Figure legends

Fig. 1. Bomb carbon dating age validation studies on shark and ray populations showing validated, uncertain and underestimated ages, ordered by increasing maximum age. The number of samples in each study is given at the end of each bar.

Fig. 2. Chemical marking age validation studies on shark and ray populations showing validated, uncertain and underestimated ages, ordered by increasing maximum age. The number of samples in each study is given at the end of each bar. * the age of some individuals was underestimated, but their revised age did not exceed that of the oldest individual aged.

Fig. 3. Occurrence and magnitude of age underestimation in 61 individuals from 10 bomb carbon dating age validation studies. (a) Plot of relative age (Age/A_{Max}) against relative length (Length/L_{∞}), size of points denotes the discrepancy between true and apparent age (Δ Age). (b) and (c) are logistic regression analyses modelling the probability of age underestimation as a function of relative length and age, respectively. White points in (b) and (c) were excluded from statistical analysis. NEP, northeast Pacific; NWA, northwest Atlantic; SA, South Africa.

Fig. 4. Hypothesised effects and implications of age underestimation on growth and mortality, illustrated with simulated data for New Zealand porbeagle sharks (Francis *et al* 2007). (a) The growth curve asymptote is effectively truncated when older individuals are under-aged, and this may result in a steeper curve with biased parameters. (b) Assuming age underestimation is a function of length, faster-growing individuals will be affected at a younger age than slower-growing individuals. (c) The apparent loss of age structure due to age underestimation may be inadvertently attributed to or indistinguishable from the effects of fishing. (d) Comparison of true $A_{Max} = 65$ years versus apparent $A_{Max} = 35$ years in population projection from a simple, density-independent demographic analysis assuming Hoenig mortality (see Supplementary Material for additional information).

Figures

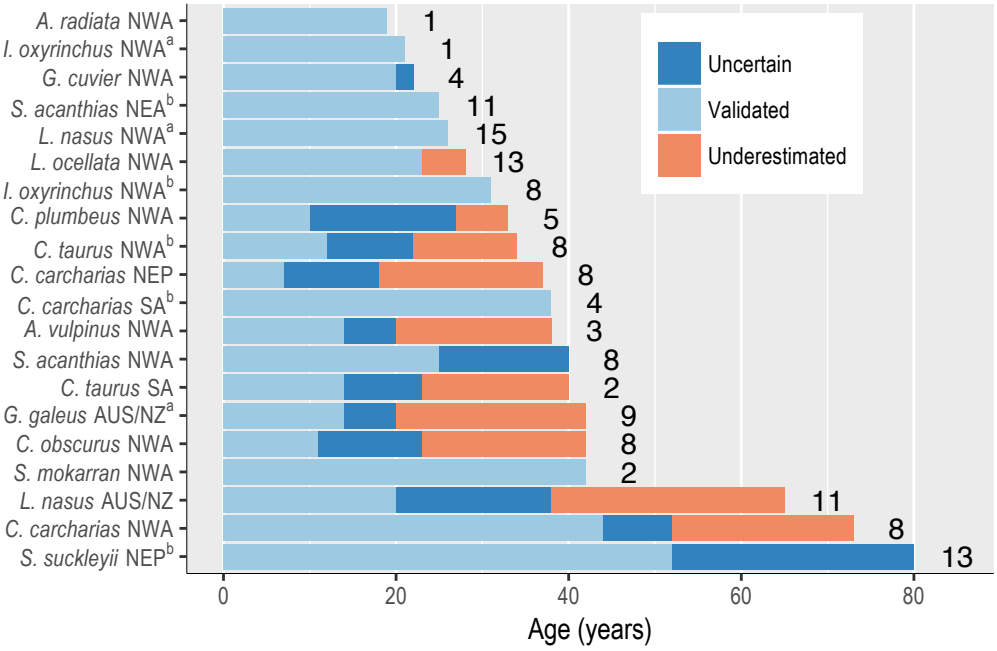

Fig 1.

