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An Assessment of the Conversion Factors used in the Division 4VsW Skate Fishery

by

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Abstract

A combination of closures of traditional groundfish fisheries on the Scotian Shelf and the opening of markets for skate wings resulted in the development of a directed skate fishery in 1994. When industry met with DFO that year to review the fishery, one of their concerns was that the 4:1 conversion factor (25% yield) used by DFO to convert wing weight to round weight was inappropriate. Industry provided evidence from daily product yield records to support this point of view, these were accepted by DFO and an interim conversion factor of 2.7:1(37 % yield) was enacted. Improved yields in 1995 and 1996 were realized as industry's experience with processing skate increased. Also a conversion from a combination of machine cutting and handcutting of wings to mostly handcutting wings resulted in improved yields. In 1997, at the request of RAP a study was initiated to investigate and document the present yields in fishery. This analysis indicated that a conversion factor of 2.2:1 (45% yield) would more accurately reflect the yields now realized by industry. These yields appear to be stable across season and the length range of skate caught by industry. At present all vessels prosecuting the fishery are hand cutting their product. Yields from machine cut fish will differ and may require different conversion factors.

Résumé

La fermeture de pêches traditionnelles du poisson de fond sur le plateau néo-écossais et l'ouverture simultanée de marchés pour les ailes de raie ont donné lieu à l'apparition d'une pêche dirigée de la raie en 1994. Lorsque les représentants de l'industrie ont rencontré les fonctionnaires du MPO cette même année pour faire l'examen de la pêche, ils ont indiqué que le facteur de conversion de 4:1 (rendement de 25 %) utilisé par le ministère pour convertir le poids des ailes en poids vif était inexact. Ils ont présenté les données de leurs registres de production quotidiens pour appuyer leur point de vue qui a été accepté par le MPO et un facteur de conversion provisoire de 2,7:1 (rendement de 37 %) a été adopté. Les rendements ont augmenté en 1995 et 1996 suite à l'expérience acquise dans le domaine de la transformation de la raie. De plus, l'utilisation presqu'exclusive du tranchage manuel en lieu d'une combinaison du tranchage à la machine et à la main a donné lieu à une augmentation du rendement. En 1997, à la demande du PCR, une étude a été réalisée dans le but d'examiner et d'évaluer les rendements de cette pêche. L'analyse a montré qu'un facteur de conversion de 2,2:1 (rendement de 45 %) refléterait de façon plus exacte le rendement atteint par l'industrie. Les rendements semblent stables tout au long de la saison et pour toute la gamme des longueurs des raies capturées. Actuellement, tous les bateaux qui pratiquent cette pêche procèdent à un tranchage manuel. Les rendements obtenus par tranchage à la machine seraient différents et pourraient exiger un autre facteur de conversion.

Introduction

In 1994, a combination of closures of traditional groundfish fisheries on the Scotian Shelf and openings in the markets for skate wings resulted in the development of a directed skate fishery. By mid-July, four vessels had landed over 1200 t. As a result of concerns within DFO, this rapidly developing fishery was closed temporarily because no harvesting plan was in place and it was not re-opened until scientific advice was reviewed. A conservative exploitation rate of 10% was chosen since these were thought to be slow growing species. Based on the 10 year mean minimum trawlable biomass from the July groundfish research survey in Div. 4VsW **(Figure 1)** of 12,000 t., a catch of 1200 t. was advised. Since this tonnage had already been reached by the fishery and a continuing need existed for biological information, an additional 800 t. was allocated in mid-August to conduct joint industry/science surveys. One of the objectives of these surveys was to review the conversion ratio of wing weight to round weight used by DFO (Simon and Frank, 1995).

During the September 1996 Regional Assessment Process (RAP) one of the research recommendations for skate was "that the changes that have occurred in the conversion rates be documented and that independent estimates of the present yields of product (wings) to round weight be investigated" (Sinclair 1997).This paper attempts to summarize the history of the conversion factor used during the fishery and whether it is at present appropriate.

