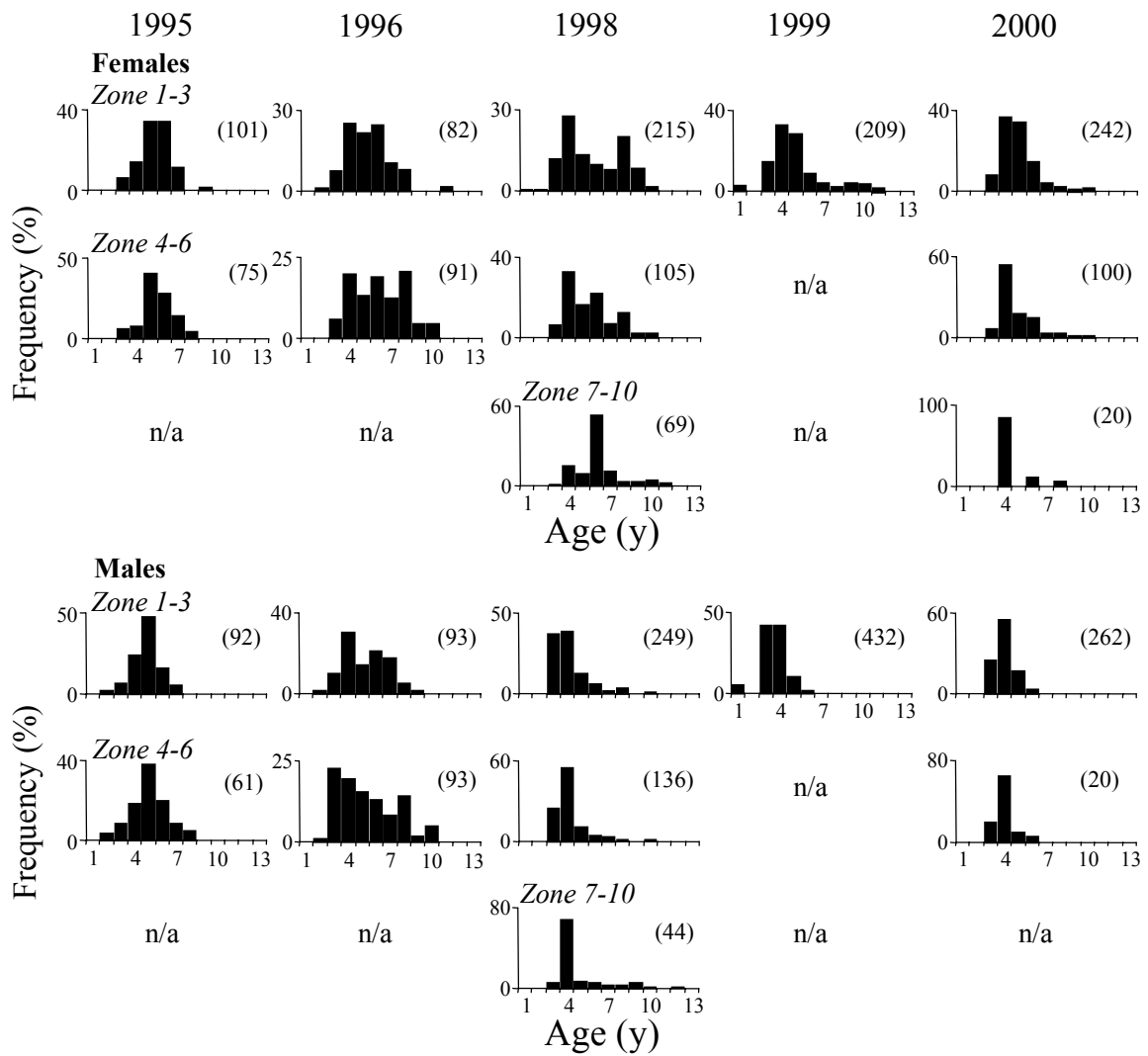


Figure 29. Age frequencies of female and male sea mullet, sampled between April and June, 1995 to 2000, pooled among NSW ocean zones. (No ages available in 1997; in parentheses - number of fish aged; n/a - no data collected; oceanic landings only; 1° latitude per zone)

