Testing

period life table for e.g. a care home

age	μ^{s}_{x}	l_x	d_x	E_x^c	$\mu_{x+\frac{1}{2}}$	z_x
90	0.202	40	10	35	0.29	1.1
91	0.215	35	8	31	0.258	0.52
92	0.236	22	4	18	0.20	-0.33
93	0.261	14	6	11	0.545	1.85
94	0.279	11	4	9	0.444	0.94
95	0.291	7	3	5.5	0.545	1.11

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Chi-squared: $X^2 = \sum_{\text{all ages } x} z_x^2 = 7.13$

```
> 1-pchisq(7.13,6)
[1] 0.3089921
```

Signs test: S=# $\{x : z_x > 0\}$=5

```
> 2*pbinom(1,6,.5)
[1] 0.21875
```

Cumulative deviations test: $Z = \frac{\sum \left(d_x - E_x^c \mu^s_{x+\frac{1}{2}} \right)}{\sqrt{\sum E_x^c \mu^s_{x+\frac{1}{2}}}} = 2.01$

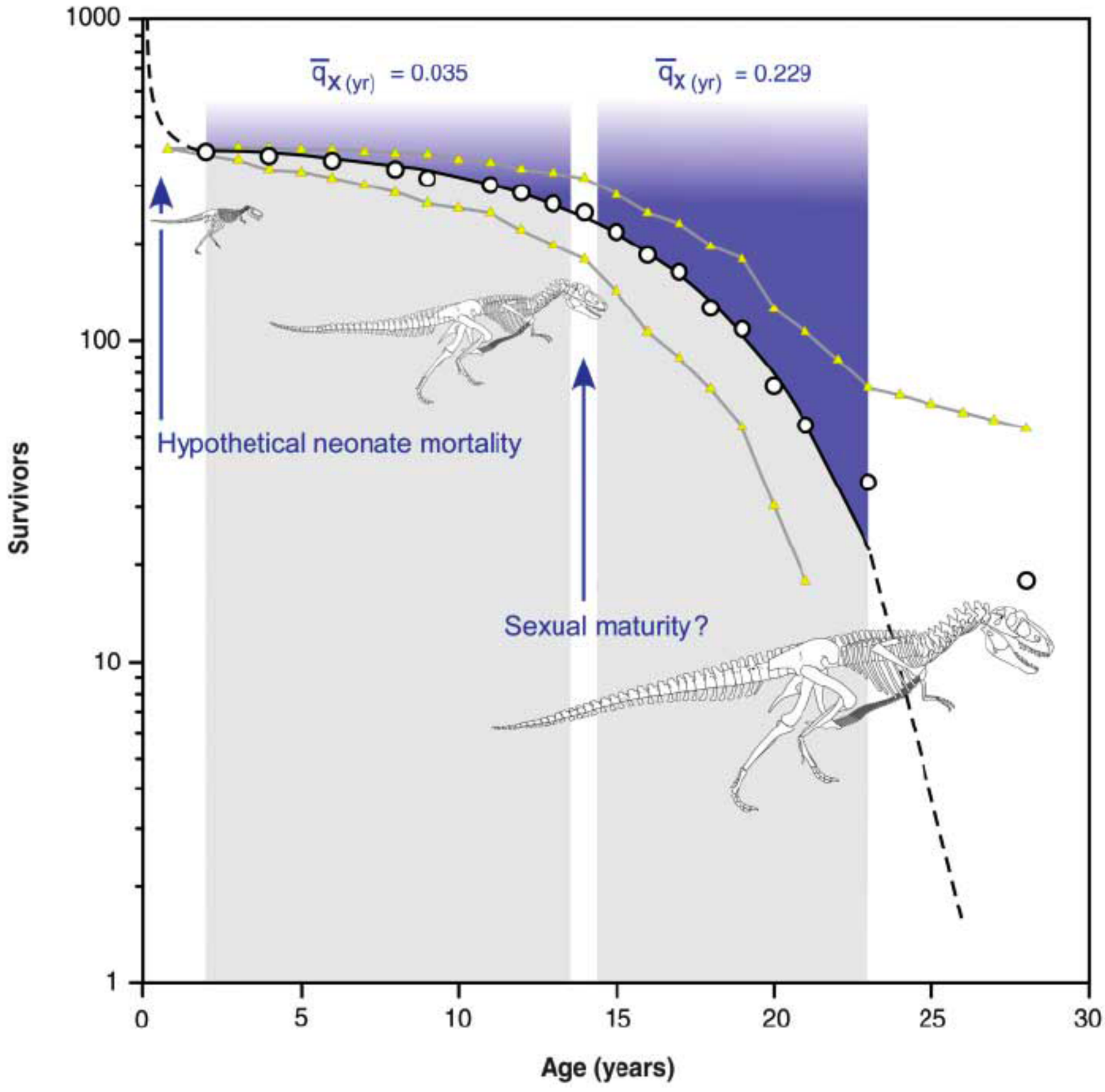
```
> 2*(1-pnorm(2.01))
[1] 0.04443119
```

