

## 1. Alternative ways of parameterization

In our original parameterisation we calculated the energy allocation factor  $\kappa$  from somatic growth and assigned additional bioenergetic costs to reproduction, leading to an increase in carbon investment per egg,  $c_E$ . However, these additional bioenergetic costs alternatively can be assigned to other processes within the energy allocation scheme. Focusing on Fig. 1 of the main publication these costs can either occur at the upper branch of Fig. 1 (i.e. related to maintenance and somatic growth) or at the left branch of the energy allocation scheme in Fig. 1 (i.e. related to food acquisition).

For achieving such alternative parameterisations, one first has to make an assumption how to parameterize  $c_E$  in the fish treatments (terminology as in the main publication). We estimated this parameter by reducing the value of  $c_E$  from each clone in the control treatment proportional to the change in weight of neonates  $W(\text{SON}_{i,t})$  between treatments. The latter represents the weight of a neonate calculated from the SON of clone  $i$  in treatment  $t$  by applying the length-weight regression given in Table 2 of the main publication. Hence, parameter  $c_{E,i,\text{fish}}$  of clone  $i$  in the fish treatment becomes:

$$c_{E,i,\text{fish}} = c_{E,i,\text{control}} \cdot \frac{W(\text{SON}_{i,\text{fish}})}{W(\text{SON}_{i,\text{control}})} \quad (1.1)$$

### Allocation of additional bioenergetic costs to somatic growth and maintenance

Here we assumed that a certain fraction  $\theta_g$  of the energy channelled to growth and maintenance, which corresponds to  $\kappa \cdot A(\text{SAM}, \text{T}, \text{F})$ , has to be paid to meet the additional bioenergetic costs. Such additional costs could arise from, for example, thicker carapaces or increased energy expenditure due to behavioural adaptations such as increased alertness. The remaining fraction of the energy channelled to growth and maintenance ( $1 - \theta_g$ ) is then used to meet the requirements of somatic growth and maintenance.

The energy allocation factor  $\kappa$  can now be calculated from the egg production by means of the size of the first clutch and the corresponding size at maturity:

$$\hat{e}_{i,t} = 1 - \frac{\text{SFC}_{i,t} \cdot c_{E,i,t}}{D \cdot A(\text{SAM}_{i,t}, \text{T}, \text{F})} \quad (1.2)$$

Once  $\kappa$  is known, one can calculate the energy flow towards somatic growth and maintenance and estimate the fraction  $\theta_g$  by numerical methods. The strategy here is similar to that outlined in the main publication, i.e. to satisfy the requirement to reach SFR at the age of AFR with the body length SON at age zero as given in (De Meester and Weider 1999). By definition,  $\theta_g$  has to have a value of 1 for all control treatments. Results of this alternative parameterization are given in Table 1.1. Values for  $\theta_g$  in the fish treatments of clone 7 appeared to be close to zero indicating the absence of additional bioenergetic costs. Clones 2 and 18 showed negative values of  $\theta_g$  meaning that they have an increased length-

dependent net production in the fish treatments (i.e. a bioenergetic gain instead of a bioenergetic cost).

### Allocation of additional bioenergetic costs to food acquisition

In this model parameterization we assumed that a reduced food acquisition rate is responsible for the detected costs. This might be relevant if the presence of fish leads to a reduced ingestion rate due to increased alertness. For achieving this parameterization we first calculated the absolute amount of resources invested into reproduction and somatic growth for the duration between AAM and AFR from the data.

$$\text{Somatic growth: } S_{i,t} = W(\text{SFR}_{i,t}) - W(\text{SAM}_{i,t}) \quad (1.3)$$

$$\text{Reproduction: } R_{i,t} = \text{NEFC}_{i,t} \times c_{E,i,t} \quad (1.4)$$

Resource allocation into maintenance  $M$  for that period has to be calculated by the model as indicated in Table 2 of the main publication. Once these amounts are known one can sum over these three entities and immediately receives the total amount of resources acquired in that period. For each clone this total amount of resources acquired differs between treatments and one can express the relative change as:

$$\ddot{a}_i = \frac{S_{i,\text{fish}} + M_{i,\text{fish}} + R_{i,\text{fish}}}{S_{i,\text{control}} + M_{i,\text{control}} + R_{i,\text{control}}} \quad (1.5)$$

This value of  $\delta_i$ , representing the ratio between total amount of resources acquired in the fish and the control treatment of clone  $i$ , consequently also quantifies the relative change in food acquisition rate between clones. The energy allocation factor  $\kappa$  in that case will be given by:

$$\kappa_{i,t} = \frac{S_{i,t} + M_{i,t}}{S_{i,t} + M_{i,t} + R_{i,t}} \quad (1.6)$$

Results of this alternative parameterization are given in Table 1.1. Clones 2, 7 and 18 showed a value of  $\delta_i$  close to or larger than one, i.e. no reduction of food acquisition occurs after exposure to fish infochemicals indicating the absence of additional bioenergetic costs.

