

## SUPPLEMENTAL DATA

Stage- and sex-dependent sensitivity to water soluble fractions of fresh and weathered oil in the marine copepod *Calanus finmarchicus*

### Photographs of the different stages

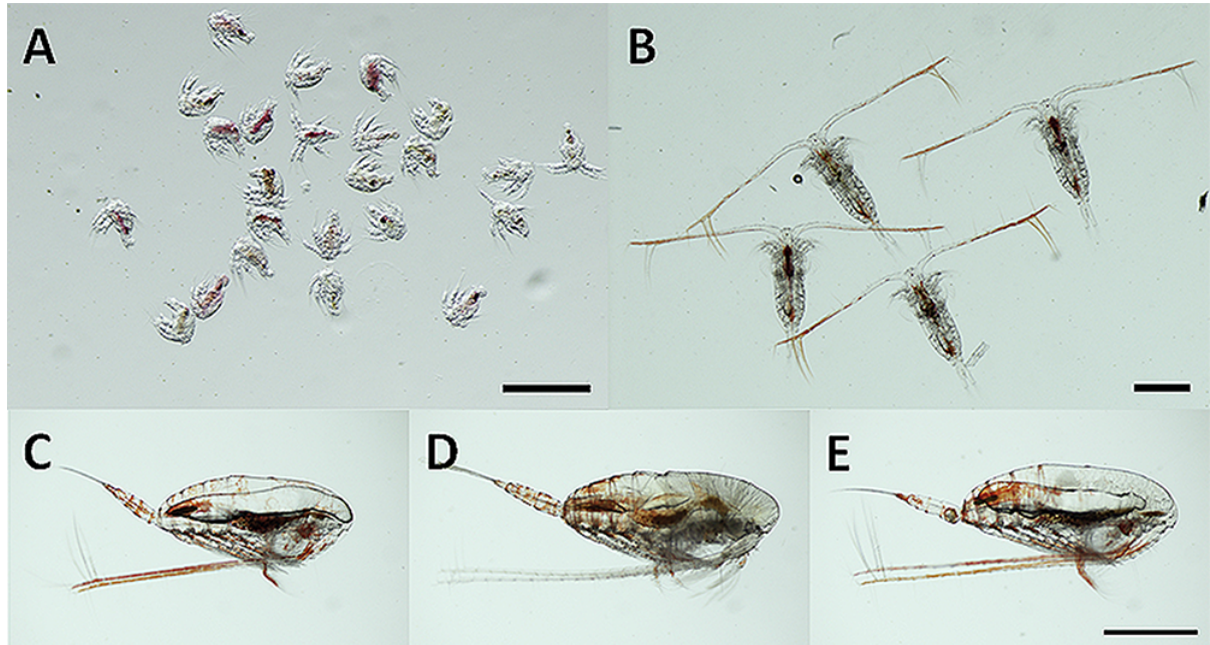


Figure S1. Images of the developmental stages of *C. finmarchicus* used in the acute toxicity tests. A: Nauplii III and IV. B: Copepodite II. C: Copepodite CV. D: Adult female. E: Adult male. The black scale bar for the top two images (A and B) is 0.5 mm, whereas for the bottom three images (D-E), the bar is 1 mm.

## Target compounds

Table S1. List of target components analyzed in WSFs.

Compound group	Components
Aliphate	Isopentane
	n-pentane
	Cyclopentane
	2-methylpentane
	3-methylpentane
	n-hexane
	methylcyclopentane
	cyclohexane
	n-heptane
	3-methylhexane
	2,3-dimethylpentane
	methylcyclohexane
	n-octane
	n-nonane
	n-decane
MAH	benzene
	toluene
	ethylbenzene
	o,m,p-xylene
	propylbenzene
	1-methyl-3-ethylbenzene
	1-methyl-4-ethylbenzene
	1,3,5-trimethylbenzene
	1-methyl-2-ethylbenzene
	1,2,4-trimethylbenzene
	1,2,3-trimethylbenzene
	n-butylbenzene
	1,2,4,5-tetramethylbenzene
	n-pentylbenzene
PAH	Naphthalene
	C1-naphthalenes
	C2-naphthalenes
	C3-naphthalenes
	C4-naphthalenes
	Biphenyl
	Acenaphthylene
	Acenaphthene
	Dibenzofuran
	Fluorene

	C1-fluorenes
	Phenanthrene
	Anthracene
	C1-phenanthrenes/anthracenes
	Dibenzothiophene
	C1-dibenzothiophenes
	C2-fluorenes
	C3-fluorenes
	C2-phenanthrenes/anthracenes
	C3-phenanthrenes/anthracenes
	C4-phenanthrenes/anthracenes
	C2-dibenzothiophenes
	C3-dibenzothiophenes
	C4-dibenzothiophenes
	Fluoranthene
	Pyrene
	C1-fluoranthrenes/pyrenes
	C2-fluoranthrenes/pyrenes
	C3-fluoranthrenes/pyrenes
	Benz(a)anthracene
	Chrysene
	C1-chrysenes
	C2-chrysenes
	C3-chrysenes
	C4-chrysenes
	Benzo(b)fluoranthene
	Benzo(k)fluoranthene
	Benzo(e)pyrene
	Benzo(a)pyrene
	Perylene
	Indeno(1,2,3-c,d)pyrene
	Dibenz(a,h)anthracene
	Benzo(g,h,i)perylene
Phenol	Phenol
	C1-Phenols (cresol)
	C2-Phenols
	C3-Phenols
	C4-Phenols

Table S2: Concentrations ( $\mu\text{g/L}$ , average  $\pm$  SD, N=3) of selected groups of oil component in 100% WSFs of fresh and weathered crude oil (oil: water ratio 1:40).