Graduation

age	l_x	d_x	E_x^c	$\mu_{x+\frac{1}{2}}$	μ_x^s	z_x	graduated μ_x^0
90	40	10	35	0.29	0.202	1.1	0.25
91	35	8	31	0.258	0.215	0.52	0.28
92	22	4	18	0.20	0.236	-0.33	0.335
93	14	6	11	0.545	0.261	1.85	0.40
94	11	4	9	0.444	0.279	0.94	0.45
95	7	3	5.5	0.545	0.291	1.11	0.48

$$\mu_x^0 = -0.279 + 2.6\mu_x^s$$

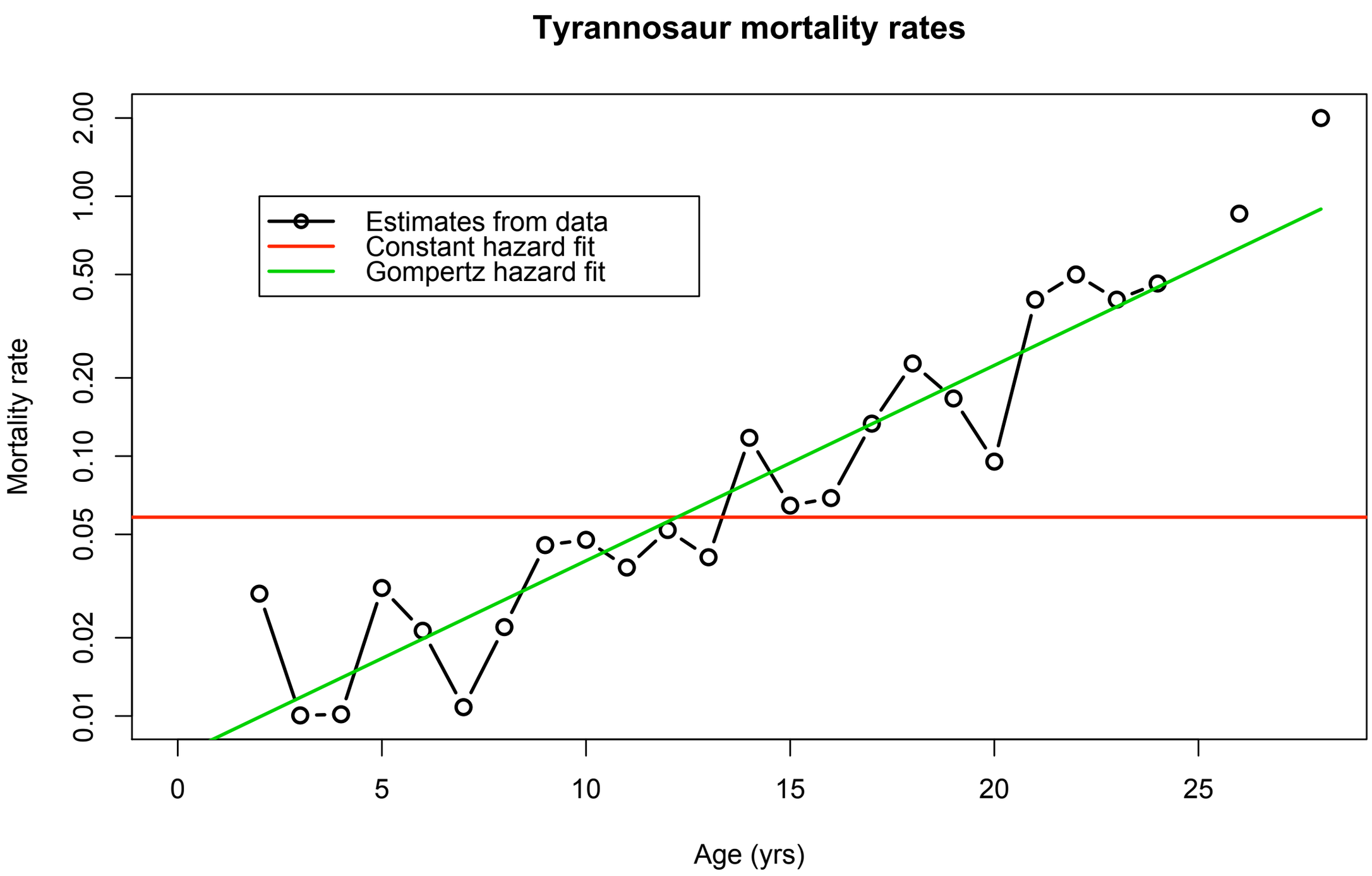
“Tyrannosaur Life Tables: An Example of Nonavian Dinosaur Population Biology” Erickson,et al. Science, 7/14/06



