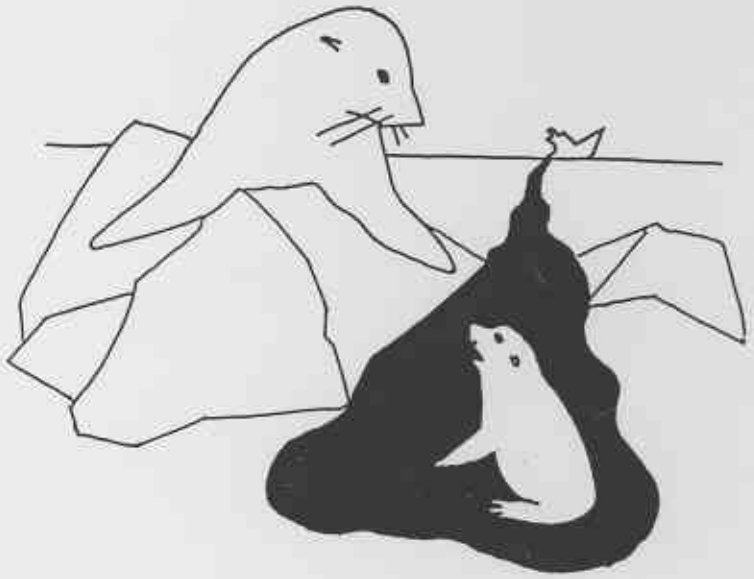
New Zealand Fur Seals and Oil: An Overview of Assessment, Treatment, Toxic Effects and Survivorship

The 1991 Sanko Harvest Oil Spill



Report to the West Australian Department of Conservation and Land Management

Nicholas J. Gales

Marine Mammal Consultant
50 Beamish Avenue
Mount Pleasant
Western Australia 6153

August 1991.

Copies of CALM's Tech. report on the Sanko Harvest cancel also be provided to EPA, M+H + Fisheries. (+ marked to E.P Branch on that file)
16/9
(1) P. Lambert
Copy sent to Sanko/Fur-seal file. Plse check that Albany + Esperance officers rec'd this. Tanzia Maxted + Barry Wilson also rec'd it; yes check re G. Pobar.
(2) Dave Abbott 1/9.
(3) Kevin Morrison 27/9
(4) Doug Coughran
(5) Andrew Burbidge
(6) Tony Friend 5/10
(7) Ian Abbot
(8) Gordon Wyre } Fyi K. McNamara 4/9

Table of Contents

1 ABSTRACT

On February 14th 1991 the bulk ore carrier "Sanko Harvest" was wrecked and spilled 700 tonnes of heavy fuel oil into the sea along the south coast of Western Australia. A portion of this oil was washed onto near-shore islands, two of which supported breeding populations of New Zealand fur seals Arctocephalus forsteri.

At the time of the oil spill the 1991 cohort of pups were aged between two weeks and two months and were the only age class of seal contaminated. Thirty nine pups on Hood Island and up to 172 pups on Seal Rocks were contaminated to varying degrees with oil. All affected pups were captured and restrained in pens. A non-solvent, biodegradable, non-ionic detergent and a hydrocarbon solvent were used to remove the oil from the fur seals' pelage. The rocks in the area of the fur seal colony were cleared of oil before the pups were released.

Analysis of haematology and blood chemistry demonstrated a general stress leucogram at the time of the oil spill which returned to normal values within two months. Minor aberrations in biochemistry reflected stress and results of handling rather than significant hydrocarbon toxicity.

Mortality of pups on Hood Island was between 13% and 33%. On Seal Rocks mortality was at least 6.4%. Mean mass of oil-fouled pups was not significantly different to pups from an unaffected colony near-by at the time of the oil spill, but decreased significantly over a two week period before returning to normal ranges after two months.

Prompt and efficient removal of the oil from the fur seals appears to have minimised the potential impact on the fur seals. This species response to such a toxic challenge is in contrast to the high mortality reported in sea otters following the Exxon Valdez oil spill.

2 INTRODUCTION

The grounding and subsequent sinking of the Japanese owned bulk carrier "Sanko Harvest" on 14 February 1991 6nm south of Cape Le Grand, Western Australia initiated a sequence of events unique to Australia's maritime and environmental history. The primary pollutants released into the marine ecosystem as a result of the wreck were approximately 30,000 tonnes of the highly soluble fertilizers, as well as 700 tonnes of bunker oil. The scope of this report is restricted to comment on the impact of the oil on two New Zealand fur seal Arctocephalus forsteri colonies in the region. Other reports have been commissioned by representatives of the West Australian state government that cover the many aspects of an environmental disaster of this magnitude.