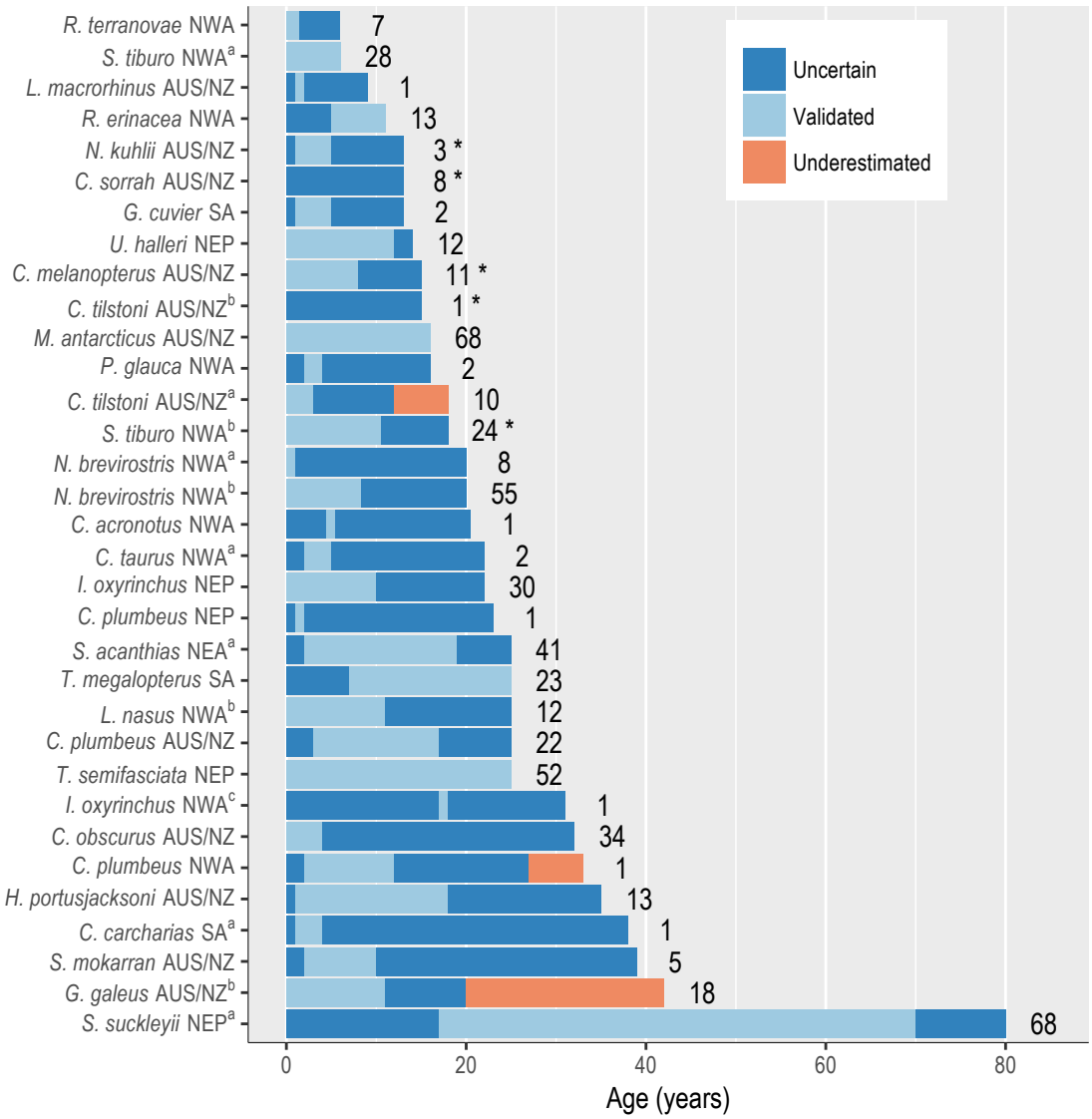
R. terranovae NWA
S. tiburo NWA[a]
L. macrorhinus AUS/NZ
R. erinacea NWA
N. kuhlii AUS/NZ
C. sorrah AUS/NZ
G. cuvier SA
U. halleri NEP
C. melanopterus AUS/NZ
C. tilstoni AUS/NZ[b]
M. antarcticus AUS/NZ
P. glauca NWA
C. tilstoni AUS/NZ[a]
S. tiburo NWA[b]
N. brevirostris NWA[a]
N. brevirostris NWA[b]
C. acronotus NWA
C. taurus NWA[a]
I. oxyrinchus NEP
C. plumbeus NEP
S. acanthias NEA[a]
T. megalopterus SA
L. nasus NWA[b]
C. plumbeus AUS/NZ
T. semifasciata NEP
I. oxyrinchus NWA[c]
C. obscurus AUS/NZ
C. plumbeus NWA
H. portusjacksoni AUS/NZ
C. carcharias SA[a]
S. mokarran AUS/NZ
G. galeus AUS/NZ[b]
S. suckleyii NEP[a]
7
28
1
13
3 *
8 *
2
12
11 *
1 *
68
2
10
24 *
8
55
1
2
30
1
41
23
12
22
52
1
34
1
13
1
5
18
68
Uncertain
Validated
Underestimated
0
20
40
60
80
Age (years)

Fig 2.

