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ROCK LOBSTER SALINITY TOLERANCE

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CONTENTS

SUMMARY

The experiments were carried out to assess the tolerance of rock lobsters to sudden changes in salinity, as may occur in areas such as Fiordland if lobsters were held in hull tanks open to the sea. Results showed increasing mortality after a $7^{o}/oo$ salinity differential but rock lobsters became acclimatised if the differential was less than $3^{o}/oo$.

INTRODUCTION

The 1970-1971 Select Committee on the Fishing Industry considered among other things, the feasibility of legislation to prevent rock lobsters - Jasus edwardsii being tailed at sea in remote areas of New Zealand. It was suggested that 'wet well' boats be used to keep rock lobsters alive until landed for processing. This system is used in Tasmania and allows sea water to pass through a perforated hull space in which rock lobsters are held.

Apart from the costs of modification to existing freezer boats and possible loss of sea-worthiness there was another major objection, namely that in sheltered anchorages in Fiordland for example, the surface waters of low salinity would adversely affect live rock lobsters in a 'wet well' boat.

The following laboratory experiments were carried out to assess the effects of variable salinities on live rock lobsters.

METHODS

Rock lobsters were obtained by diving, mostly from rocky areas down to 50 feet at Owhiro Bay, Wellington. Clean seawater was taken from the same area and transported to the Fisheries Division Laboratory in large plastic containers.

Specimens were held in large rectangular glass tanks containing well aerated seawater and left for at least 24 hours before commencing experiments. Fresh clean rainwater was used to reduce normal seawater to salinities of 15, 20, 25, 28, 30 and $32^{o}/oo$ in six rectangular 10 gallon plastic fish boxes. All tanks were well aerated and fitted with a re-cycling filtration system through glass wool, gravel and activated charcoal. Food in the form of live limpets (Cellana radians radians) and blue mussels - Mytilus edulis aoteanus was supplied at intervals and all food scraps were removed the following day. Experiments took place in a well insulated laboratory to reduce temperature fluctuations. Temperature and range (13-17°C). Control specimens were held in seawater (33.6-35°/oo) and two specimens at a time were held in each lower salinity tank for seven days or longer trial periods. Dead specimens were removed and deep frozen. Rock lobsters were taken from seawater and placed in different lower salinities and some were gradually acclimatised in stages down to the lowest salinity of 15°/oo. Specimens were also moved from lower to higher salinities to observe tolerances.

An RS5 Portable Salinometer was used to adjust and check salinities and fresh rainwater was added when required to compensate for evaporation. The laboratory experiments were carried out from 27.9.1971 to 10.11.1971. Rock lobsters were observed while diving and salinities and sea temperatures were recorded in some Fiordland areas in February and July 1972 during a cruise of the "W. J. Scott" to assess the commercial viability of a tuna fishery on the South Island West Coast.

RESULTS

Appendix 1 gives details of each rock lobster specimen used in the trials.

Appendix 2 supplies data obtained in Fiordland.

Table 1 summarises experimental data for rock lobsters taken from seawater (33.6 - 35°/oo) and placed directly in different salinities down to 15°/oo. Controls were held in seawater. Seven day experimental periods 28/9/71-10/11/71.

Table 2 shows results of acclimatisation experiments when survivors from one salinity stage were placed in higher or lower salinities on a progressive basis. Only one of the first five specimens survived the whole range of salinity changes from seawater (33.6 - 35°/oo) down to 15°/oo and back to seawater. The fact that it did, however, shows that rock lobsters can become acclimatised in stages although activity was much reduced at 15°/oo salinity.

TABLE 1

SALINITY	Number of Specimens	Tail Length Range-Inches	Mean Survival Time	Per Cent Mortality
Control Seawater 33.6-35 $^{0}/oo$	6 {3 male, 3 female	$3\frac{1}{4}$ - $7\frac{1}{2}$	7 days	0
32 $^{0}/oo$	4 {2 male, 2 female	$3\frac{1}{2}$-5	7 days	0
30 $^{0}/oo$	4 {3 male, 1 female	$3\frac{1}{2}$-5	7 days	0
28 $^{0}/oo$	4 {3 male, 1 female	$3\frac{3}{4}$-$6\frac{1}{8}$	5 days 6 hours	50
25 $^{0}/oo$	4 {3 male, 1 female	$4\frac{1}{4}$-$6\frac{3}{4}$	4 days 10 hours	50
20 $^{0}/oo$	5 {4 male, 1 female	$4\frac{1}{4}$-$6\frac{1}{8}$	$4\frac{1}{2}$ hours	100
15 $^{0}/oo$	6 {1 male, 5 female	$3\frac{1}{4}$-$6\frac{1}{4}$	$2\frac{1}{2}$ hours	100

