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**SIZE-WEIGHT RELATIONSHIP OF MALE SNOW CRAB  
(Chionoecetes opilio) IN THE SOUTHWESTERN GULF OF  
ST. LAWRENCE**

by

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Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

## **INTRODUCTION**

Knowledge of the size-weight relationship is important in converting numbers into weights from size frequency distributions obtained from landings or sea samples. The body weight of snow crab may change in relation to molt stage and morphometric maturity.

In the present paper, length-weight relationships for male snow crab in the Southwestern Gulf of St. Lawrence are presented as a method to convert numbers into weights for biomass estimation based on trawl survey data.

## **MATERIAL AND METHODS**

Trawl survey using a 20m Nephrops trawl and experimental trap survey using 1.8 m X 1.8m (6' x 6') rectangular crab traps covered with small mesh were conducted in the Southwestern Gulf of St. Lawrence in two distinct periods (June-July and September-October). The following measurements were recorded on board for all crabs caught: sex, carapace width, chela height, missing appendages, carapace rigidity and color. When carapace rigidity and/or color were not sufficient to separate molt categories, further observations were made on setal development on the maxilla (Moriyasu and Mallet, 1986). Crabs with both claws intact and with less than three missing legs (total number of 507 crabs) were chosen for each molt category and brought to the laboratory for morphometric maturity determination (Conan and Comeau, 1986) and weight measurements. When any missing appendage occurred during sampling process, the sample was discarded, because the loss of body fluid might largely affect total body weight.

A predictive linear regression was fitted by least squares to each set of paired data for carapace width (mm) and wet body weight (g) after logarithmic transformation. The comparison of regression equations for carapace width-weight was made by an  $\rightarrow$  Anova and a graphic comparison of ellipses of joint 95% confidence region for slopes and elevations (Conan, 1978).

## **RESULTS AND DISCUSSION**

Samples were separated into three molt category (New, Intermediate and old). These molt categories were further divided by morphometric maturity.

(1) Category "New" was identified as crabs with soft to relatively soft shell (soft chela), which correspond to molt stage B-C2. This category, consisting of both morphometrically immature and mature crabs, was observed only in late spring to early summer in the Southwestern Gulf of St. Lawrence fishery. For the crabs in this category, weight loss caused by loss of body fluid is critical for correct weight measurement and occurs when appendages are lost or crabs are kept under ambient air temperature. Therefore, crabs in this category were carefully kept either in a holding tank or in a cooler with ice.

(2) Category "Intermediate" was identified as crabs with a clean carapace and a relatively soft posterior region of the carapace, which corresponds to molt stage C3. Molting activity was observed in aquarium to be very high between mid-April and mid-May. If the same phenomenon occurs in the S.W.Gulf of St. Lawrence, it would take 16-20 weeks for newly molted crabs to reach postmolt stage C3. Both morphometrically immature and mature crabs in this category were observed in the S.W. Gulf in late summer. In certain years, category "New" was observed in certain area in late summer but during our sampling no "New" crabs were observed. The identification of this category is very difficult when handling large samples on board. According to our experience, the presence of macro-epizoites on the carapace especially hard tube worm (*Spirorbis* spp.) can separate this category from the category "old" in the S.W.Gulf.

(3) Category "Old" was identified as crabs with hard shell (with a variety of epizoites on the carapace such as hard tube worm, tube dwelling polychaete, bryozoan, hydroid etc.) which corresponds to molt stage C4. Among the crabs in this category, more than 99.0% were identified as morphometrically mature. This category was observed in June-July and Sep.-Oct. samples.

Carapace width-weight relationship was therefore established for six sets of data i.e. New mature (June-July), New immature (June-July), Intermediate mature (Sep.-Oct.), Intermediate immature (Sept.-Oct.), Old (June-July) and Old (Sept.-Oct.).