Historical Estimates

1994

A directed fishery for skates began on the Grand Banks (Div. 3LNO & Div. 3Ps) in 1994, with thorny skate (*Raja radiata*) the primary species caught (Kulka et al. 1996). No attempts were made to record landings by species. Roy Russell (pers. comm.), a DFO employee in Fisheries Management from the Newfoundland Region, indicated that a conversion factor of 4:1 was used in the 1994/1995 fisheries to calculate round weights for all species. Though not able to confirm the source for its initial use the 4:1 is the same value for wings, skin on, listed in a preliminary STACAC (Statistical Coordinating Committee for the Atlantic Coast) Standards Document No. 2. (Standard Conversions, All Species) (June 1984).

When the Div. 4VsW fishery began in 1994, DFO in the Scotia Fundy Region used this same conversion factor of 4:1 (25% yield) round weight to wing weight as Newfoundland.

After the closure of the fishery in July, industry meet with DFO to discuss the development of the fishery. One of the points made by industry was that in their opinion the current yield estimates used by DFO was inappropriate. To support their opinion industry provided DFO with daily product yield records from the two plants where fish were landed. The daily records gave only a single value, total wing weight / total round

weight, no individual fish weights. No information was available on the composition of species landed. While two of the vessels fishing were hand cutting their product at sea, the other two vessels were landing their fish for processing by machine at the two plants. Based on these plants reports yields were at least 37% and could be as high as 42% **(Table 1)**. It was felt that an interim value of 37% be adopted in August and that it be reviewed following the survey. Subsequently, landings were adjusted to reflect the new rate for the entire year.

When the fishery resumed in August, a small sample of fish were machine cut at sea yielding only 32.8% product, while yields from handcut fish at sea was 44.8%. Species identification though was still problematic and without individual fish records any yield differences by length would not be identifiable. No further changes in the conversion factor were made that year (Simon and Frank 1995).

1995 / 1996

The question of species composition was resolved in 1995 through a combination of observer and DFO personnel reports. Overall, greater than 95% of the landings were winter skate (*Raja ocellatta*) though in the fall of that year some landings contained upwards of 22% thorny skate. Conversion factors were not raised as an issue again until late 1995 when industry asked that it be reviewed in 1996. No action was taken at that time. In 1996, one additional vessel converted to hand cutting. Industry reported that yields by hand cutting had improved to 45.6% **(Table 1)** while yields by machine cutting were also reported to have increased. These improvements and the indication that the remaining vessel would convert to hand cutting in 1997 indicated that the 2.7:1 conversion factor be reviewed (Simon and Frank 1996).

In 1996 the Newfoundland Region adjusted their skate conversion factor to 2.7:1 to reflect the factor used in Scotian Fundy Region.

1997

To review the conversion factors in use it was felt that independent detailed samples be collected throughout the year so that seasonal , sex, and length differences could be considered.

A detailed sample of 305 winter skates was measured during March of 1997 that was collected during routine commercial fishing operations from the Eastern Shoal area of Banquereau Bank. This sample was processed at the same Plant 1 as the 1994 conversion factor samples. Total length, sex, round weight and wing weight were collected. Electronic scales which rounded to the nearest gram were used. A DFO port technician recorded the sample while the person who hand cut the fish was a plant worker who routinely processed skate for market. The results from this sample are given in **Figure 2**. Overall yield was 44.9%. No differences by length or sex were evident.

In June of 1997 a detailed sample of 164 winter skate were collected from the same area of Banquereau Bank. This sample was landed at a different fish plant (Plant 2) from the March sample and the individual who cut the wings was a fisherman experienced in handcutting skate. The electronic scales used were less sensitive and rounded to 5 grams. Overall yield was 47.6%**(Figure 3)**. No significance differences were evident between sexes or length. Standard error was higher than the March sample. Four thorny skates were also measured from this sample with a yield of 43.4%

Due to the cessation of the fishery during the summer, due to poor market conditions, no further samples were available during the year. For seasonal comparison a small sample of 41 winter skate that were measured at sea in September of 1994 was analyzed **(Figure 4).** These fish were cut by a regular crewmember and recorded by a fisheries observer during one of the industry surveys. Fifteen kilogram spring scales which are accurate to 10 grams were used. The overall yield was 44.9%. Again no length or sex differences were observed.