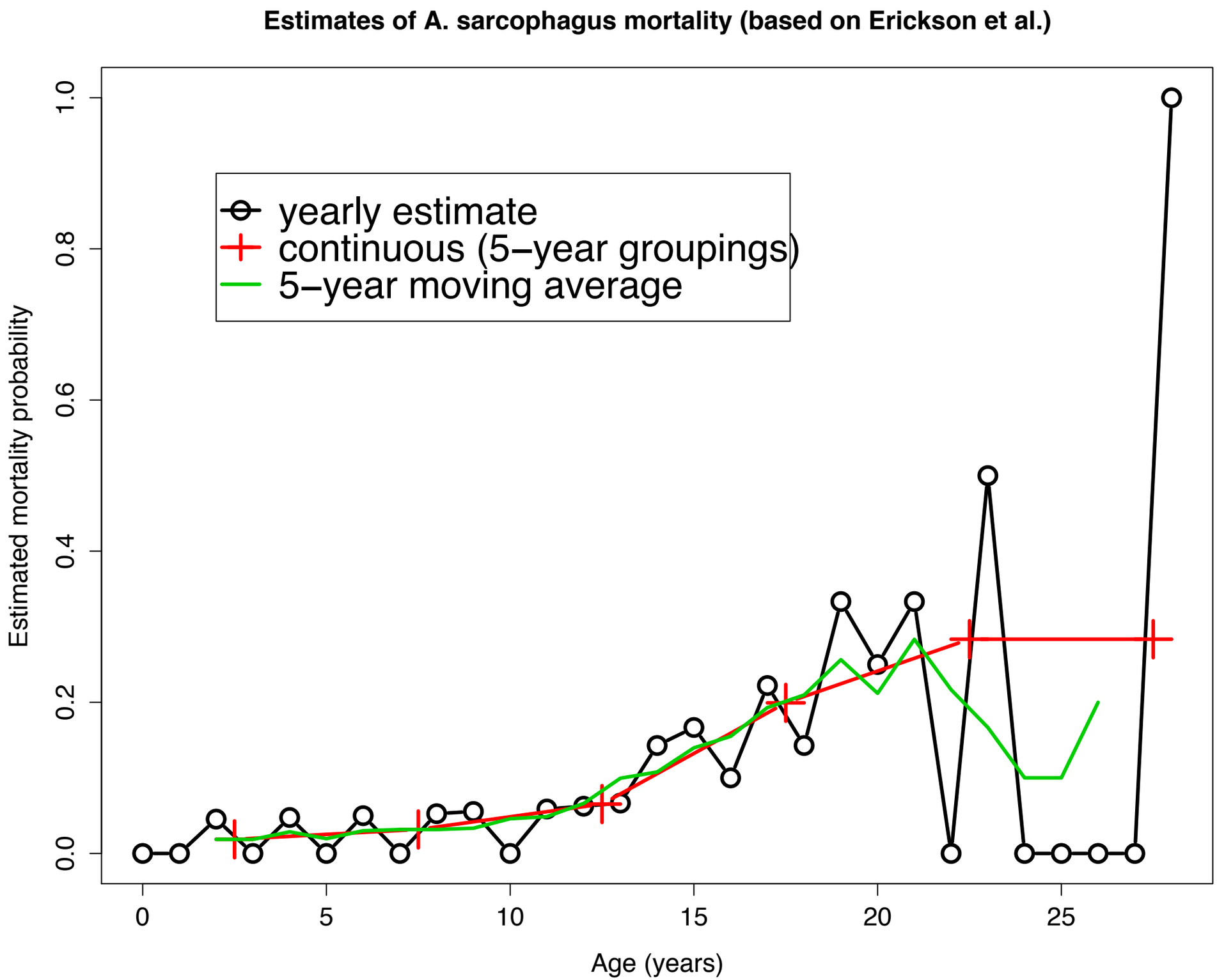
A. sarcophagus	2,4,6,8,9,11,12,13,14,14,15, 15,16,17,17,18,19,19,20,21,23,28
T. rex	2,6,8,9,11,14,15,16,17,18,18, 18,18,18,19,21,21,21, 22,22,22,22,22,22,23,23,24,24,28
G. libratus	2,5,5,5,7,9,10,10,10,11,12,12,12,13,13, 14,14,14,14,14,15,16,16,17,17,17,18, 18,18,19,19,19,20,20,21,21,21,21,22
Daspletosaurus	3,9,10,17,18,21,21,22,23,24,26,26,26