Statistical information of regression parameters and graphic comparison of regressions by ellipses of joint 95% confidence region are showed in Table I and Figures 1,2 and 3. The two group comparison between immature and mature of "New" category showed that the slopes are not significantly different (Figures 1 and 2) but the elevations are significantly different. Both New-immature and New-mature differ significantly from other molt categories (Figure 1). Carapace width-weight relationships for those two groups were described as follows:

$$\text{New (Immature)} : \text{Log}_e(\text{Weight}) = -9.9486 + 3.4067 \text{ Log}_e(\text{Carapace-width}) \quad r = 0.9548$$

$$\text{New (Mature)} : \text{Log}_e(\text{Weight}) = -9.8186 + 3.3983 \text{ Log} (\text{Carapace-width}) \quad r = 0.9803$$

The two group comparison between immature and mature of "Intermediate" category does not show significant difference in the slopes but shows significant difference in the elevations (Figure 1 and 2). Intermediate-mature group does not differ significantly from either Old (June-July) or Old (Sep-Oct) group (Figures 1 and 3). Carapace width-weight relationships for those two groups were described as follows:

$$\text{Intermediate (Immature)}: \text{Log}_e(\text{Weight}) = -7.5117 + 2.8990 \text{ Log}_e(\text{Carapace width}) \\ r = 0.9869$$

$$\text{Intermediate (Mature)}: \text{Log}_e(\text{Weight}) = -8.0502 + 3.0541 \text{ Log}_e(\text{Carapacewidth}) \\ r=0.9866$$

The comparison between "Old" category sampled in June-July and those sampled in September-October does not show any significant difference. Carapace width-weight relationship for those two groups and overall relationships for "Old" category are described as follows:

Old (June-July):  $\text{Log}_e(\text{Weight}) = -8.3258 + 3.1183 \text{ Log}_e(\text{Carapace width})$   $r = 0.9752$

Old (Sep.-Oct.):  $\text{Log}_e(\text{Weight}) = -8.3237 + 3.1182 \text{ Log}_e(\text{Carapace width})$   $r = 0.9774$

Old (Combined):  $\text{Log}_e(\text{Weight}) = -8.2709 + 3.1058 \text{ Log}_e(\text{Carapace width})$   $r = 0.9768$

Significant differences between morphometrically mature and immature groups for both "New" and "Intermediate" categories can be explained by the morphometrical change in claw weight at molt to morphometric maturity. Crabs in the "New" category (molt stage B-C2) should be treated separately from other categories when establishing size-weight relationship until crabs reach molt stage C3 (i.e. Intermediate category). If a size-weight relationship is required before that period (mid-August-September in the S.W. Gulf of St. Lawrence), it is very important to establish the relationship periodically based on morphometric maturity and on molt category (Old and New) in order to avoid bias caused by continuous weight increase during this period.

Once crabs reach molt stage C3 i.e. "Intermediate" category, immature group should be separated from mature group, while Intermediate-mature group can not be separated from Old category based on size-weight relationship. This does not necessarily mean that crabs in "Intermediate" mature group have the same meat condition as those in the "Old" category because the results of meat yield tests in the fall generally show lower percentage compared to the early spring when the catch consists mainly of crabs from the "Old" category.