	<b>Fresh oil WSF</b>	<b>Weathered oil WSF</b>
	<b><math>\mu\text{g/L}</math></b>	<b><math>\mu\text{g/L}</math></b>
<b>TPH (C10-C36)</b>	3683.7 $\pm$ 984.1	2663.2 $\pm$ 736.2
<b>THC (C5-C36)</b>	9207.5 $\pm$ 925.6	3918.8 $\pm$ 592.1
<b>VOC (C5-C9)</b>	5523.8 $\pm$ 750.5	1255.6 $\pm$ 382.0
<b>Aliphates</b>	2901.9 $\pm$ 875.2	116.4 $\pm$ 111.8
<b>MAH</b>	2575.6 $\pm$ 183.0	1086.8 $\pm$ 282.3
<b>C4-C5-benzenes</b>	46.4 $\pm$ 7.4	52.4 $\pm$ 16.3
<b>Sum SVOC</b>	260.6 $\pm$ 20.5	232.5 $\pm$ 43.3
<b>Naphthalenes</b>	217.4 $\pm$ 21.2	189.4 $\pm$ 42.2
<b>3-4 ring PAH</b>	18.8 $\pm$ 1.9	18.9 $\pm$ 3.0
<b>5-6 ring PAH</b>	0.2 $\pm$ 0.2	0.3 $\pm$ 0.2
<b>C0-C5 phenols</b>	21.1 $\pm$ 7.5	22.4 $\pm$ 13.6

## More detailed fits

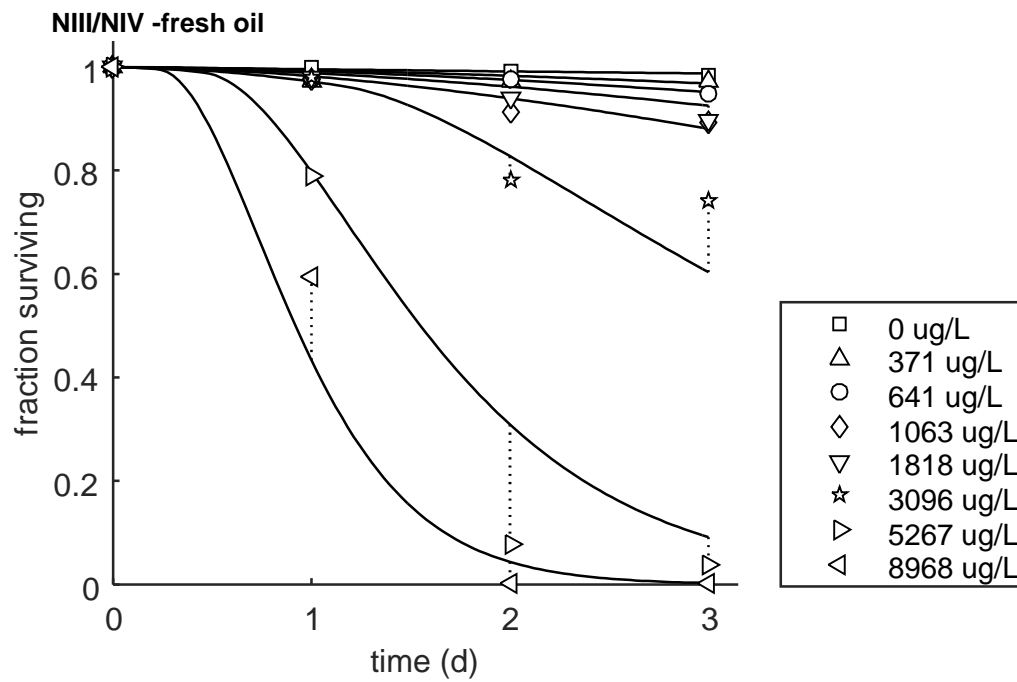


Figure S2. Fit to survival data for nauplii exposed to fresh oil.

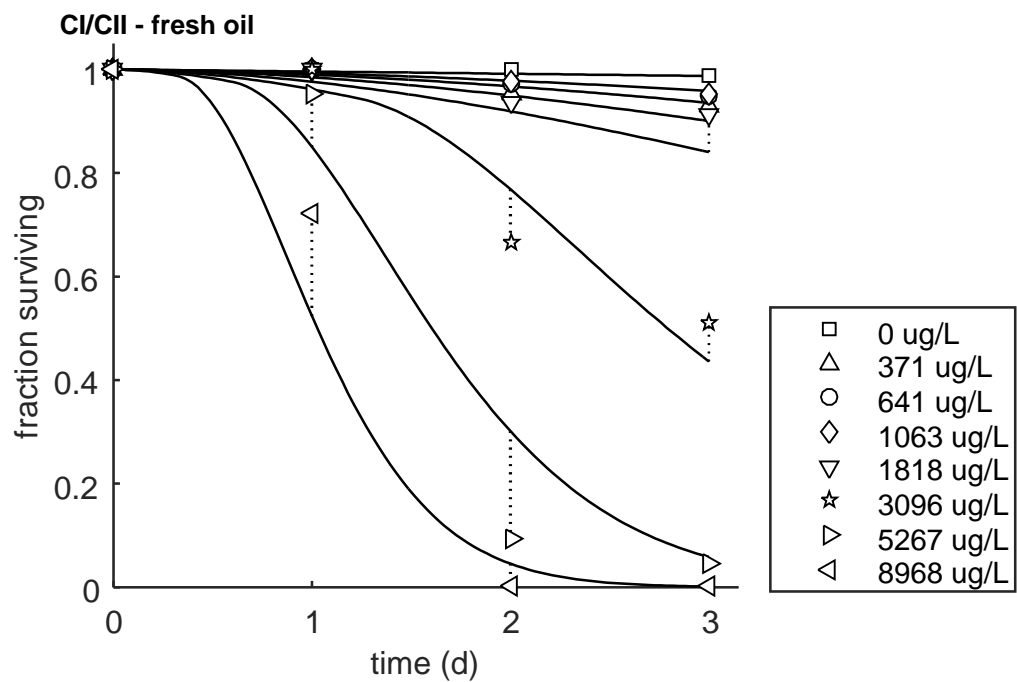


Figure S3. Fit to survival data for early copepodites exposed to fresh oil.