Analysis of Results

An analysis of covariance was used to test the similarity between the two 1997 samples and the 1994 handcut sample.

The presence of a significant interaction between experiment 2 (i.e. cutter 2) and wing weight as a covariate, when experiment is non-significant as a main effect indicates that cutter 2 had a different yield rate which varied with the wing size from the others **(Table 2, Figure 5)**. This analysis resulted in the lowest mean square value. The estimate of -0.115 corresponds to a yield rate approximately 2.5% higher than the other two experiments.

Wing wt.		Expt. 1,3	Expt. 2
1 kg.	rw*	2.31	2.20
	yield	43.3%	45.6%
3 kg.	rw*	6.47	6.28
	yield	46.4%	47.8%

* round weight

The significant positive intercept is consistent with slightly higher yields from larger fish. As shown above, the predicted round weights from the ANCOVA model corresponding to yields of 1 and 3 kg. wing weights indicate that the predicted yield rate ranges from 43.3% to 47.8% respectively.

During the RAP discussions it was recommended that a simple conversion factor (multiplier) be based on a model with no intercept. This analysis **(Table 3)** also detected a significant interaction for cutter 2 with wing size with no other significant effects involving the experiment (cutter). This results in a conversion factor of 2.22:1 for cutters 1 & 3 representing a yield of 45.1%. The estimate of -0.12 for the cutter 2 * wing weight interaction corresponds to a yield rate approximately 2.6% higher than the other two experiments.

Discussion

The directed skate fishery in Div. 4VsW has only existed for four years. Concern has been expressed by DFO on the long-term viability of this fishery and the FRCC has progressively reduced the allocation from the 2000 t. in 1994, to 1600 t. in 1995 and 1996 and 1200 t. for the 1997 fishing season. Improved information on the species composition of landings, discards and basic biology of skates have only been acquired with the cooperation of the fishers involved. Observer coverage was as high as 33% of all trips during 1996, at the request of the fishers. As more information has been collected, modifications to the yearly fishing plans have been enacted to help conserve the stock. The 2.7:1 conversion factor was enabled as a conservative interim values, until more independent, accurate information could be collected.

One of the areas of concern by DFO was the targeting of the larger individuals of the population. It was recommended that industry attempt to expand their markets so that a wider length range be prosecuted. This could result in a higher percentage of the smaller thorny skate in the landings. If the bycatch of thorny skates increases, the conversion factor may need to be reviewed again to reflect this change.

Because cutter 2 was selected as an above average cutter it was determined that the yields of the other two cutters would better represent the current practices in the fishery. The corresponding conversion factor would be 2.22:1, representing a yield rate of 45%. A change in the nominal yield rate from the current value of 37% to 45% would result in an extra 96 t. of wings landed from a 1200 t. fishery.

At present all vessels prosecuting the fishery are hand cutting their product. This would need to become a requirement of any licensing agreement due to the differences in yield for the two methods.

Acknowledgments:

I would like to thank Paul Fanning for his help with the ANCOVA model.

References:

Kulka D.W. , E.M. DeBlois and D.B. Atkinson 1996. Non-traditional groundfish species on the Labrador Shelf and Grand Banks - Skate. DFO Atlantic Fisheries Research Document 96/98.

Simon J.E. and K.T. Frank 1995. An assessment of the skate fishery in Division 4VsW. DFO Atlantic Fisheries Research Document 95/71.

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Sinclair M. 1996. Fall Meeting Scotian Shelf Subcommittee 10-13 September 1996 Regional Advisory Process(RAP) of the Maritimes Region.

Table 1. Conversion rates of skates (species unknown) as calculated from the 1994 and 1996 fisheries.

Year	Method	Weight(kg.) Round	Wings	Yield (%)	Data Source	
1994	Hand	184	83	44.8	survey	Individual weights at sea
"	Machine	555349	233890	42.1	Plant 1	Total weight (on land)
"	"	569	210	36.9	Plant 2	"
"	"	2544	835	32.8	survey	" (at sea)
1996	Hand	415293	189210	45.6	Plant 1	Total weight (on land)

Table 2. Descriptive statistics generated by the analysis of covariance used to test the similarity of the three yield experiments (March 97(1), June 97(2) and September 94(3)) with the lowest mean square value.