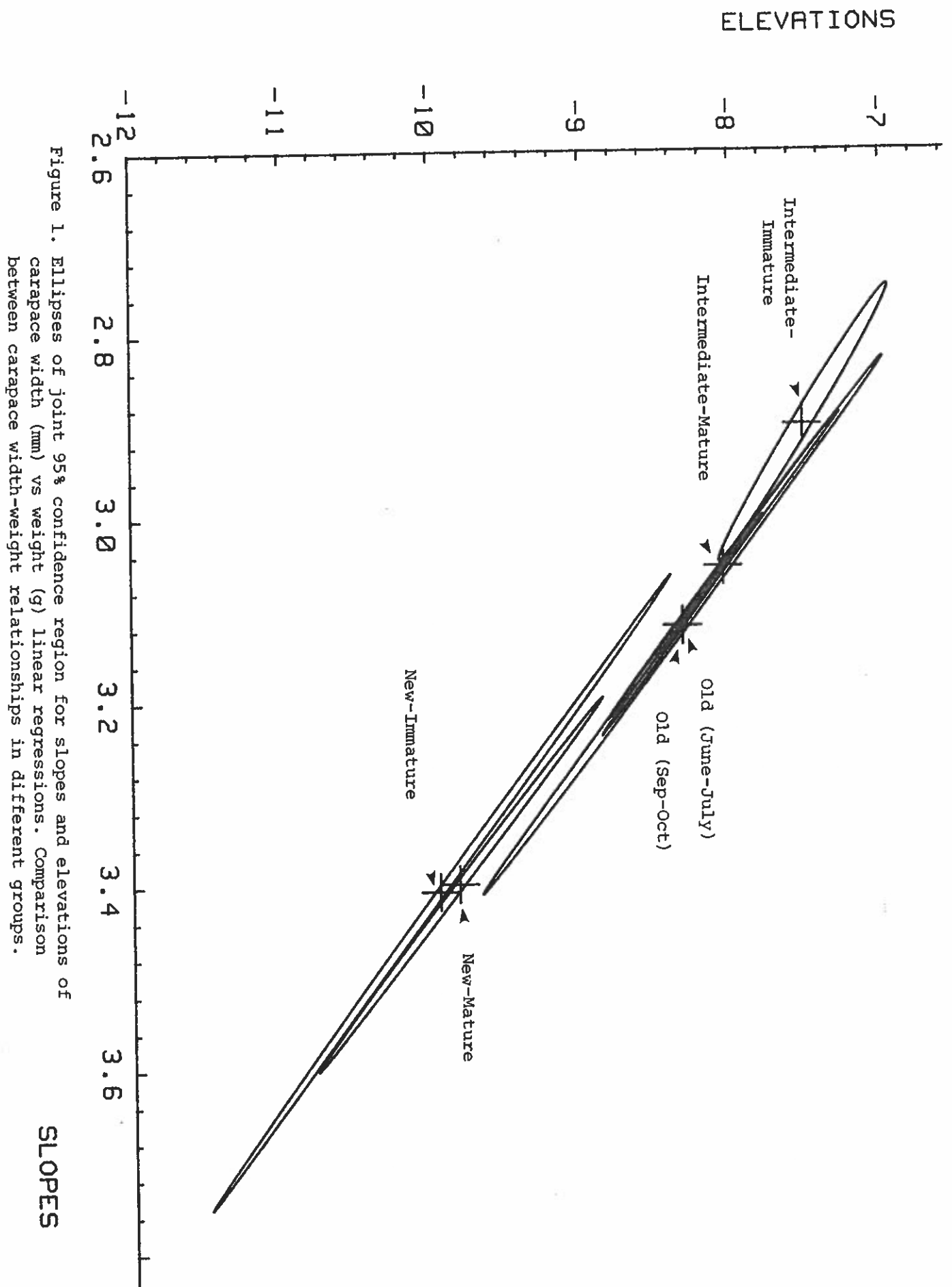
In a crab fishery where the catch consists mainly of newly molted immature males and/or "Intermediate" immature males, the fishery cannot fully benefit from the molting. Those crabs are harvested not only before reaching commercially acceptable level of meat yield (20%) but also before reaching morphometric maturity for which weight increment is significantly higher than for normal molt.

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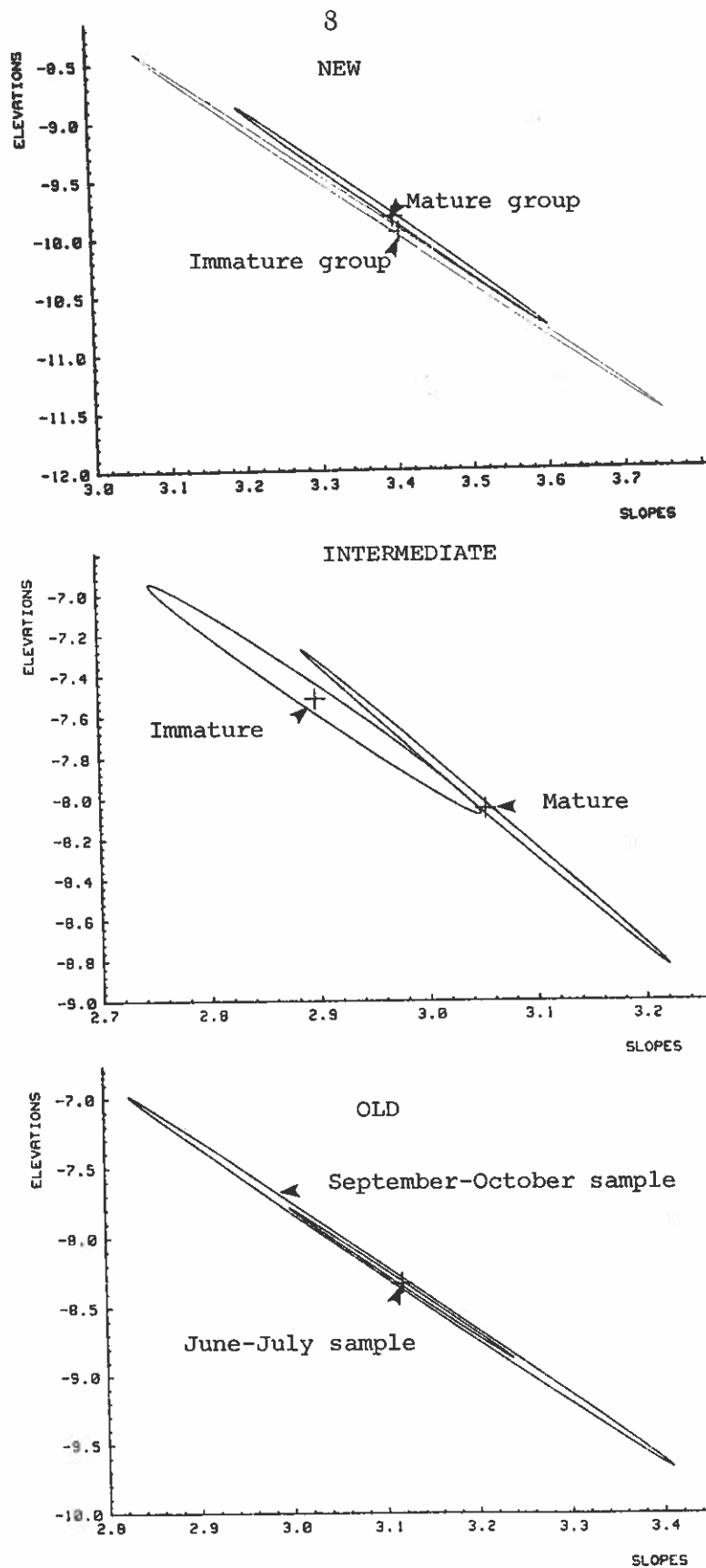