I was commissioned as a marine mammal consultant and veterinarian by the West Australian Department of Conservation and Land Management to assess, treat and monitor marine mammals affected by the sinking of the Sanko Harvest.

2.1 An historical perspective: pinnipeds and oil

The amphibious life history of seals presents special considerations when dealing with the potential risks of oil contamination in this group of marine mammals. The extensive nature of hydrocarbon exploration and transport has resulted in few marine ecosystems being safe from potential contamination with oil. The past four decades have seen at least 29 episodes of encounters between pinnipeds and oil (St. Aubin 1990), though these have resulted in few quantitative accounts to allow us to accurately predict the impact of oil or to formulate meaningful treatment and action plans. Most reports have described oil fouling of grey and harp seals. Large scale mortality has never been observed, but oil has clearly been implicated in some deaths.

Fur seals possess a dense under-fur used to trap a layer of air close to the skin which assists in thermoregulation. Fouling of this pelage with oil leads to thermoregulatory and energetic imbalance, the insulative value to the pelt being reduced by as much as 50% (Kooyman et al 1976). Few reports exist that describe large scale oiling in wild fur seals, thus providing little predictive data. The Exxon Valdez oil spill in 1989 resulted in the contamination of over three hundred sea otters. Like fur seals these marine mammals have a dense under-fur and the physical challenge of oil contamination may well have many parallels with fur seals. The massive amount of data accumulated as a result of the treatment and rehabilitation of these animals was used as a predictor for impact on the fur seals described in this report.

2.2 A summary of the events

On February 14 1991 the "Sanko Harvest", a Japanese owned, 30,000 tonne deadweight bulk carrier bound from Tampa, USA to Esperance, Western Australia struck an unnamed reef 6nm south of Cape Le Grand (35 km south-east of Esperance). Within 24 hours the ship was rendered unsalvageable and broke up and sank over the following two week period. The 30,000 tonnes of soluble fertiliser (22,000 tonnes of di-ammonium phosphate and 8,000 tonnes of triple superphosphate) was rapidly dissolved and dispersed. A monitoring programme commissioned by the West Australian Environmental Protection Agency detected no adverse effects from the fertiliser. The 700 tonnes of heavy fuel oil was not able to be removed from the ship or contained in the adjacent sea. The majority of this oil washed up on beaches of the Cape Le Grand National Park, with some oil impacting near-shore islands in the vicinity.

Two days after the ship's grounding oil was seen on the northern end of Hood Island (34°09'S, 122°03'E) and the following day officers from the West Australian Department of Conservation and Land Management (CALM) flew to

the island by helicopter to assess the damage. A small colony of New Zealand fur seals was found to be impacted and a rescue operation was mounted the following day. Personnel remained on Hood Island from 17th February until 24th February, the seals having being cleaned and released on 21st February. On the 19th February aerial survey work reported oil on Seal Rocks (34°01'S,121°40'E), the site of another colony of A. forsteri. A rescue operation was mounted at this site on 21st February until 24th February, with workers being taken to the island on each day, but not remaining overnight.

During further aerial survey work a new colony of fur seals was found on Libke Island (34°13'S, 122°04'E). This island was not affected by oil and was visited on 24th February to obtain mass data from fur seals unaffected by oil for comparison with affected fur seals.

Oil was observed on rocky platforms on several other near-shore islands, the worst affected being Figure of Eight Island (34°02'S, 121°37'E). Two Australian sea lions Neophoca cinerea were observed on this island with oil on their coats. No other seals were observed to be affected by the oil spill on any other islands.

Following the fur seal clean-up operation visits were conducted to Hood Island (on 6th March, 13th March, 20th April and 6th July) and Seal Rocks (on 8th March, 13th March, 21 April and 7th July) to assess survivorship of affected animals. Libke Island was also revisited for further comparative mass change data on 8th March, 20th April and 6th July.