General Linear Model

Between-Subjects Factors

		Value Label	N
EXPT	1.00		308
	2.00		163
	3.00		41

Descriptive Statistics

	EXPT	Mean	Std. Deviation	N
TOTAL	1.00	2.7811	1.0093	308
	2.00	3.9153	.9488	163
	3.00	4.8659	1.7393	41
	Total	3.3091	1.2704	512

Tests of Between-Subjects Effects

Dependent Variable: TOTAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Corrected Model	811.461[b]	5	162.292	6176.200	.000	30881.002	1.000
Intercept	.266	1	.266	10.128	.002	10.128	.888
EXPT	8.067E-02	2	4.034E-02	1.535	.216	3.070	.326
WING	480.183	1	480.183	18273.863	.000	18273.863	1.000
EXPT * WING	.522	2	.261	9.924	.000	19.848	.984
Error	13.296	506	2.628E-02				
Total	6431.302	512					
Corrected Total	824.757	511					

a. Computed using alpha = .05

b. R Squared = .984 (Adjusted R Squared = .984)

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Noncent. Parameter	Observed Power[a]
						Lower Bound	Upper Bound		
TOTAL	Intercept	.154	.075	2.046	.041	6.131E-03	.301	2.046	.533
	[EXPT=1.00]	-.114	.080	-1.430	.153	-.271	4.263E-02	1.430	.298
	[EXPT=2.00]	-4.109E-02	.092	-.446	.656	-.222	.140	.446	.073
	[EXPT=3.00]	0[b]	.	.	.	.	.	.	.
	WING	2.156	.032	66.664	.000	2.093	2.220	66.664	1.000
	[EXPT=1.00] * WING	3.853E-02	.038	1.010	.313	-3.642E-02	.113	1.010	.172
	[EXPT=2.00] * WING	-.115	.043	-2.681	.008	-.199	-3.060E-02	2.681	.763
	[EXPT=3.00] * WING	0[b]	.	.	.	.	.	.	.

a. Computed using alpha = .05

b. This parameter is set to zero because it is redundant.

Table 3. Descriptive statistics generated by the analysis of covariance used to test the similarity of the three yield experiments (March 97(1), June 97(2) and September 94(3)) with the intercept set to zero.

General Linear Model

Between-Subjects Factors

		Value Label	N
EXPT	1.00		308
	2.00		163
	3.00		41

Tests of Between-Subjects Effects

Dependent Variable: TOTAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Model	6417.723[b]	3	2139.241	80187.709	.000	240563.128	1.000
WING	5325.716	1	5325.716	199630.131	.000	199630.131	1.000
EXPT * WING	5.073	2	2.537	95.086	.000	190.171	1.000
Error	13.579	509	2.668E-02				
Total	6431.302	512					

a. Computed using alpha = .05

b. R Squared = .998 (Adjusted R Squared = .998)

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
TOTAL	WING	2.219	.011	201.892	.000	2.197	2.240
	[EXPT=1.00] * WING	4.172E-03	.013	.320	.749	-2.142E-02	2.977E-02
	[EXPT=2.00] * WING	-.120	.013	-9.323	.000	-.145	-9.460E-02
	[EXPT=3.00] * WING	0[b]	.	.	.	.	.