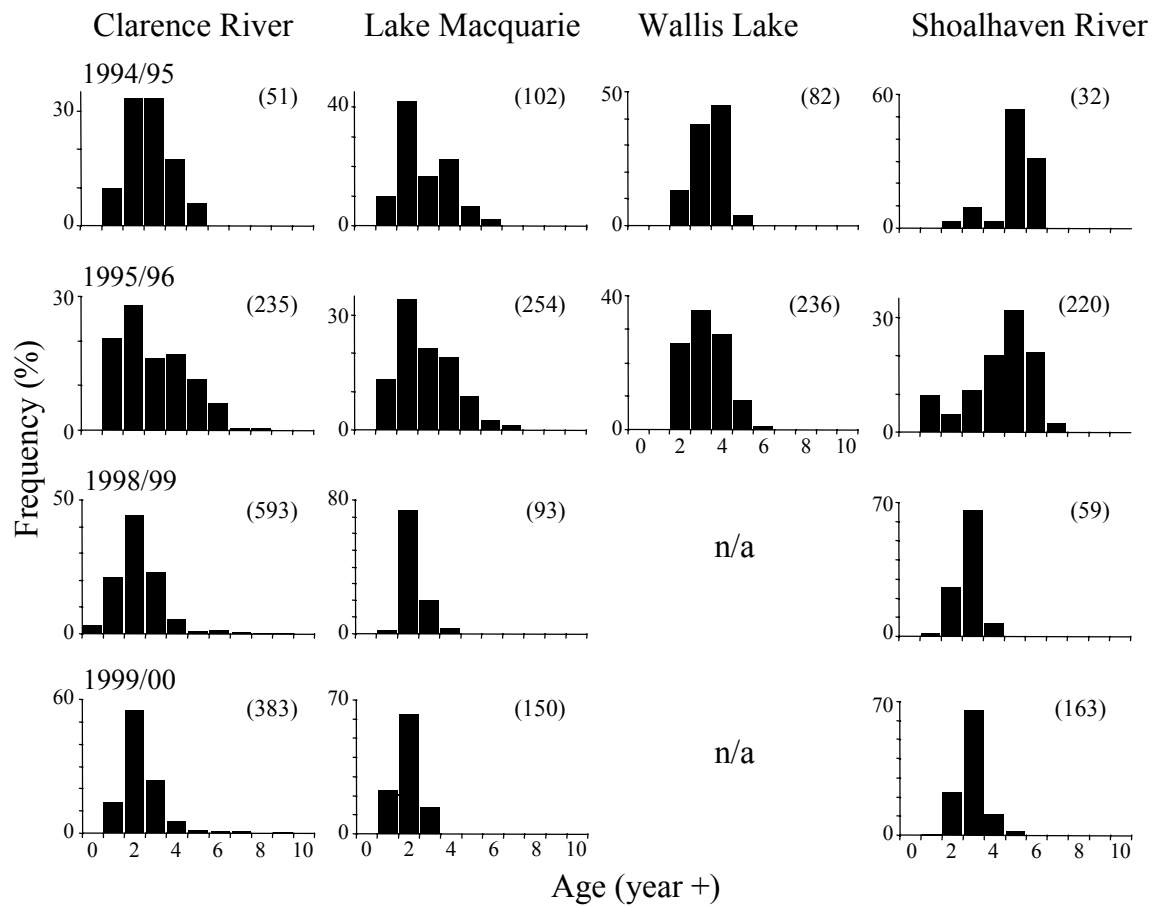


Figure 30. Age frequencies of sea mullet, sampled from NSW estuaries between August and February, 1994/95 to 1999/2000. (No ages available in 1996/97 or 1997/98; in parentheses - number of fish aged; n/a - no data collected)

Mortality

Thomson (1963) lists previous estimates of total mortality (Z) for sea mullet, ranging from 0.53 - 0.993. Within these values, natural mortality, M , was estimated to range from 0.29 to 0.58, and fishing mortality, F , from 0.2 to 0.5. Hwang et al. (1990) estimated $M = 0.33$, and $F = 0.99/1.36$ (female/male) for a Taiwanese fishery.