ACCLIMATISATION EXPERIMENTS

TABLE 2

Salinity Gradient	Number of Specimens	Tail Length Range (inches)	Mean time in Next Salinity Stage	Mortality Condition of Survivors
Seawater (33.6-35 $^{o}/oo$) to 32 $^{o}/oo$	5	$3\frac{1}{2}$-5	6 days 12 hrs	0 good
32 $^{o}/oo$ to 30 $^{o}/oo$	3	$3\frac{3}{8}$-5	3 days 6 hrs	33% 1 poor 1 good
30 $^{o}/oo$ to 28 $^{o}/oo$	3	$3\frac{3}{8}$-5	7 days	0 good
28 $^{o}/oo$ to 25 $^{o}/oo$	4	$3\frac{3}{8}$-$5\frac{7}{8}$	5 days 7 hrs	0 good
25 $^{o}/oo$ to 20 $^{o}/oo$	4	$3\frac{3}{8}$-$6\frac{3}{4}$	4 days 13 hrs	25% good
20 $^{o}/oo$ to 15 $^{o}/oo$	3	5 -$6\frac{3}{4}$	2 days 16 hrs	0 poor
15 $^{o}/oo$ to 20 $^{o}/oo$	2	5-$5\frac{7}{8}$	1 day 2 hrs	0 improving
20 $^{o}/oo$ to 25 $^{o}/oo$	2	5-$5\frac{7}{8}$	22 hours	0 good
28 $^{o}/oo$ to 30 $^{o}/oo$	2	5-$5\frac{7}{8}$	16 hours	0 good
30 $^{o}/oo$ to 32 $^{o}/oo$	2	5-$5\frac{7}{8}$	2 hours	0 good
30 $^{o}/oo$ to 34 $^{o}/oo$	2	$3\frac{3}{8}$-$3\frac{1}{2}$	2 days 16 hrs	0 good
32 $^{o}/oo$ to 33.6 $^{o}/oo$	1	$4\frac{1}{2}$"	6 days $12\frac{1}{2}$ hrs	0 good
32 $^{o}/oo$ to 35 $^{o}/oo$	2	5-$5\frac{7}{8}$"	8 days 12 hrs	50% poor
25 $^{o}/oo$ to 34.4 $^{o}/oo$	1	$4\frac{1}{4}$	3 days	0 good
25 $^{o}/oo$ to 35 $^{o}/oo$	1	$4\frac{1}{4}$	2 hours	100
15 $^{o}/oo$ to 34.6 $^{o}/oo$	1	$6\frac{3}{4}$	2 hours	100

DISCUSSION

The experimental results show that rock lobsters can tolerate changes in salinity provided that the differential is not too great.

Specimens remained alive and in good condition for the seven day trial period when transferred from sea-water (33.6 - 35^{o}/oo) down to salinities of 30^{o}/oo i.e. a difference of 3-5^{o}/oo. When this differential was increased to 7-10^{o}/oo half of the specimens died and the survivors were in poor condition. When the differential increased to between 10 and 20^{o}/oo all specimens died within 4-5 hours. The abdominal segments swelled and movement became sluggish, the apparent cause being the failure of the excretory and osmo-regulation apparatus, the antennary glands, to cope with the difference in salinities between body fluids and the aquatic environment.

When specimens which had become acclimatised to low salinities by stages were put back into normal seawater there was again a high mortality e.g. of three specimens acclimatised to 15-25^{o}/oo salinities and put back into seawater (35^{o}/oo), two died within two hours and abdominal shrinkage due to loss of body fluids was observed.