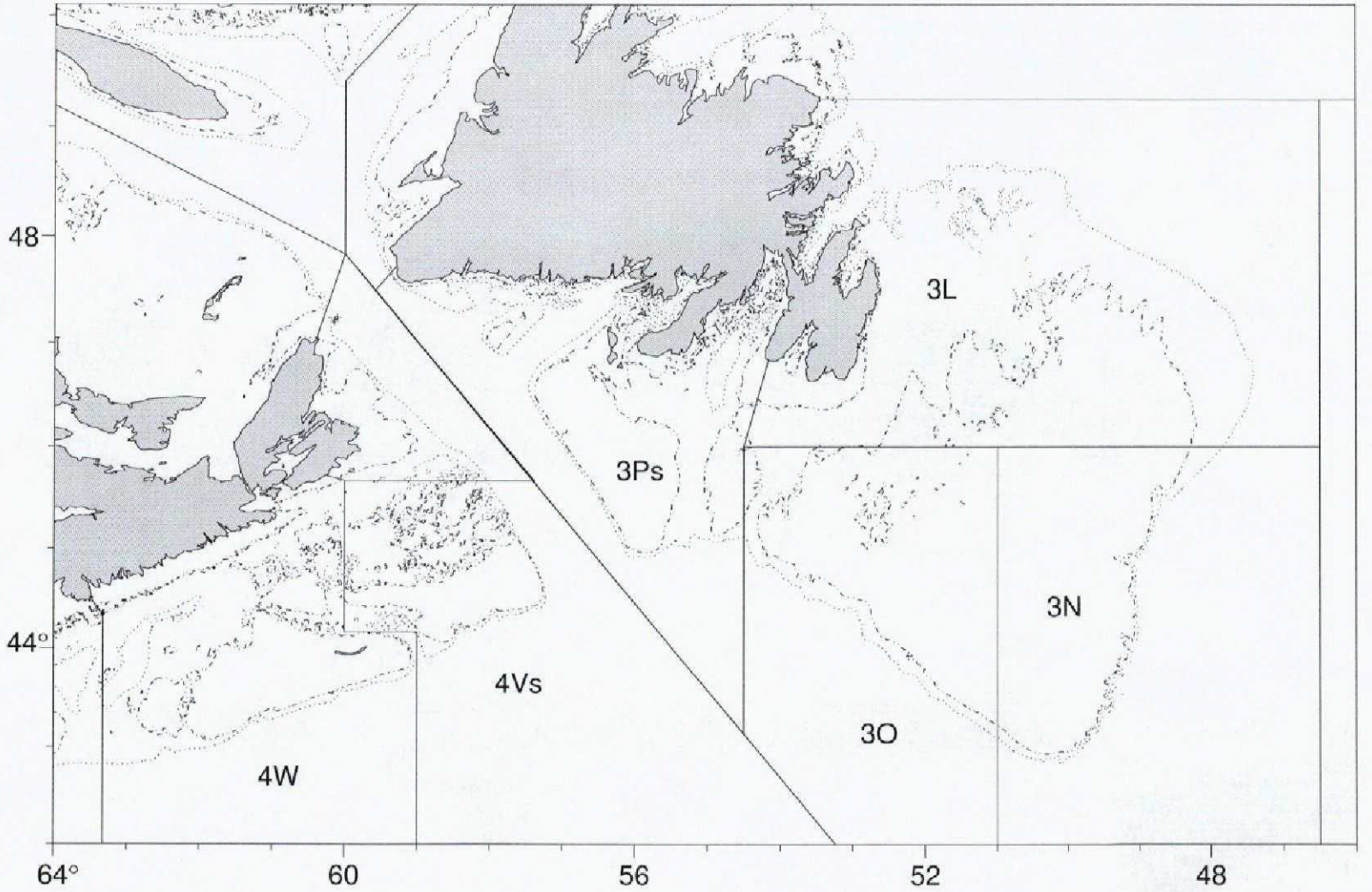
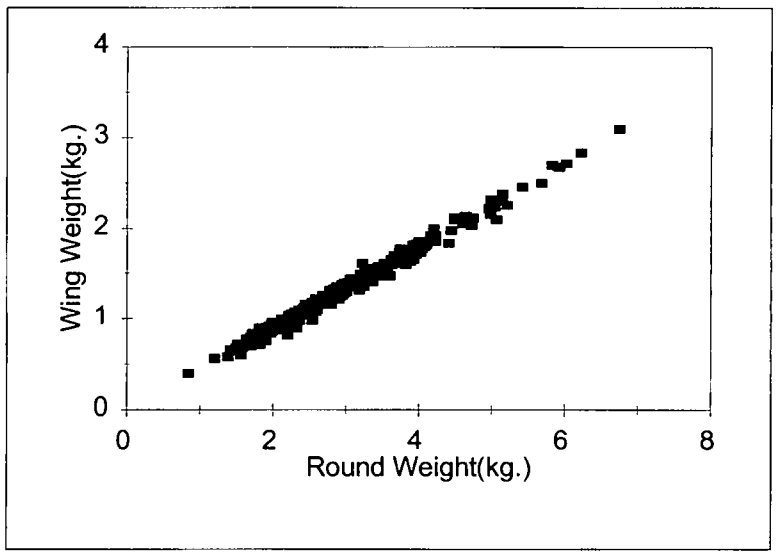