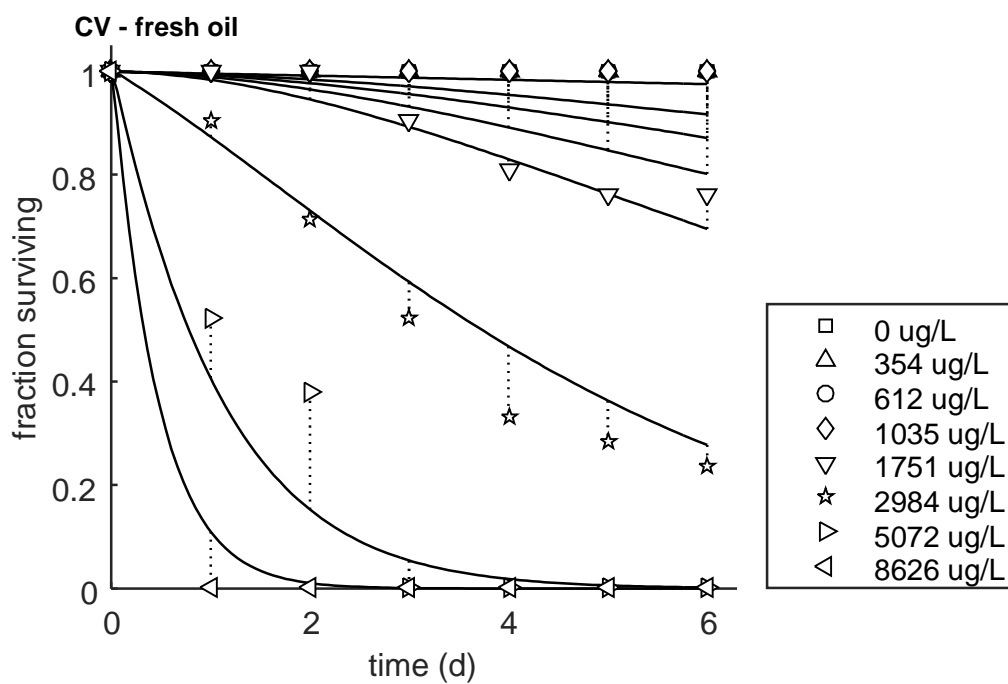


Figure S4. Fit to survival data for late copepodites exposed to fresh oil.

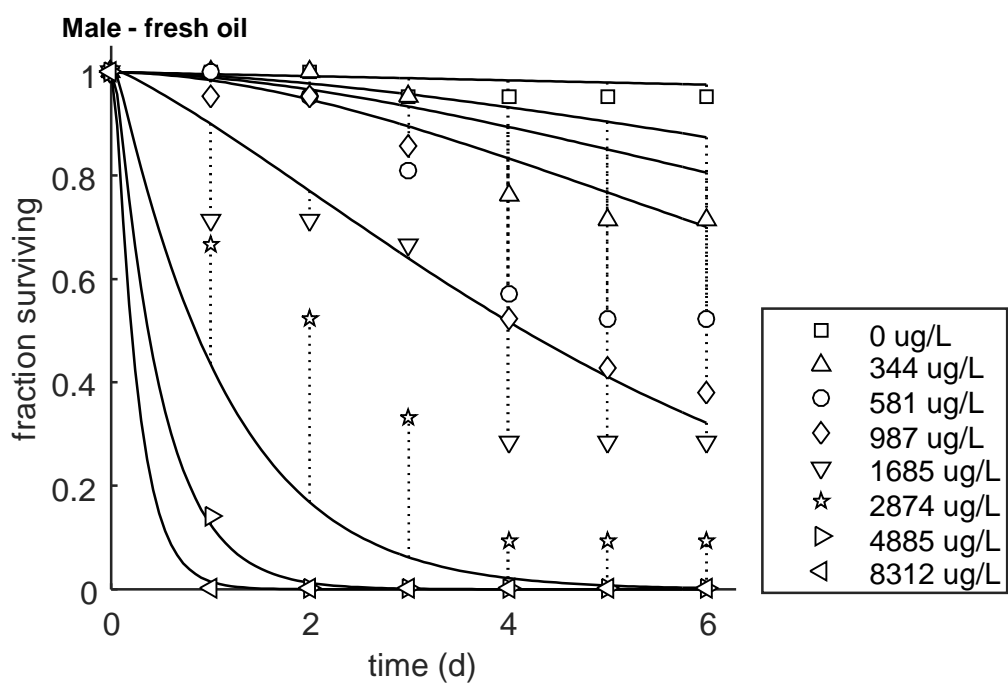


Figure S5. Fit to survival data for males exposed to fresh oil.