Appendix 2 shows some salinity data from Fiordland. For six areas sampled the mean surface salinity was 18.6^{o}/oo. Heavy rainfall and run-off into these confined bays and inlets causes very low salinities at the surface. Diving has shown turbid conditions down to about six feet in many areas due to mixing of fresh and salt water. The difference between mean salinities of 18.6^{o}/oo and seawater is about 16^{o}/oo which is enough to kill most rock lobsters. The evidence, therefore, suggests that the use of 'live-well' boats with hull tanks exposed to sea would not be feasible in areas such as Fiordland as boats usually anchor overnight in the sheltered inlets at the head of the Sounds.

An alternative method of keeping rock-lobsters alive at sea is to use enclosed sea-water tanks fitted into the hold space. Pumps can be used to circulate seawater, but in certain areas such as Fiordland it would be necessary to keep the intake pipe below about six feet beneath the surface to avoid pumping in fresh or brackish water.

Aerators and temperature regulating units may also be used with these holding tanks.

CONCLUSIONS

Rock lobsters can tolerate small changes in salinity up to about $5^{o}/oo$ but differentials above this resulted in increased mortalities. A rapid change of salinity of $10^{o}/oo$ or more resulted in $100^{o}/o$ mortality within a few hours. Rock Lobsters became acclimatised if allowed to adjust to each successive salinity stage, the differential not exceeding $5^{o}/oo$.

In view of the very low surface salinities in most inner Fiordland Sounds the use of 'live well' boats with perforated hulls holding rock lobsters is not considered feasible in this area.

ACKNOWLEDGMENTS

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APPENDIX 1

Rock Lobster Salinity Experiments

Specimen 1 — Whole Length — $6\frac{1}{8}$"/15.2 cm

Male — Tail Length — $3\frac{1}{2}$"/8.5 cm

History				Condition
Ex Owhiro Bay (35‰) at 1200 hours 27.9.71				Good
34.6°/oo	1300/27.9.71	1100/28.9.71	22 hours	Good
32°/oo	1100/28.9.71	0900/6.10.71	7 days 22 hours	Good
30°/oo	0900/6.10.71	1400/7.10.71	1 day 5 hours	Sluggish

Tail swelling 7.10.71 and died 1400 hours.

Specimen 2 — Whole Length — $8\frac{3}{4}$"/22.2 cm

Female — Tail Length — 5"/12.7 cm

History				Condition
Ex - Owhiro Bay	1200 hrs 27.9.71			Good
34.6°/oo	1300/27.9.71	1100/28.9.71	22 hours	Good
32°/oo	1100/28.9.71	0900/6.10.71	7 days 22 hours	Good
30°/oo	0900/6.10.71	0900/14.10.71	8 days	Good
28°/oo	0900/14.10.71	0900/19.10.71	5 days	Good
25°/oo	0900/19/10/71	0900/20.10.71	1 day	Good
20°/oo	0900/20.10.71	0900/21.10.71	1 day	Good
15°/oo	0900/21.10.71	0900/23.10.71	2 days	Sluggish
20°/oo	0900/23.10.71	1100/24.10.71	1 day 2 hours	Improving
25°/oo	1100/24.10.71	0900/25.10.71	22 hours	Good
28°/oo	0900/25.10.71	1630/25.10.71	$7\frac{1}{2}$ hours	Good
30°/oo	1630/25.10.71	0830/26.10.71	16 hours	Good
32°/oo	0830/26.10.71	1000/26.10.71	$1\frac{1}{2}$ hours	Good
35°/oo	1000/26.10.71	1000/11.11.71	16 days	Good

Specimen 3	Whole Length	-	7¼"/18.4 cm
Male	Tail Length	-	4"/10.1 cm

History					Condition
Ex Owhiro Bay	1200 hrs	27.9.71	-		Good
34.6°/oo	- 1300/27.9.71	- 1100/28.9.71	-	22 hours	Good
32°/oo	- 1100/28.9.71	- 0900/6.10.71	-	7 days 22 hrs	Good
30°/oo	- 0900/6.10.71	- 2300/6.10.71	-	14 hours	Poor

Tail swelling during 6.10.71 - died approx. 2300 hrs.

