Preliminary Data on Euphausiid Distribution and Growth in the Northern Gulf of Alaska.

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Abstract
Seasonal and interannual variability in distribution and population structure of two major euphausiids species *Thysanoessa spinifera* and *Euphausia pacifica* were studied in the northern Gulf of Alaska in 1998-2001. Other common euphausiid species were *T. inermis, T. longipes, T raschii and T. inspinata*. Euphausiid aggregations were related to water mass properties with *E. pacifica* frequently observed on outer shelf during years, when a strong shelf break front was developed. In contrast, *T. spinifera* was more abundant on the inner shelf in spring. Individual euphausiid growth rates were positive in first 4 days after capture, showing indications of body shrinkage under unfavorable food conditions later on. Intermoult periods averaged ~11-12 days at 5oC and ~7-8 at 8oC. Reproduction of *T. spinifera* seemed to coincide with the phytoplankton bloom in spring, while *E. pacifica* continued to spawn from May through October. Clutch size of *E. pacifica* tended to be higher in mid summer.

Methods

Euphausiids were collected at the 13 stations on the Seward Line using a 1-m MOCNESS with 0.5 mm mesh nets. The net were fished from 100 m to the surface in 20 m increments. Collected specimens were preserved in 10% formalin. To collect live animals for experiments, location and depth of euphausiid aggregations were identified with an HTI acoustic system operating at 42, 120, 240 and 420 kHz during night time acoustic survey along the Seward Line. The detected aggregations were fished using MOCNESS with 100 µm mesh nets. Euphausiids were gently removed from the catch and placed in individual 750 ml tissue flasks filled with seawater collected simultaneously at the site. The animals were maintained at the ambient mixed layer water temperature in the dark and were checked every 12-24 hours for moults and egg production. If an animal moulted the exuviae were removed and preserved in 5% formalin. If a female produced eggs, they were removed with a pipette and either preserved or incubated. At the end of each experiment all animals were preserved individually. The length of uropods were measured on all moults and preserved animals using a digitized measuring system (Roff & Hopcroft, 1986).

Map showing the location of the study site, the Seward Line stations (labeled GAK), and the Prince William Sound stations.

Table 1. Summary of moulting rates and egg production experiments

Meters Below Mean Sea Level

Cruise	Date	Station	Temperature (ºC)	# of euphausiids in experiment	
				moulting	egg production
HX241	04.06.01	GAK13	5	90	-
	04.10.01	CCSE	5	48	-
HX243	05.06.01	GAK13	5	60	-
	05.08.01	GAK9	5	60	-
	05.10.01	CCSE	5	60	-
HX246	06.30.01	GAK9	8	45	14
	07.02.01	GAK7	8	45	-
	07.07.01	CCSE	8	75	-
HX248	07.31.01	GAK12	8	50	18
	08.01.01	GAK9	8	50	-
	08.02.01	GAK6	8	50	10
	08.04.01	GAK1	8	-	28
HX252	10.13.01	GAK13	8	-	7
Total animals incubated				633	70

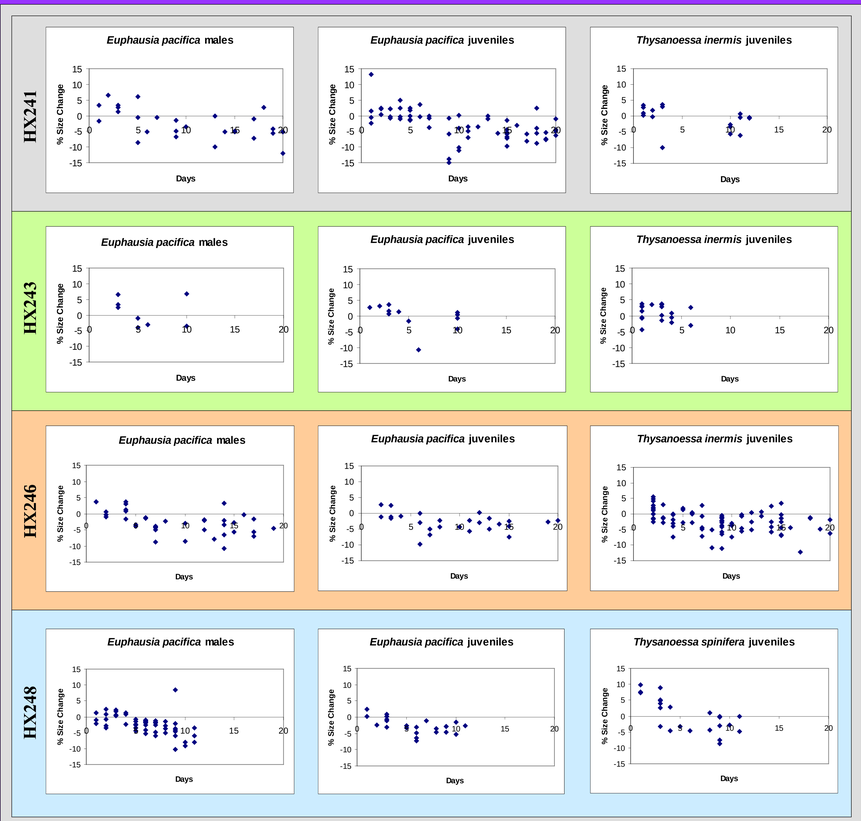

Figure 1.Relative size change of *E. pacifica*, *T. inermis* and *T. spinifera* shown as the percentage change in uropod length per day. Most of the euphausiids that moulted during the first 4 d following collection showed positive growth. Body shrinkage was observed for all species after day 5, reflecting unfavorable conditions in captivity, which could include limited food, low oxygen and high ammonia concentrations as well as restriction of animal movement.