Erickson et al., Science 2005

Parametric smoothing



Nonparametric smoothing



age	l_x	d_x	$q_x^{(\exp)}$	$d_x^{(\exp)}$	$z_x^{(\exp)}$	$q_x^{(\text{Gom})}$	$d_x^{(\text{Gom})}$	$z_x^{(\text{Gom})}$
0	103	0	0.007	5.87	-2.50	0.008	0.78	-0.89
1	103	0	0.008	5.87	-2.50	0.009	0.93	-0.97
2	103	3	0.010	5.87	-1.23	0.011	1.10	1.84
3	100	1	0.012	5.70	-2.03	0.013	1.26	-0.24
4	99	1	0.014	5.64	-2.02	0.015	1.48	-0.40
5	98	3	0.016	5.59	-1.14	0.018	1.73	0.98
6	95	2	0.019	5.42	-1.52	0.021	1.99	0.01
7	93	1	0.023	5.30	-1.93	0.025	2.30	-0.87
8	92	2	0.027	5.24	-1.47	0.029	2.69	-0.43
9	90	4	0.032	5.13	-0.52	0.035	3.12	0.52
10	86	4	0.038	4.90	-0.42	0.041	3.52	0.27
11	82	3	0.044	4.67	-0.80	0.048	3.96	-0.50
12	79	4	0.052	4.50	-0.25	0.057	4.50	-0.25
13	75	3	0.062	4.28	-0.64	0.067	5.04	-0.95
14	72	8	0.073	4.10	2.04	0.079	5.70	1.03
15	64	4	0.086	3.65	0.19	0.093	5.96	-0.86
16	60	4	0.101	3.42	0.33	0.109	6.56	-1.08
17	56	7	0.118	3.19	2.27	0.128	7.18	-0.08
18	49	10	0.139	2.79	4.69	0.150	7.36	1.11
19	39	6	0.162	2.22	2.72	0.175	6.84	-0.37
20	33	3	0.189	1.88	0.86	0.204	6.74	-1.65
21	30	10	0.220	1.71	7.15	0.237	7.12	1.35
22	20	8	0.255	1.14	7.40	0.275	5.49	1.40
23	12	4	0.295	0.68	4.52	0.317	3.80	0.14
24	8	3	0.339	0.46	4.30	0.363	2.91	0.08
25	5	0	0.388	0.29	-0.55	0.414	2.07	-1.88
26	5	3	0.441	0.29	6.26	0.470	2.35	0.70
27	2	0	0.498	0.11	-0.35	0.528	1.06	-1.50
28	2	2	0.558	0.11	8.13	0.590	1.18	1.67

Gompertz: $\sum z_x^2 = 28.7$

27 degrees of freedom

Lump together categories 0-9 as single category with E[D]=103·0.168=17.3.

Observed 17 deaths. z=0.08.

Remove last three categories.

End up with X^2=11 on 14 d.f.