Specimen 4	Whole Length	-	5½"/13.9 cm
Male	Tail Length	-	3⅜"/8.6 cm

History					Condition
Ex Owhiro Bay	1200 hrs.	27.9.71	-		Good
34.6°/oo	- 1300/27.9.71	- 1100/28.9.71	-	22 hours -	Good
30°/oo	- 1100/28.9.71	- 0900/6.10.71	-	7 days 22 hours	Good
28°/oo	- 0900/6.10.71	- 0900/14.10.71	-	8 days -	Good
25°/oo	- 0900/14.10.71	- 0900/19.10.71	-	5 days -	Good

Cast shell during night of 16.10.71

20°/oo	- 0900/19.10.71	- 1200/20.10.71	-	1 day 3 hours	Poor

Tail swelling and sluggish during 20.10.71

Died at 1200 hours

Specimen 5	Whole Length
Male	Tail Length

History					Condition
Ex. Owhiro Bay	1200 hrs.	27.9.71		-	Good
34.6°/oo	- 1300/27.9.71	- 1100/28.9.71	-	22 hours -	Good
30°/oo	- 1100/28.9.71	- 0900/6.10.71	-	7 days 22 hours	Good
28°/oo	- 0900/6.10.71	- 0900/14.10.71	-	8 days -	Good
25°/oo	- 0900/14.10.71	- 1400/21.10.71	-	7 days 5 hours	Good
35°/oo	- 1400/21.10.71	- 1600/21.10.71	-	2 hours -	Poor

Tissue shrinkage - died 1600 hours.

Specimen 6	Whole Length	$11\frac{1}{8}$"/28.4 cm
Male	Tail Length	$6\frac{1}{8}$"/15.7 cm

History — Condition

		Ex. Owhiro Bay 1200 hrs. 27.9.71			-	Good
$34.6^{o}/oo$	-	1300/27.9.71	- 1100/28.9.71	- 22 hours	-	Good
$28^{o}/oo$	-	1100/28.9.71	- 0800/3.10.71	- 4 days 21 hours		Poor

Died 0800 hrs. 3.10.71 Body swollen

Specimen 7	Whole Length	$10\frac{1}{8}$"/25.8 cm
Male	Tail Length	$5\frac{7}{8}$"/14.7 cm

History — Condition

		Ex. Owhiro Bay	1200 hrs. 27.9.71		-	Good
$34.6^{o}/oo$	-	1300/27.9.71	- 110/28.9.71	- 22 hours	-	Good
$28^{o}/oo$	-	1100/28.9.71	- 0900/6.10.71	- 7 days 22 hrs	-	Good
$25^{o}/oo$	-	0900/6.10.71	- 0900/14.10.71	- 8 days	-	Good
$20^{o}/oo$	-	0900/14.10.71	- 0900/22.10.71	- 8 days	-	Fair
$15^{o}/oo$	-	0900/22.10.71	- 0900/23.10.71	- 1 day	-	Sluggish
$20^{o}/oo$	-	0900/23.10.71	- 1100/24.10.71	- 1 day 2 hours		Fair
$25^{o}/oo$	-	1100/2 .10.71	- 0900/25.10.71	- 22 hours	-	Improving
$28^{o}/oo$	-	0900/25.10.71	- 1600/25.10.71	- 7 hours	-	Good
$30^{o}/oo$	-	1600/25.10.71	- 0800/26.10.71	- 16 hours	-	Good
$32^{o}/oo$	-	0800/26.10.71	- 1000/26.10.71	- 2 hours	-	Good
$35^{o}/oo$	-	1000/26.10.71	- 0900/27.10.71	- 23 hours	-	Poor