Figure 1 Geographic display of the Div. 4VsW winter skate fishery and the Div. 3LNOPs thorny skate fishery.

Figure 2 Conversion rates from winter skate during March, 1997 in Div.4Vs.

Length	%	n
50-59cm	46.16	5
60-69cm	44.74	143
70-79cm	45.02	123
80-89cm	44.84	32
90-99cm	45.22	5
Males	44.86	140
Females	44.92	168
all	44.89	308

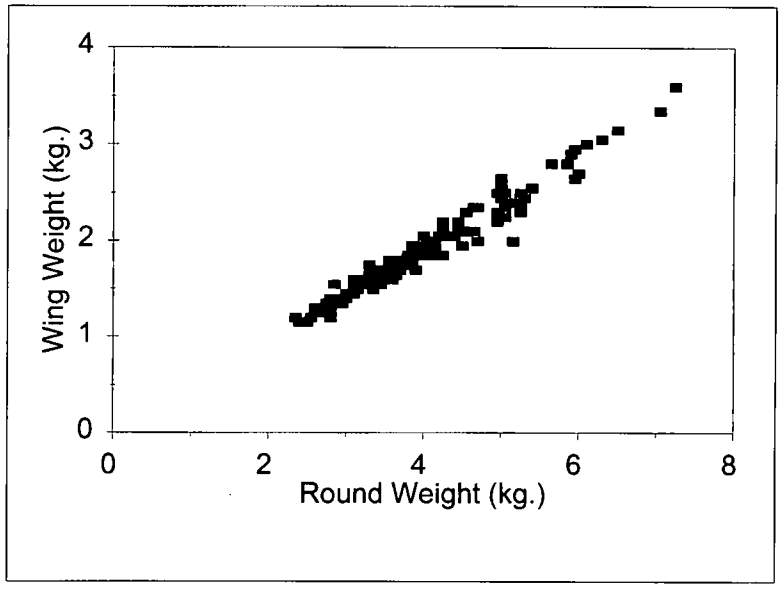


Regression Output:

Constant	0.039581
Std Err of Y Est	0.106789
R Squared	0.988842
No. of Observations	308
Degrees of Freedom	306
X Coefficient(s)	2.194788
Std Err of Coef.	0.013328

Figure 3. Conversion rates from winter skate during June,1997 in Div. 4Vs.

Length	%	n
50-59cm	-	-
60-69cm	48.59	13
70-79cm	47.63	100
80-89cm	47.11	41
90-99cm	48.32	9
Males	47.57	92
Females	47.67	71
all	47.62	163