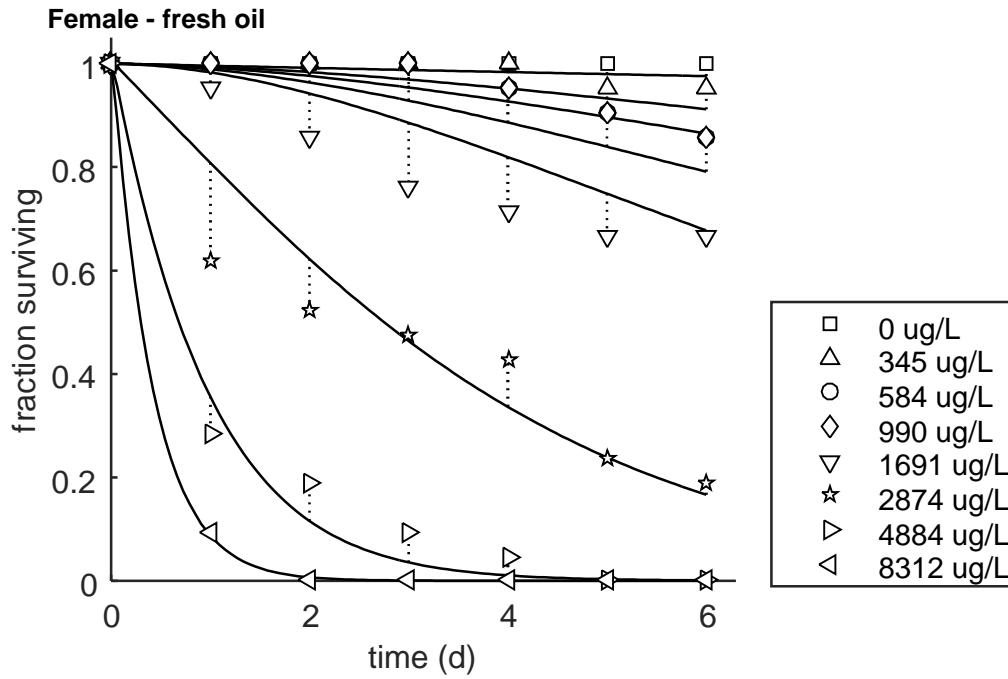


Figure S6. Fit to survival data for females exposed to fresh oil.

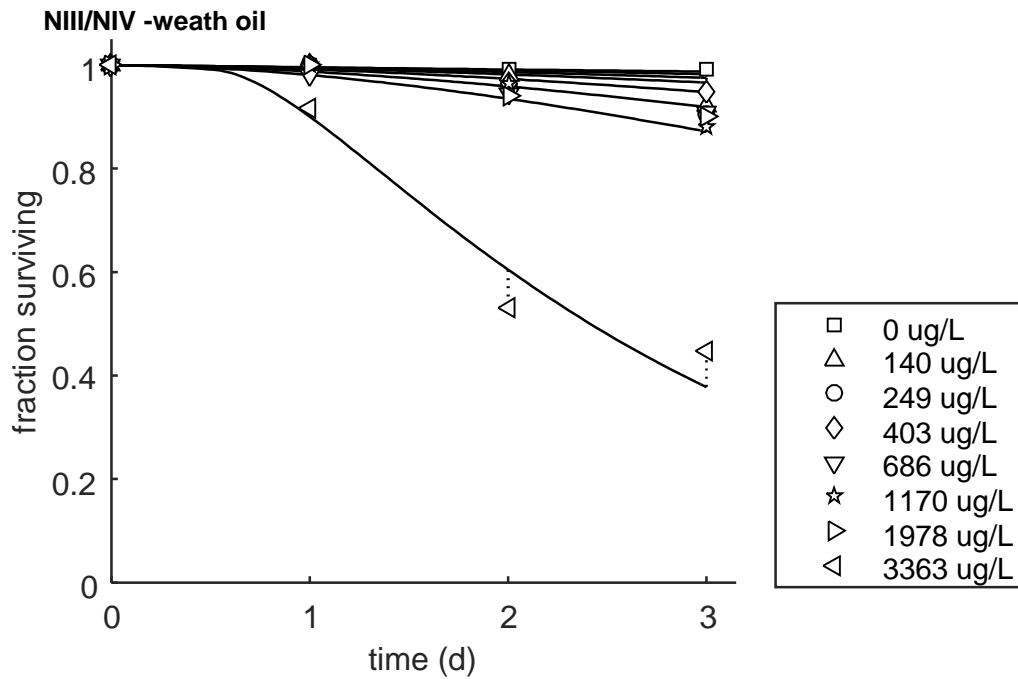


Figure S7. Fit to survival data for nauplii exposed to weathered oil.

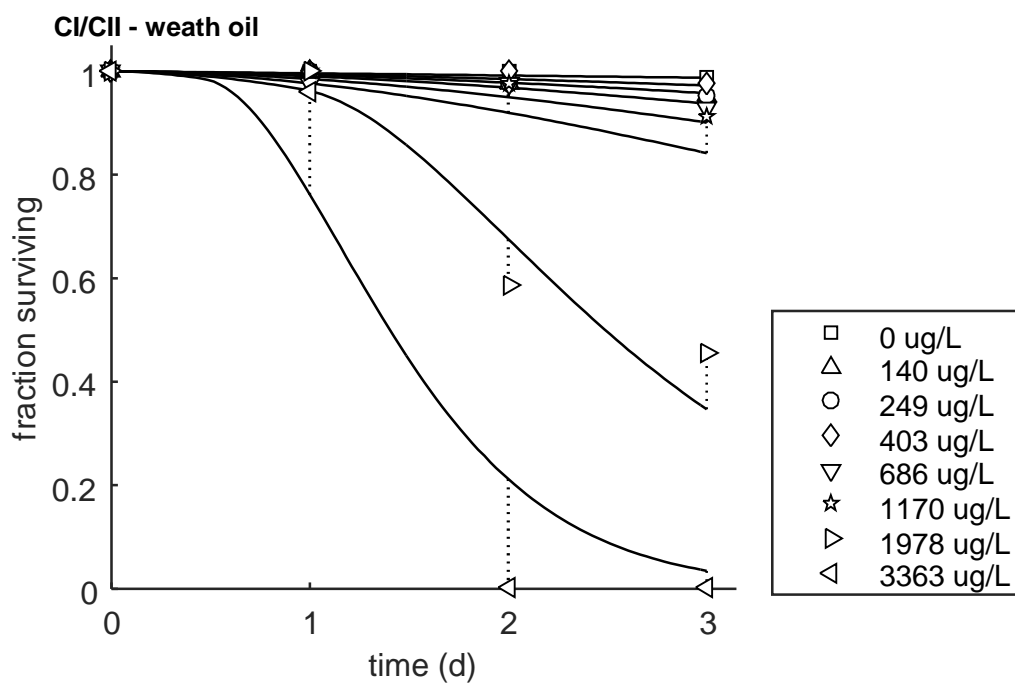


Figure S8. Fit to survival data for early copepodites exposed to weathered oil.