Died 0900 hours 27.10.71

Specimen 8 Whole Length $8\frac{1}{4}$"/20.9 cm

Male Tail Light $4\frac{1}{2}$"/11.4 cm

History Condition

Ex Owhiro Bay 1200 hours 27.9.71 - Good

34.6°/oo - 1300/27.9.71 - 1100/28.9.71 - 22 hours - Good

25°/oo - 1100/28.9.71 - 1800/30.9.71 - 2 days 7hrs - Poor

Tail swelling 29/30.9.71 - died 1800/30.9.71

Specimen 9 Whole Length 11.0"/27.9 cm

Male Tail Length $6\frac{3}{4}$"/17.2 cm

History Condition

Ex Owhiro Bay 1200 hours 27.9.71 - Good

34.6°/oo - 1300/27.9.71 - 1100/28.9.71 - 22 hours - Good

25°/oo - 1100/28.9.71 - 0900/6.10.71 - 7 days 22hrs - Good

20°/oo - 0900/6.10.71 - 0900/14.10.71 - 8 days - Good

15°/oo - 0900/14.10.71 - 0900/19.10.71 - 5 days - Sluggish

34.6°/oo - 0900/19.10.71 - 1100/19.10.71 - 2 hours - Poor

Tissue shrinkage - died 1100 hours

Specimen 10 Whole Length 9.0"/22.9 cm

Male Tail Length $4\frac{3}{4}$"/12.1 cm

History Condition

Ex Owhiro Bay 1200 hours 27.9.71 - Good

34.6°/oo - 1300/27.9.71 - 1100/28.9.71 - 22 hours - Good

20°/oo - 1100/28.9.71 - 1600/28.9.71 - 5 hours - Poor

Sluggish movements, antennae forward,
tail swelling - died 1600/28.9.71

Specimen 11 — Whole Length 9.0"/22.8 cm

Male — Tail Length $4\frac{7}{8}$"/12.4 cm

History					Condition
	Ex Owhiro Bay	1200 hours	27.9.71		Good
$34.6^{o}/oo$	1300/27.9.71	1100/28.9.71	22 hours		Good
$20^{o}/oo$	1100/28.9.71	1800/28.9.71	7 hours		Poor

Tail swelling, sluggish - died about 1800 hours

Specimen 12 — Whole Length $10\frac{7}{8}$"/27.6 cm

Female — Tail Length $6\frac{1}{4}$"/15.8 cm

History					Condition
	Ex Owhiro Bay	1200 hours	27.9.71		Good
$34.6^{o}/oo$	1300/27.9.71	1100/28.9.71	22 hours		Good
$15^{o}/oo$	1100/28.9.71	1700/28.9.71	6 hours		Poor

Vigorous swimming at first, then tail swelling, died 1700 hours

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Specimen 13 — Whole Length $5\frac{3}{8}$"/13.6 cm

Male — Tail Length $3\frac{1}{4}$"/8.2 cm

History					Condition
	Ex Owhiro Bay	1200 hours	27.9.71		Good
$34.6^{o}/oo$	1300/27.9.71	1100/28.9.71	22 hours		Good
$15^{o}/oo$	1100/28.9.71	1300/28.9.71	2 hours		Poor

Usual symptoms died 1300 hours

Specimen 14 — Whole Length $10\frac{1}{4}$"/26.1. cm

Female — Tail Length $5\frac{3}{4}$"/14.6 cm

History					Condition
	Ex Owhiro Bay	1200 hours	27.9.71		Good
$34.6^{o}/oo$	1300/27.9.71	1100/14.10.71	16 days 22hrs		Good
$15^{o}/oo$	1100/14.10.71	1230/14.10.71	$1\frac{1}{2}$ hours		Poor

Usual symptoms - body swelling died 1230 hours

Specimen 15		Whole Length	10.0"/25.4cm	
Female		Tail Length	$5\frac{3}{4}$"/14.6 cm	
History				Condition
	ex Owhiro Bay	1200 hrs.	27.9.71 -	Good
$34.6^{o}/oo$ - 1300/27.9.71 - 1130/15.10.71		17 days $22\frac{1}{2}$hrs	-	Good
$15^{o}/oo$ - 1130/15.10.71- 1300/15.10.71		$1\frac{1}{2}$ hrs	-	Poor

Usual symptoms - died 1300 hrs

Specimen 16		Whole Length	$10\frac{1}{2}$"/26.7 cm	
Female		Tail Length	$6\frac{1}{8}$"/15.5 cm	
History				Condition
	ex Owhiro Bay	1200 hrs	27.9.71 -	Good
$34.6^{o}/oo$ - 1300/27.9.71 - 1130/15.10.71		17 days $22\frac{1}{2}$hrs	-	Good
$20^{o}/oo$ - 1130/15.10.71 - 1315/15.10.71		1 hr 45 mins	-	Poor

Usual symptoms - body swelling - died 1315 hrs.