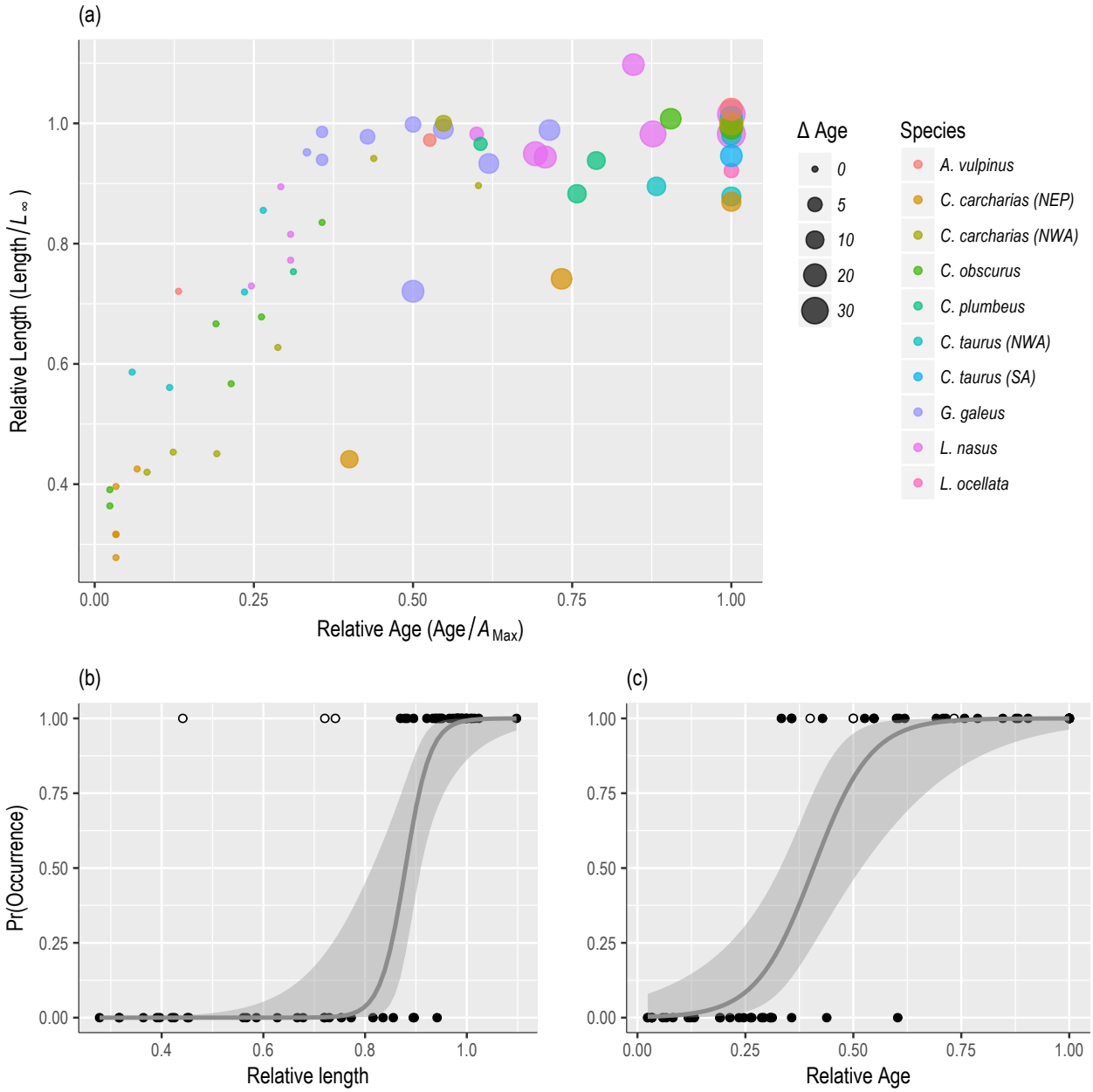
(a)
Relative Length (Length/L_∞)
Relative Age (Age/A_{Max})
0.00
0.25
0.50
0.75
1.00
0.4
0.6
0.8
1.0
Δ Age
0
5
10
20
30
Species
A. vulpinus
C. carcharias (NEP)
C. carcharias (NWA)
C. obscurus
C. plumbeus
C. taurus (NWA)
C. taurus (SA)
G. galeus
L. nasus
L. ocellata
(b)
Pr(Occurrence)
Relative length
(c)
Relative Age

Fig 3.