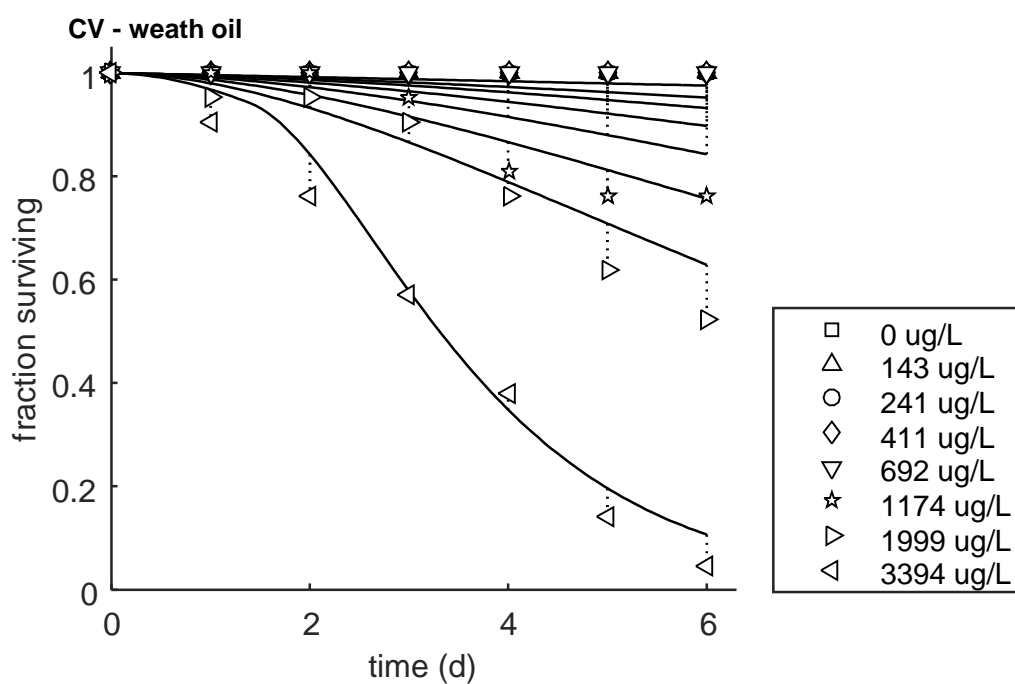


Figure S9. Fit to survival data for late copepodites exposed to weathered oil.



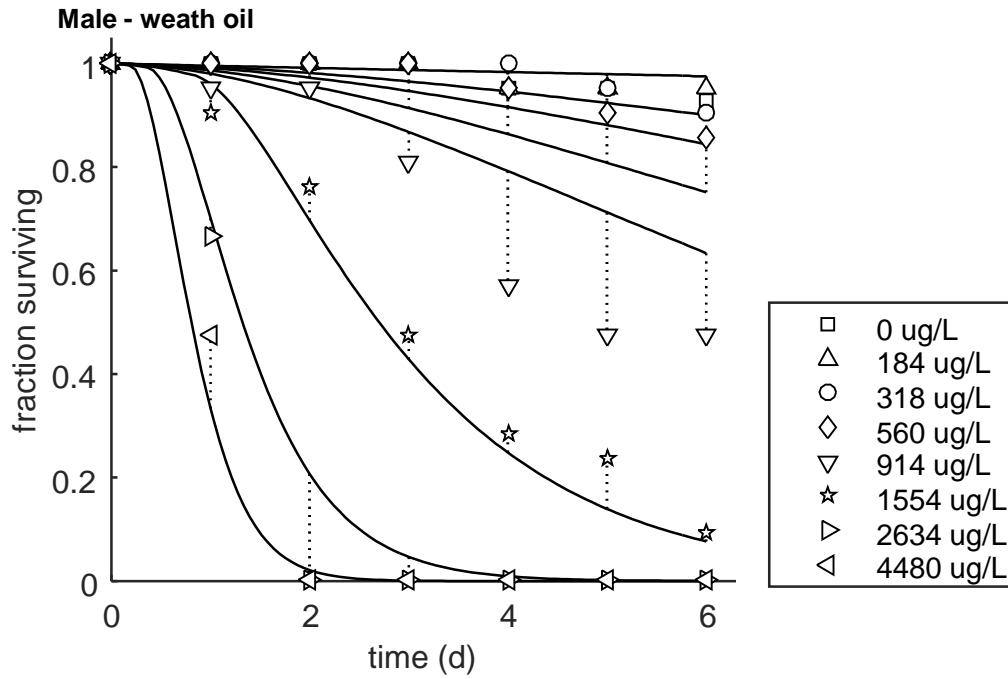


Figure S10. Fit to survival data for males exposed to weathered oil.