Total mortality (Z) was estimated from the average age structure of landings from NSW ocean zones 1-5, between 1995 to 2000 using the 'catch curve' method (Ricker 1975). Insufficient data were available from ocean zones 6-10 to allow inclusion. Data from individual years suggested total mortalities of 0.40 - 0.80 for females, and 0.46 - 1.07 for males (Table 7). Total mortalities estimated from the average age composition among years were 0.45 for females and 0.53 for males (Table 7, Fig. 31). Total mortality estimates from estuarine age compositions (not shown) were considerably higher, because of the poor representation of older fish in estuarine landings.

It is important to note that length composition, and therefore age composition, of samples is influenced by fishing gear selectivity (Fig. 26). Hence, estimates of mortality by the catch curve method will vary according to the selectivity of fishing gear used to collect samples.

It is also important to note that age composition of samples was highly variable among years, leading to variable estimates of mortality. Estimation of mortality by the catch curve method is potentially confounded by recruitment variability, which does appear to occur in the NSW fishery (as suggested by variable age composition of oceanic landings among years). There is also some uncertainty about the representativeness of available age composition data, given poor spatial sampling of landings. Other methods of estimating mortality may be more appropriate until more robust estimates of total stock age composition are available.

Using the alternative method of Hoenig (1983), where

$$\log_e(Z) = 1.44 - (0.982 * \log_e(\text{maximum age})),$$

total mortality (Z) of sea mullet was estimated to be 0.40 (female) and 0.44 (male), assuming maximum ages of 11 and 10 years, respectively.

Using the alternative method of Pauly (1979), where

$$\log M = (0.654 * \log K) - (0.28 * \log L_{inf}) + (0.463 * \log T),$$

natural mortality (M) of sea mullet was estimated to be 0.72 (female) and 0.86 (male). T (average temperature) was assumed to be 18 °C. See Table 4 for other parameter values where $t_0 = 0$. These estimates of natural mortality are relatively high, and may reflect incorrect parameter values.

Table 7. Estimates of mortality within NSW sea mullet stock from various methods. (Z – total mortality, M – natural mortality)

Year	Mortality	Female	Male	Method
1995	Z	0.80	0.94	Catch curve, annual commercial ocean landings (zones 1-5, ages >2 y only)
1996	Z	0.41	0.46	" "
1997	Z	n/a	n/a	" "
1998	Z	0.40	0.47	" "
1999	Z	0.41	0.93	" "
2000	Z	0.55	1.07	" "
1995-2000	Z	0.45	0.53	Catch curve, 5 y average of ocean landings (zones 1-5, ages >2 y only)
all	Z	0.4	0.44	Hoening (1983)
all	M	0.72	0.86	Pauly (1979)

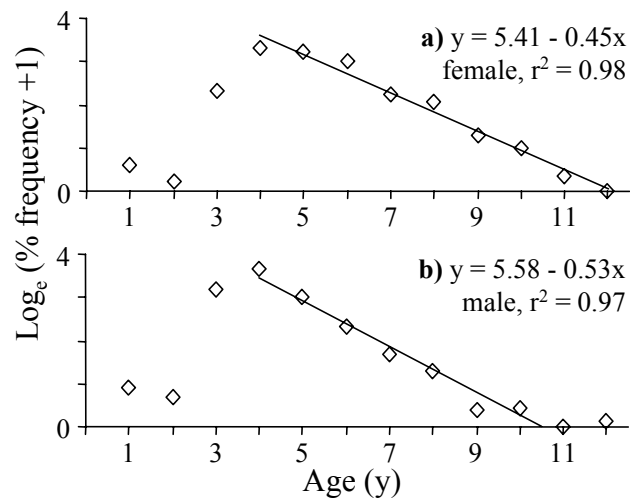


Figure 31. Age versus \log_e (frequency + 1) for **a)** female and **b)** male sea mullet. Data pooled from oceanic landings, zones 1-5, from 1995 to 2000. Linear regressions fitted to ages 4-12 y (females), and 4-11 y (males).

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