Figure 2. Ellipses of joint 95% confidence region for slopes and elevations of carapace width (mm) vs weight linear regressions. Comparison between two groups of the same molt category. Two ellipses do not intersect each other for NEW and INTERMEDIATE categories.

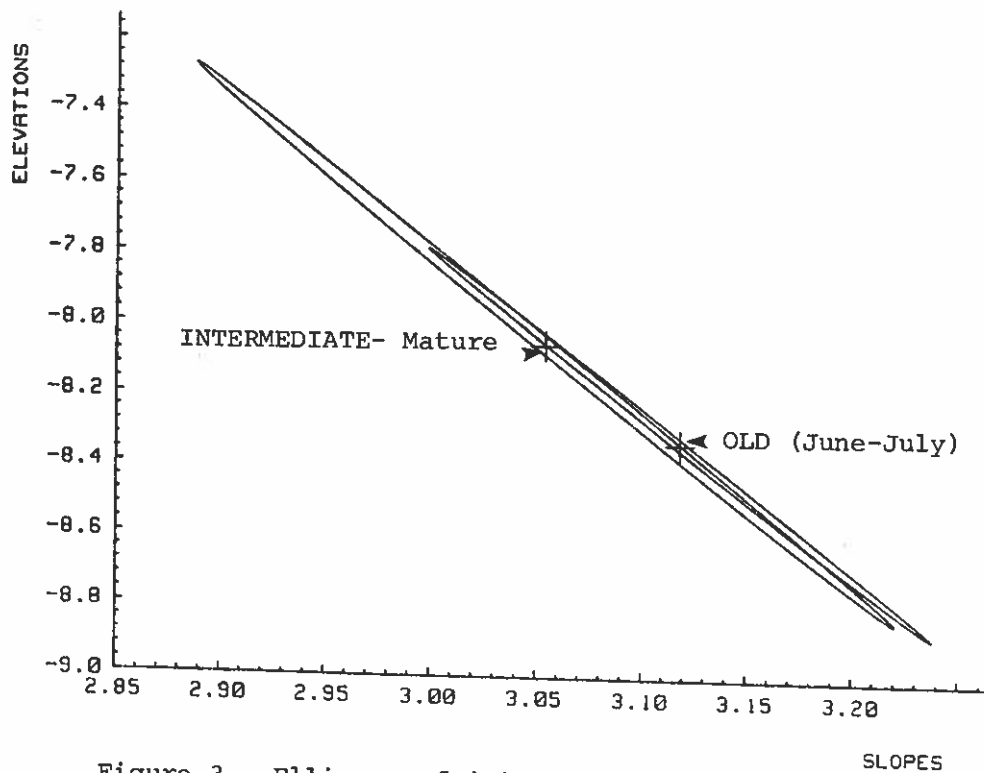
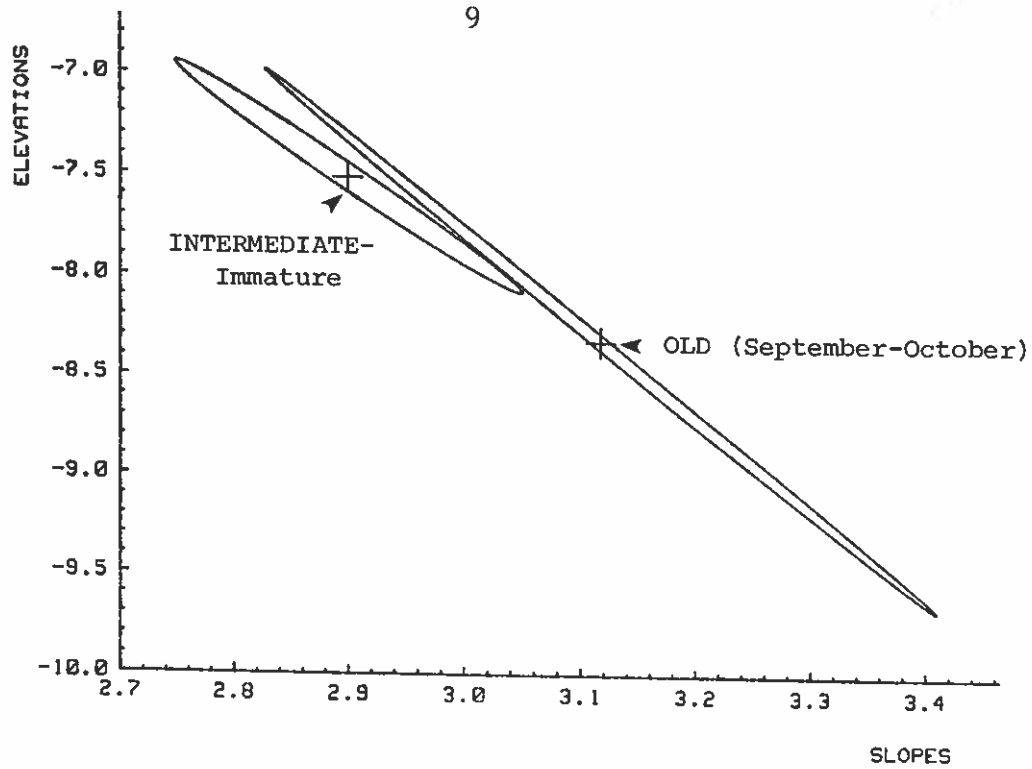