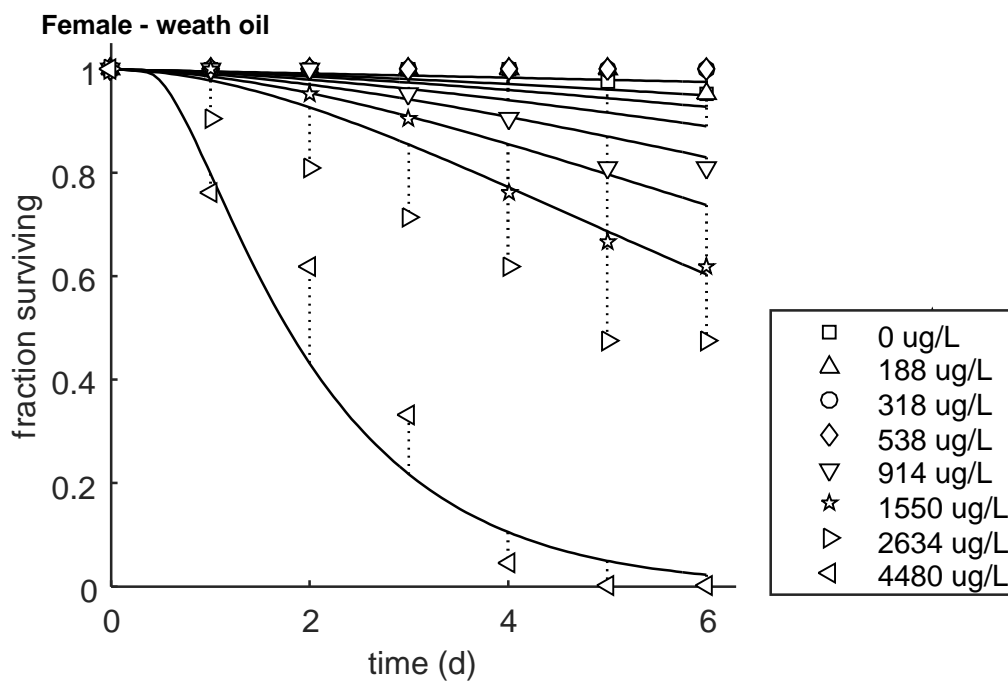


Figure S11. Fit to survival data for females exposed to weathered oil.

## Alternative analysis with IT

We only presented the analysis with the hypothesis of stochastic death in the main text; an alternative analysis with individual tolerance is presented here.

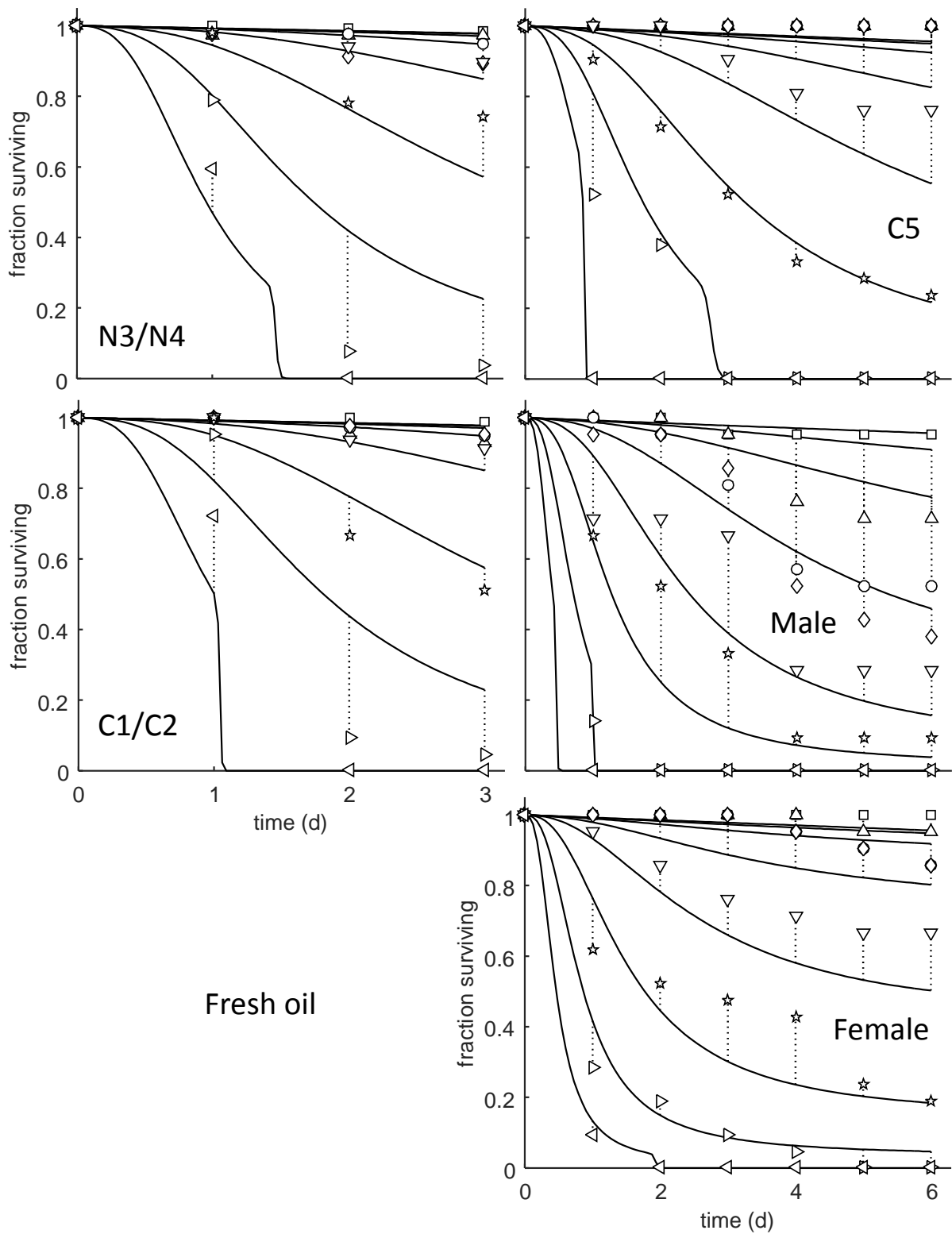


Figure S12. Fit to survival data, using the individual tolerance model, for different stages exposed to fresh oil.