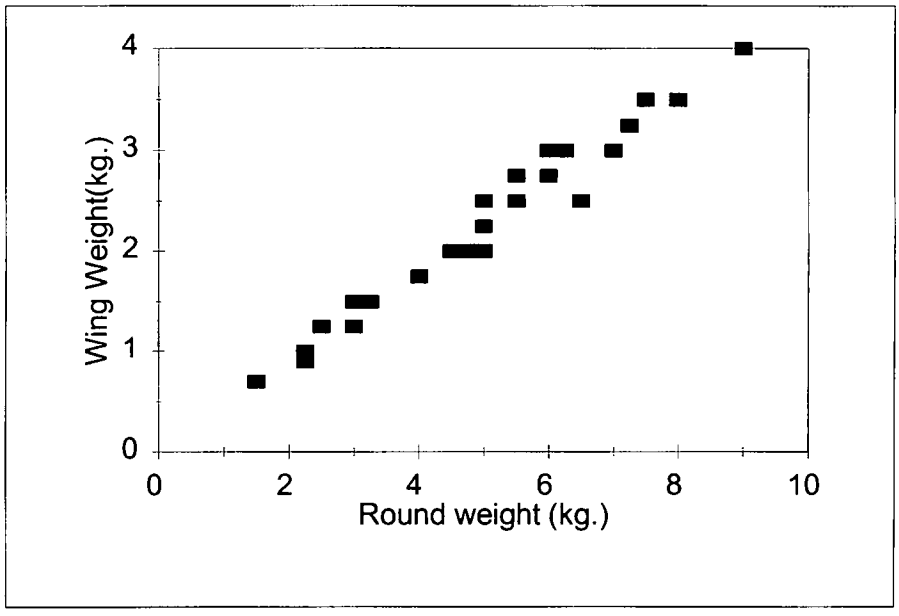


Regression Output:

Constant		0.112551
Std Err of Y Est		0.186015
R Squared		0.961803
No. of Observations		163
Degrees of Freedom		161
X Coefficient(s)	2.041681	
Std Err of Coef.	0.032066	

Figure 4. Conversion rates from winter skate measured at sea during Sept.,1994 in Div. 4Vs.

Length	%	n
50-59cm	46.7	1
60-69cm	0.5	2
70-79cm	43.1	12
80-89cm	45.7	15
90-99cm	44.6	10
100-109c	44.4	1
Males	44.9	30
Females	44.8	11
all	44.87	41



Regression Output:

Constant		153.6443
Std Err of Y Est		329.5601
R Squared		0.964997
No. of Observations		41
Degrees of Freedom		39
X Coefficient(s)	2.156257	1
Std Err of Coef.	0.065759	2.69E-15

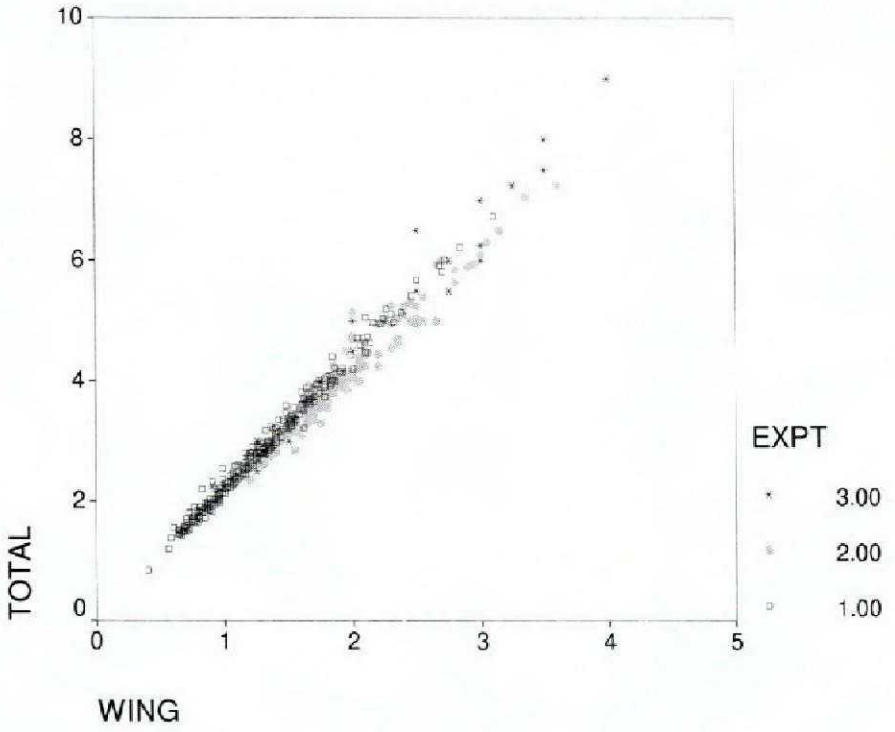


Figure 5. Comparison of the three samples(March 97(1), June 97(2) and September 94(3)) used in the analysis of covariance test for differences in yields. The total and wing estimates are in kilograms.