## 2. Parameter estimation for life-history shifts of *Daphnia* in response to *Chaoborus*

In addition to studying energy allocation patterns in response to fish we applied the energy allocation model to experimental results from Weber et al. (2003). They studied the life-history response of four clones of *Daphnia galeata* to kairomones from *Chaoborus* larvae. This predator typically feeds preferably on smaller individuals

and induces a life-history response opposite to that expressed under fish exposure. Results of the parameter estimation are given in Table 1.2. Except for one clone,  $\kappa$  increased in response to *Chaoborus*-kairomones, indicating increased energy allocation to growth. In this analysis no energetic costs of the altered energy allocation could be detected since  $c_E$  was lowered in all *Chaoborus*-treatments compared to the control. These results thus comply with the association between kappa and  $c_E$  as given in Fig. 9 of the original manuscript.

## References

- De Meester, L. and Weider, L. J. 1999. Depth selection behavior, fish kairomones, and the life histories of *Daphnia hyalina*  $\times$  *galeata* clones. – Limnol. Oceanogr. 44: 1248–1258.
- Weber, A. et al. 2003. The supposed lack of tradeoff among *Daphnia galeata* life history traits is explained by increased adult mortality in *Chaoborus* conditioned treatments. – Hydrobiologia 491: 273–278.

Table 1.1. Alternative parameterizations.

Clone	Treatment	$c_{E, it}$ ( $\mu\text{g C egg}^{-1}$ )	Additional costs allocated to growth and maintenance		Additional costs allocated to food acquisition	
			$\kappa_{it}$	$\theta_{g, it}$	$\kappa_{it}$	$\delta_i$
1	control	1.29	0.35	1.00	0.38	0.83
	fish	1.20	0.45	0.34	0.37	
2	control	1.18	0.35	1.00	0.38	1.04
	fish	1.16	0.28	-0.18	0.34	
3	control	1.10	0.36	1.00	0.38	0.60
	fish	0.99	0.66	0.58	0.46	
4	control	1.27	0.37	1.00	0.40	0.59
	fish	1.17	0.68	0.58	0.49	
5	control	1.01	0.37	1.00	0.40	0.66
	fish	0.88	0.60	0.53	0.43	
6	control	0.89	0.38	1.00	0.41	0.63
	fish	0.74	0.72	0.53	0.57	
7	control	0.94	0.40	1.00	0.43	1.01
	fish	0.81	0.40	0.02	0.44	
8	control	0.92	0.40	1.00	0.44	0.90
	fish	0.70	0.48	0.25	0.45	
9	control	0.89	0.40	1.00	0.44	0.89
	fish	0.80	0.49	0.23	0.46	
10	control	1.56	0.33	1.00	0.35	0.90
	fish	1.48	0.41	0.24	0.37	
11	control	1.27	0.36	1.00	0.38	0.96
	fish	1.24	0.34	0.08	0.34	
12	control	1.09	0.40	1.00	0.44	0.94
	fish	0.89	0.38	0.09	0.39	
13	control	0.80	0.40	1.00	0.44	0.88
	fish	0.71	0.47	0.25	0.43	
14	control	1.03	0.39	1.00	0.43	0.81
	fish	0.96	0.54	0.35	0.46	
15	control	0.84	0.40	1.00	0.44	0.85
	fish	0.66	0.53	0.30	0.48	
16	control	0.94	0.40	1.00	0.43	0.92
	fish	0.86	0.46	0.20	0.45	
17	control	0.74	0.42	1.00	0.46	0.86
	fish	0.68	0.51	0.27	0.47	
18	control	1.61	0.39	1.00	0.42	1.22
	fish	1.36	0.18	-1.18	0.36	
19	control	1.23	0.42	1.00	0.45	0.89
	fish	1.02	0.41	0.21	0.38	
20	control	1.11	0.42	1.00	0.46	0.81
	fish	0.98	0.55	0.34	0.48	
21	control	1.35	0.43	1.00	0.47	0.89
	fish	1.10	0.48	0.22	0.45	
22	control	1.00	0.42	1.00	0.44	0.92
	fish	0.77	0.47	0.20	0.45	

Table 1.2. Measured original data from Weber et al. (2003); the estimated parameters were calculated according to the procedure explained in the text. Derived parameters were computed from these data by applying the energy allocation model.

Clone	Treatment	Measured data				Estimated parameters		Derived parameters	
		SFR (mm)	SON (mm)	AFR (mm)	NEFC (eggs)	$\kappa$	$c_E$ ( $\mu\text{g C egg}^{-1}$ )	$L_{\text{max}}$ (mm)	SAM (mm)
W1	control	1.78	0.59	7.0	4.8	0.467	1.68	3.44	1.28
W1	<i>Chaoborus</i>	1.65	0.59	6.3	5.5	0.455	1.19	3.34	1.14
W2	Control	1.70	0.62	6.2	4.6	0.471	1.46	3.47	1.17
W2	<i>Chaoborus</i>	1.81	0.61	5.8	5.5	0.535	1.07	3.94	1.17
W3	Control	1.82	0.70	6.5	4.6	0.482	1.76	3.55	1.30
W3	<i>Chaoborus</i>	1.73	0.61	6.0	5.1	0.496	1.23	3.65	1.16
W4	Control	1.59	0.59	6.3	5.0	0.436	1.29	3.20	1.11
W4	<i>Chaoborus</i>	1.75	0.61	5.8	5.5	0.515	1.07	3.79	1.14