Specimen 17		Whole Length	$10\frac{3}{8}$"/26.4 cm	
Female		Tail Length	$5\frac{5}{8}$"/14.3 cm	
History				Condition
	ex Owhiro Bay	1100 hrs	4.10.71 -	Good
$33.6^{o}/oo$ - 1200/4.10.71 - 1300/1.11.71		27 days 1 hour	-	Good
$15^{o}/oo$ - 1300/1.11.71 - 1500/1.11.71		2 hours	-	Poor

Usual symptoms - body swelling - died 1500 hours

Specimen 18		Whole Length	$7\frac{7}{8}$"/20.0 cm	
Male		Tail Length	$4\frac{1}{4}$"/10.7 cm	
History				Condition
	ex Owhiro Bay	1100 hrs	4.10.71 -	Good
$33^{o}/oo$ - 1200/4.10.71 - 1300/1.11.71		27 days 1 hour	-	Good
$20^{o}/oo$ - 1300/1.11.71 - 1800/1.11.71		5 hours	-	Poor

Usual symptoms - body swelling, yellow discharge from head area on tank bottom. - Died 1800 hours

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Specimen 19 | Whole Length $9\frac{1}{8}$"/23.2 cm

Female | Tail Length 5.0"/12.7 cm

History

Salinity	From	To	Duration	Condition
	ex Owhiro Bay 1100 hours 4.10.71		-	Good
$33.6^{o}/oo$	1200/4.10.71	1300/1.11.71	27 days 1 hour	Good
$25^{o}/oo$	1300/1.11.71	2200/1.11.71	approx. 9 hours	Poor

Usual symptoms - sluggish - body swelling
Died during night of 1.11.71
Found dead at 0800 2.11.71.

Specimen 20 | Whole Length $6\frac{7}{8}$"/17.4 cm

Male | Tail Length $3\frac{3}{4}$"/9.5 cm

History

Salinity	From	To	Duration	Condition
	Ex Owhiro Bay 1100 hours 4.10.71		-	Good
$33.6^{o}/oo$	1200/4.10.71	1300/1.11.71	27 days 1 hour	Good
$28^{o}/oo$	1300/1.11.71	0830/8.11.71	6 days $19\frac{1}{2}$ hours	Good
$33.6^{o}/oo$	0830/8.11.71	0830/11/11/71	3 days	Good

Still alive and in good condition in normal seawater after 11.11.71

Specimen 21 | Whole Length $5\frac{7}{8}$"/14.8.cm

Female | Tail Length $3\frac{1}{2}$"/8.9 cm

History

Salinity	From	To	Duration	Condition
	Ex Owhiro Bay 1100 hours 4.10.71		-	Good
$33.6^{o}/oo$	1200/4.10.71	1300/1.11.71	27 days 1 hour	Good
$30^{o}/oo$	1300/1.11.71	0830/8.11.71	6 days $19\frac{1}{2}$ hours	Good
$33.6^{o}/oo$	0830/8.11.71	0830/11.11.71	3 days	Good

Still alive and in good condition after 11.11.71.

Specimen 22 | Whole Length $7\frac{3}{4}$"/19.6 cm

Female | Tail Length $4\frac{1}{2}$"/11.4 cm

History

Salinity	From	To	Duration	Condition
	Ex Owhiro Bay 1100 hours 4.10.71		-	Good
$33.6^{o}/oo$	1200/4.10.71	1300/1.11.71	27 days 1 hour	Good
$32^{o}/oo$	1300/1.11.71	08300/8.11.71	6 days $19\frac{1}{2}$hrs	Good
$33.6^{o}/oo$	0830/8.11.71	remained alive.		

Specimen 23 (Specimen 2) Whole Length

Female Tail Length

History Condition

Ex Owhiro Bay 1200/27.9.71

Remained in seawater ($35^{o}/oo$) after 11.11.71 as control for next series.

Remained in good condition.