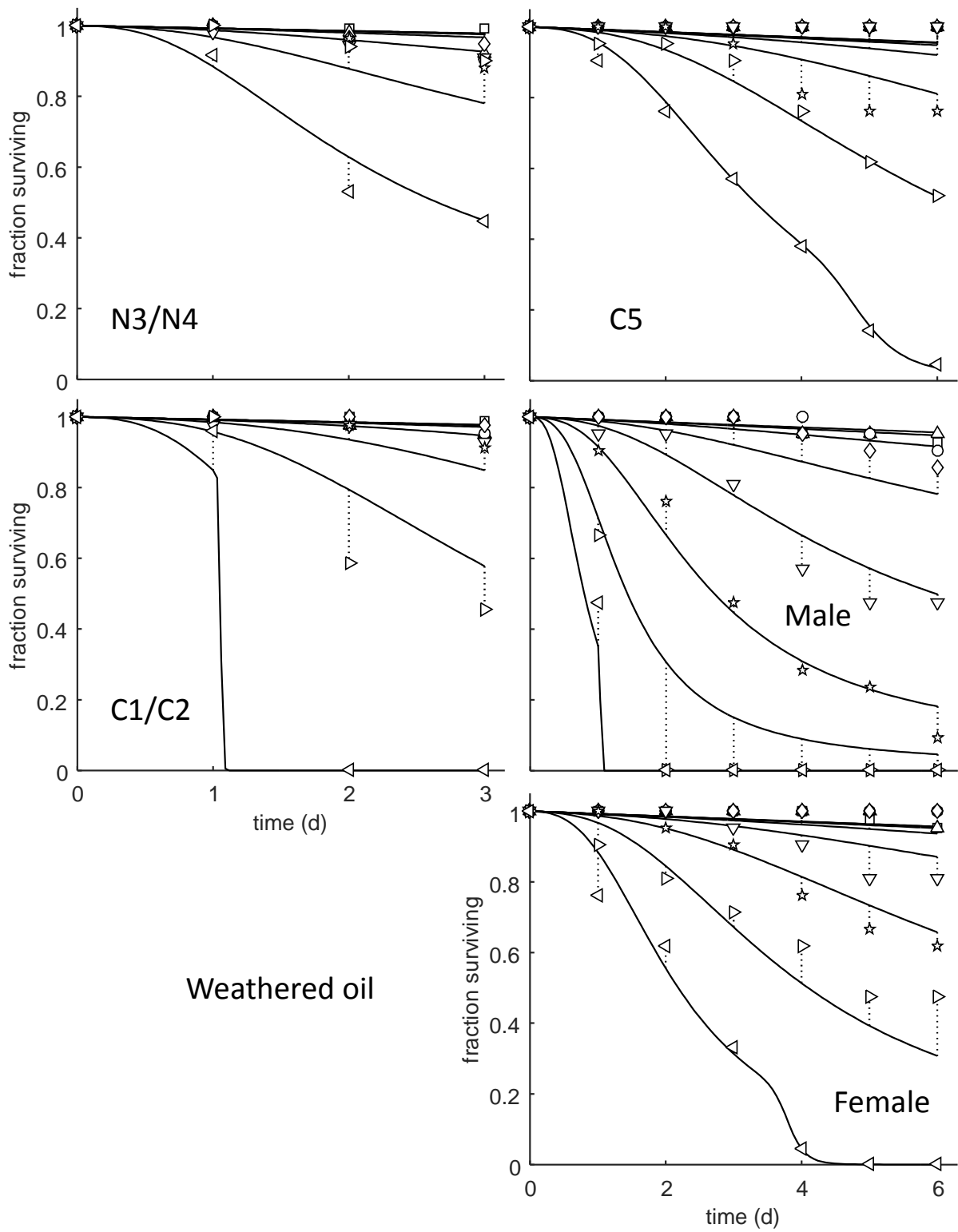


Figure S13. Fit to survival data, using the individual tolerance model, for different stages exposed to weathered oil.

Table S3. Parameter estimates with 95% confidence intervals for the common parameters of all data sets. Fitted with the individual tolerance model. Parameters that differ between each data set are shown in Fig. S14.

Symb.	Parameter	Estimate (95% CI)	Unit
$h_b$	Background hazard rate	$7.45 (5.20-10.1) \cdot 10^{-3}$	$d^{-1}$
$z_1$	Reference threshold (MoA 1)	1580 (1130-1960)	$\mu g L^{-1}$
$F_{s1}$	Fraction spread (MoA 1)	3.54 (3.13-4.07)	[-]
$k_{e2}$	Elimination rate (MoA 2)	0.905 (0.713-1.11)	$d^{-1}$
$z_2$	Threshold (MoA 2)	6600 (4600-8050)	$\mu g L^{-1}$
$F_{s2}$	Fraction spread (MoA 2)	1.01 (1.00-1.05)	[-]