Figure 3. Ellipses of joint 95% confidence region for slopes and elevations. Comparison between two groups of different category. Two ellipses do not intersect between Intermediate-Immature and Old (Sept-Oct). Two ellipses intersect between Intermediate-Mature and Old (June-July).



Table 1. Regression equations of logarithm of carapace width (mm) vs logarithm of total wet body weight (g) for male snow crab (*Chionoecetes opilio*) in the S.W. Gulf of St. Lawrence snow crab fishery.

	NEW *		INTERMEDIATE**		OLD	
	Immature	Mature	Immature	Mature	June-July	Sept.-Oct.
a	-9.94860086359	-9.81860685087	-7.51166562724	-8.05017662191	-8.32582126997	-8.32367397681
b	3.40670320408	3.39834915987	2.89904172913	3.05406111895	3.11830580109	3.11820967324
r	0.954806603714	0.980364448427	0.986923638926	0.986578932578	0.975247417353	0.977433300718
N	62	73	68	59	214	37
Σx	279.306772858	342.735511364	238.843825818	280.19614109	973.016363311	170.473300684
Σx <sup>2</sup>	1258.86997912	1611.32692149	906.709270144	1310.17912999	4428.54669882	786.183580571
Σxy	1509.88478973	2110.66625001	834.473053659	1745.73871522	5708.40252766	1032.52106924
Σy <sup>2</sup>	1814.59573098	2775.29361001	832.609228577	2331.51581566	7375.19430559	1358.82000208
Σy	334.702024475	407.976636993	211.671617648	372.725542869	1252.4368185	223.59555808
Size range (mm)	71 - 119	65 - 135	14 - 105	67 - 132	63 - 130	63 - 130
Weight range (g)	98 - 542	56 - 902	3 - 414	113 - 920	106 - 1020	106 - 1020

\* "NEW" category observed only during June-July sampling

\*\* "INTERMEDIATE" category observed only during September-October