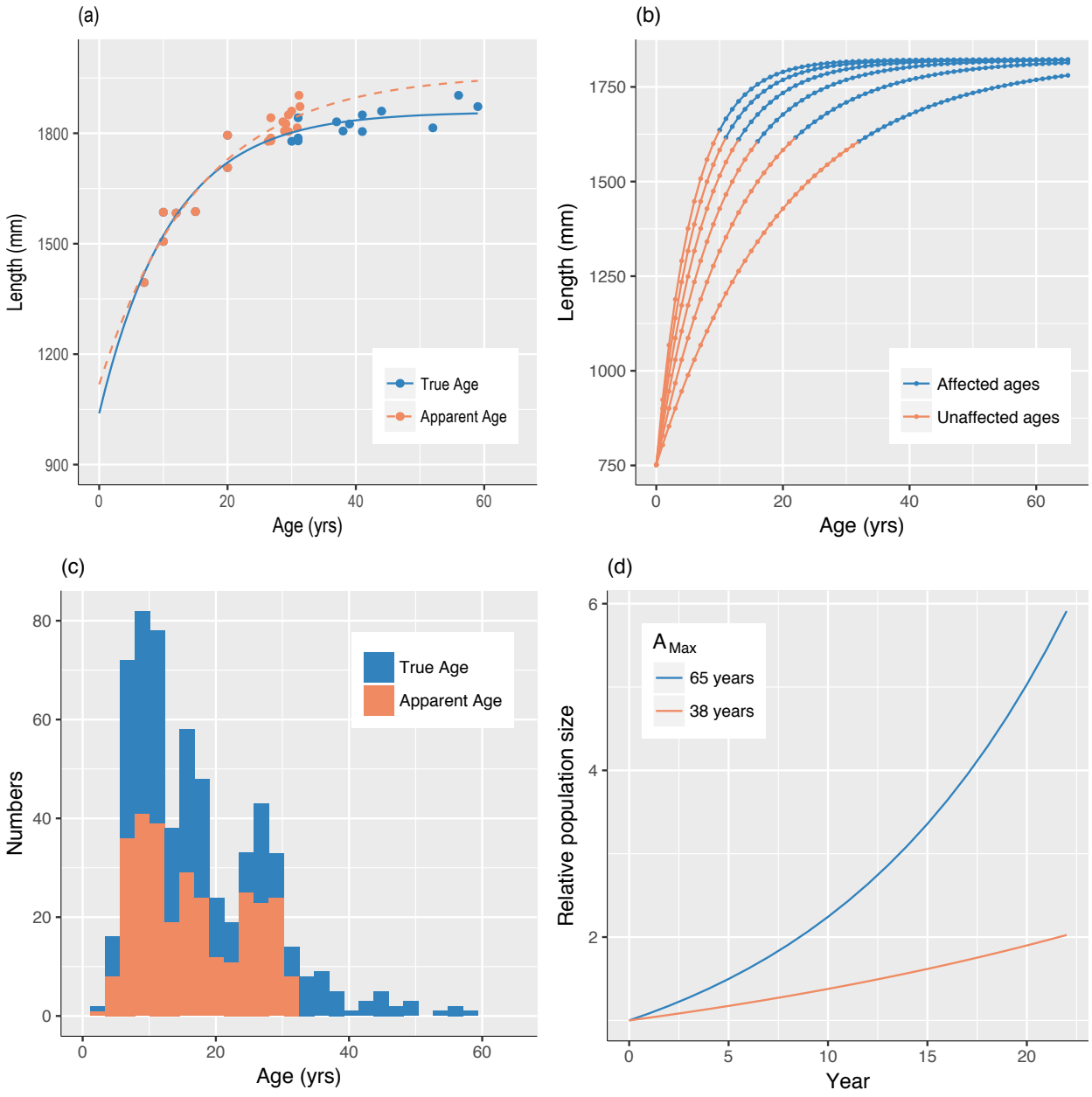
(a)
Length (mm)
Age (yrs)
True Age
Apparent Age
(b)
Length (mm)
Age (yrs)
Affected ages
Unaffected ages
(c)
Numbers
Age (yrs)
True Age
Apparent Age
(d)
Relative population size
Year
A Max
65 years
38 years

Fig 4.