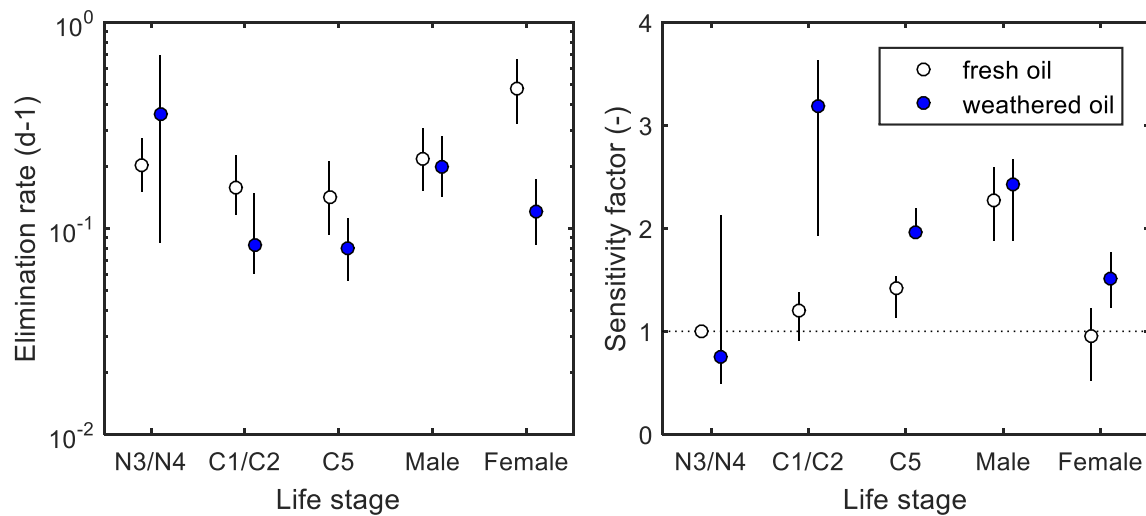


Figure S14. Estimated values, with 95% likelihood-based confidence intervals, for the fitted parameters that are allowed to differ between life stages. Common fitted parameters provided in Table S3. The sensitivity factor is relative to NIII/NIV exposed to fresh oil, which is set to 1.

In the stochastic-death fit, mechanism 2 was a slow mechanism with a low threshold. For the best individual-tolerance fit, mechanism 2 is a relatively fast mechanism with a very high threshold. Mechanism 2 is now responsible for additional mortality at the highest exposures.

## Raw data

First row: total hydrocarbon content in µg/L. First column: exposure time in hours. Remainder of the matrix is the number of survivors.

### NIII/NIV -fresh oil

	0	370.7	641.4	1063	1818	3096	5267	8968
0	129	35	40	46	49	50	52	57
24	129	34	39	45	48	49	41	34
48	128	34	39	42	46	39	4	0
72	127	34	38	41	44	37	2	0

### CI/CII - fresh oil

	0	370.7	641.4	1063	1818	3096	5267	8968
0	82	41	39	42	46	45	43	43
24	82	41	39	42	46	45	41	31
48	82	39	38	41	43	30	4	0
72	81	38	37	40	42	23	2	0

### CV - fresh oil

	0	353.6	612.4	1035	1751	2984	5072	8626
0	42	21	21	21	21	21	21	21
24	42	21	21	21	21	19	11	0
48	42	21	21	21	21	15	8	0
72	42	21	21	21	19	11	0	0
96	42	21	21	21	17	7	0	0
120	42	21	21	21	16	6	0	0
144	42	21	21	21	16	5	0	0

### Male - fresh oil

	0	344.0	581.4	987.4	1685	2874	4885	8312
0	42	21	21	21	21	21	21	21
24	42	21	21	20	15	14	3	0
48	42	21	20	20	15	11	0	0
72	40	20	17	18	14	7	0	0
96	40	16	12	11	6	2	0	0
120	40	15	11	9	6	2	0	0
144	40	15	11	8	6	2	0	0

### Female - fresh oil

	0	345.2	583.5	990	1691	2874	4884	8312
0	42	21	21	21	21	21	21	21
24	42	21	21	21	20	13	6	2
48	42	21	21	21	18	11	4	0
72	42	21	21	21	16	10	2	0
96	42	21	20	20	15	9	1	0
120	42	20	19	19	14	5	0	0
144	42	20	18	18	14	4	0	0

NIII/NIV -weathered oil

	0	139.8	249.0	402.9	685.7	1170	1978	3363
--	---	-------	-------	-------	-------	------	------	------

0	129	51	52	57	54	59	50	47
24	129	51	52	57	53	59	50	43
48	128	50	50	55	51	57	47	25
72	128	47	47	54	49	52	45	21

CI/CII - weathered oil

	0	139.8	249.0	402.9	685.7	1170	1978	3363
--	---	-------	-------	-------	-------	------	------	------

0	82	44	42	41	43	46	46	51
24	82	44	42	41	42	46	46	49
48	82	43	41	41	42	45	27	0
72	81	42	40	40	40	42	21	0

CV - weathered oil

	0	142.6	241.0	410.7	692.5	1174	1999	3394
--	---	-------	-------	-------	-------	------	------	------

0	42	21	21	21	21	21	21	21
24	42	21	21	21	21	21	20	19
48	42	21	21	21	21	21	20	16
72	42	21	21	21	21	20	19	12
96	42	21	21	21	21	17	16	8
120	42	21	21	21	21	16	13	3
144	42	21	21	21	21	16	11	1

Male - weathered oil

	0	183.7	318.1	560.0	913.8	1554	2634	4480
--	---	-------	-------	-------	-------	------	------	------

0	42	21	21	21	21	21	21	21
24	42	21	21	21	20	19	14	10
48	42	21	21	21	20	16	0	0
72	42	21	21	21	17	10	0	0
96	40	20	21	20	12	6	0	0
120	40	20	20	19	10	5	0	0
144	39	20	19	18	10	2	0	0

Female - weathered oil

	0	188.1	318.1	537.6	913.8	1550	2634	4480
--	---	-------	-------	-------	-------	------	------	------

0	42	21	21	21	21	21	21	21
24	42	21	21	21	21	21	19	16
48	42	21	21	21	21	20	17	13
72	42	21	21	21	20	19	15	7
96	42	21	21	21	19	16	13	1
120	41	21	21	21	17	14	10	0
144	40	20	21	21	17	13	10	0