Specimen 24 Whole Length $9\frac{1}{2}$"/24.2 cm

Female Tail Length $5\frac{1}{2}$"/13.9 cm

History					Condition
		Ex Island Bay 1200 hours 5.11.71		-	Good
$34.4^{o}/oo$	-	1300/5.11.71 - 1045/8.11.71	- 2 days $21\frac{3}{4}$hrs	-	Good
$15^{o}/oo$	-	1045/8.11.71 - 1145/8.11.71	- 1 hour	-	Poor

Body swelling - died 1145 hours

Specimen 25 Whole Length $8\frac{1}{2}$"/21.6 cm

Male Tail Length $4\frac{3}{4}$"/12.1 cm

History					Condition
		Ex Island Bay 1200 hours 5.11.71		-	Good
$34.4^{o}/oo$	-	1300/5.11.71 - 1045/8.11.71	- 2 days $21\frac{3}{4}$ hrs	-	Good
$20^{o}/oo$	-	1045/8.11.71 - 1345/8.11.71	- 3 hours	-	Poor

Body swelling - died 1345 hours

Specimen 26 Whole Length $7\frac{1}{4}$"/18.4 cm

Male Tail Length $4\frac{1}{4}$"/10.8 cm

History					Condition
		Ex Island Bay 1200 hours 5.11.71			
$34.4^{o}/oo$	-	1300/5.11.71 - 1045/8.11.71	- 2 days $21\frac{3}{4}$ hrs	-	Good
$25^{o}/oo$	-	1045/8.11.71 - 0800/11.11.71	- 2 days $21\frac{1}{4}$ hrs	-	Good
$34.4^{o}/oo$	-	0800/11.11.71 -	remained alive		

Specimen 27 — Whole Length $7\frac{1}{2}$/19.0 cm

Female — Tail Length $4\frac{3}{8}$"/11.2 cm

				Condition
History				
		Ex Owhiro Bay 1100 hours 4.10.71	-	Good
33.6°/oo	-	1200/4.10.71 - 1045/8.11.71 - 34 days $22\frac{1}{4}$hrs	-	Good
28°/oo	-	1045/8.11.71 - 2300 hours approx. 9.11.71	-	Poor

Body swelling - sluggish movements. Died during night of 9.11.71. i.e about $1\frac{1}{2}$ days

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Specimen 28 — Whole Length $5\frac{5}{8}$"/14.3 cm

Male — Tail Length $3\frac{3}{8}$"/8.6 cm

						Condition
History						
		Ex Owhiro Bay		1700 hours 4.10.71	-	Good
33.6°/oo	-	1200/4.10.71	-	1045/8.11.71	- 34 days $22\frac{1}{4}$hrs	- Good
33°/oo	-	1045/8.11.71	-	0800/11.11.71	- 2 days $21\frac{1}{4}$ hrs	- Good
34°/oo	-	0800/11.11.71	-	remained alive		- Good

Specimen 29 — Whole Length $5\frac{5}{8}$"/14.3 cm

Male — Tail Length $3\frac{3}{8}$"/8.6 cm

						Condition
History						
		Ex Owhiro Bay		1100 hours 4.10.71	-	Good
33.6°/oo	-	1200/4.10.71	-	1045 hours 8.11.71	-34 days $22\frac{1}{4}$hrs	- Good
32°/oo	-	1045/8.11.71	-	0800/10.11.71	- 1 day $21\frac{1}{4}$ hrs	- Good

Specimen jumped from tank on 9.11.71, was found on same day still alive and was replaced. However, this may have accelerated decline. Found dead with swollen tail on 0800/10.11.71.

Specimen 30 (Specimen 2)

Female

Used as control - held in 31.4°/oo until end of experiments - remained in good condition.

APPENDIX 2

Fiordland Hydrology - "W. J. Scott" - February and July 1972

Vertical Profiles with RS_5 - Salinometer

AREA & DATE	DEPTH (feet)	SALINITY (°/oo)	SEA TEMPERATURE (°C)
Harrison Cove Milford Sound 7-2-72	Surface 15	20.6 32.3	15.3 -
Daggs Sound (entrance) Anchorage Arm 8.2.72	Surface Surface 2 3 5 20	34.5 6.0 26.0 30.0 30.6 32.2	- 12.0 14.0 15.0 15.0 15.4
Revolver Bay Preservation Inlet 9.2.72	Surface 5	23.2 24.1	14.3 14.5
Isthmus Sound Preservation Inlet 10.2.72	Surface 60	27.7 33.8	14.4 13.7
Seymour Island Doubtful Sound 11.2.72	Surface 6 20 50	25.0 27.9 34.7 35.2	16.2 16.1 14.2 13.3
Fanny Bay Dusky Sound 15.7.72	Surface 34	9.4 34.8	6.3 12.4