Species	July	August	October
Euphausia pacifica	60.7(34.8) n=6	123.4(16.4) n=51	87.6(41.6) n=7
Thysanoessa spinifera	-	128(n/a) n=2	-

Table 4. Mean clutch size (95% confidence interval) of *E. pacifica* and *T. spinifera*. The gravid females of *E. pacifica* and *T. spinifera* first were observed in May, but actual spawning in captivity occurred from early July through October. The number of gravid females of *E. pacifica* and their clutch size appeared to be higher in August then in July.

Conclusions

1. The close agreement between consecutive intermoult periods at a given temperature as well as consistent percentage of daily moulting suggest that the experimental euphausiids moulted at the same rate.
2. The moulting rate appeared to be affected largely by temperature, rather then other environmental conditions such as food limitation.
3. In contrast, the size change expressed as % of uropod length change did not appeared to be affected by temperature, but controlled by other conditions, presumably food availability.
4. While the spawning season of *E. pacifica* in the Gulf of Alaska extended from early May to October, the maximum clutch size seemed to occur in August.

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Species	Temperature, ºC	Intermolt Period 1 (95% Confidence Interval), days	Intermolt Period 2 (95% Confidence Interval), days
Euphausa pacifica , males	5	11.2(0.92) n=19	14(n/a) n=1
	8	6.6(0.38) n=37	8.6(0.89) n=8
Euphausa pacifica juveniles	5	10.7(0.52) n=39	10.75(0.59) n=8
	8	6.8(0.47) n=20	7.7(1.4) n=3
Thysanoessa inermis males	5	11.2(1.04) n=5	10.7(2.87) n=3
	8	6.87(0.53) n=30	7.07(0.77) n=14
Thysanoessa inermis juveniles	5	9.75(1.24) n=8	13(n/a) n=2
	8	6.59(0.34) n=39	6.87(0.66) n=15
Thysanoessa spinifera juveniles	5	10.1(1.46) n=7	-
	8	7(1.09) n=8	7.5(n/a) n=2

Table 2.Consecutive intermoult periods(IP) of euphausiids measured directly from laboratory experiments. IP did not differ between seasons, locations nor between species, but were significantly (P<0.05) different for selected temperatures. There was no significant difference between consecutive IPs.

Temperature (ºC)	Daily moulting in % of population (95% confidence interval)	Equivalent IP
5	8.3(1.85) n=5	12.6(2.81)
8	11.6(1.22) n=5	8.6(0.79)

Table 3. Percentage of animals moulting and equivalent IP measured from shipboard experiments at 5ºC and 8 ºC (n – number of experiments). Moulting rates derived from observed numbers of successfully moulted animals were significantly (P<0.05) different between selected temperatures.

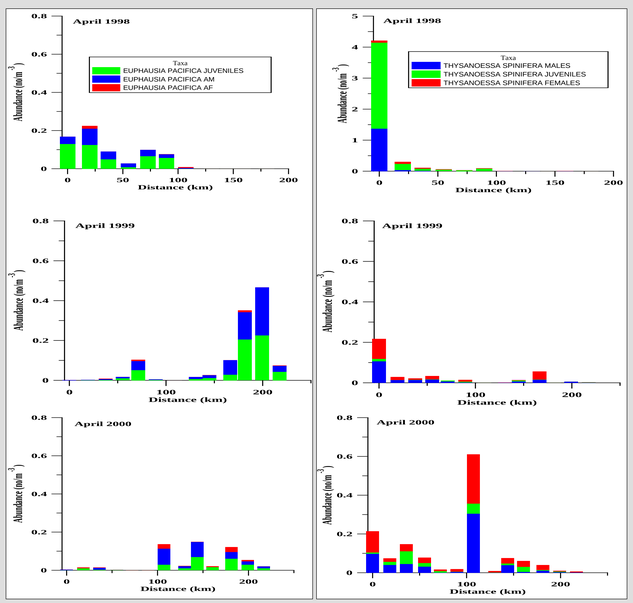

Figure 2. The cross-shelf distribution of *E. pacifica* and *T. spinifera* in April in 1998-2000. *E. pacifica* occurred on the outer shelf during years when a strong shelf break front was developed. *T. spinifera* was common on the inner shelf, but occasionally it formed large aggregations offshore.