2.3 The life history of New Zealand fur seals

The New Zealand fur seal Arctocephalus forsteri breeds in the New Zealand region and on the southern coasts of Western Australia and South Australia (Shaughnessy 1990). An estimate of approximately 4,600 A. forsteri are found along the south coast of Western Australia (Shaughnessy and Gales 1990),

almost all of which are in the Recherche Archipelago. A. forsteri breed annually in December and January, the bulls holding territories during this period. Following the birth of the pup the mothers remain ashore for about ten days during which time they are mated by a territorial male. The cows then begin making foraging trips to sea which last three to five days, returning to spend two to four days with the pup. As the pup gets older the cow's feeding trips become longer, and the temporarily abandoned pups gather in groups and often play in protected rock pools. The pups are suckled for almost a year and will remain in the general vicinity of their natal site during this period.

3 METHODS

3.1 Assessment of scale of impact

Until recently knowledge of marine mammal populations in the Recherche Archipelago was scant. Fortunately, since 1987 thorough surveys of the only two native pinniped species, the Australian sea lion and the New Zealand fur seal, have been conducted in this region (Gales 1990, Shaughnessy and Gales 1990), providing recent data on the current distribution of these species. These data were used to identify key terrestrial locations to assess for impact. Bottlenose dolphins (Tursiops truncatus) and Common dolphins (Delphinus delphis) are abundant in the region with sightings of other Cetacean species being uncommon during February.

Helicopters were used to monitor the movement of the oil slick and, where necessary, to land on islands for more detailed assessment. Most islands 40nm east and west of the wreck site were surveyed. If Cetaceans were seen they were observed from the air for aberrant behaviour.

Where impact on pinnipeds was determined the approximate number, age class, behaviour and degree of fouling of the animals was noted. The level of contamination in the immediate environment was also assessed.

3.2 Objectives and methodology of the fur seal rescue program

At the major sites where oil contamination of fur seals was recorded the objectives were:

- accurately record the number and age and sex class of affected seals
- capture and temporarily contain contaminated seals
- remove all oil from the local environment before release of treated seals
- remove oil from contaminated seals
- clinically examine, quantify degree of oiling, weigh, measure length, treat if indicated, collect blood and tag all affected seals prior to release
- minimise time of clean up operation in order to minimise potential impact of disturbance
- collect all carcases for post-mortem examination
- revisit the site at regular intervals to assess impact of the oiling event and survivorship of contaminated animals (criteria for frequency of visits to be determined by data from preceding assessment)

3.2.1 Assessment of degree of oiling

The degree of contamination of individual seals was quantified using an arbitrary scale of 0-5. Nil contamination being assigned 0; animals that had oil completely covering their coat being assigned 5.

3.2.2 Blood collection procedure

Blood samples were collected via venipuncture of the lateral gluteal vein. Twenty gauge needles were used and blood was collected into three vacutainer tubes with either no anti-coagulant, 15% EDTA (K_3) or Potassium Oxalate.

Blood was sent to Vetpath Laboratory Services for analysis.

3.2.3 Tagging

All handled fur seals were tagged in the caudal axillar of both fore flippers with cattle ear tags (Sidney ear tags, Stockbrands Co. Pty Ltd, Western Australia). The tags were not numbered so a permanent ink marker pen was used to number the tags initially, however when the numbers were found not to last the remaining tags had numbers burned into the surface using a heat engraver.

3.2.4 Selection of cleaning chemicals

Two cleaning agents were used to wash oil from the coats of oil-fouled fur seals. Selection of appropriate chemicals was constrained by logistics and in particular supply and availability. As such, chemicals available locally in Esperance in sufficient quantity for such an operation were utilised.

Dr Randall Davis had advised that "Dawn detergent" (made by Proctor and Gambol) had been successfully used to clean oil from the fur of sea otters after the Exxon Valdez oil spill. Unfortunately this was not available in Australia.

"CT 18 concentrated cleansing gel" (distributed and made by Chemtech Products) was selected and trialed. It is a neutral pH, non-ionic detergent with a

phosphate building system that works well in hard water such as salt water and is low-irritant to skin and mucus membranes. Furthermore, it is a non-solvent and is biodegradable.

Following the use of the "CT 18" the animals were sprayed with "Preen Trigger Prewash Spray" (made by Samual Taylor) and this powerful degreaser was massaged into the fur before being rinsed off. "Preen" contains a low odour aliphatic hydrocarbon solvent and less that 20 percent by weight of a nonionic degradable surfactant (alcohol ethoxylates).

3.3 Environment and operational logistics

The islands of the Recherche Archipelago are typically high granite monoliths with low , sparse vegetation cover of scattered shrubs, grasses and herbfields. Beaches are rare. Landing on such islands from the sea is treacherous and usually constrains the supply of bulky equipment. As a result helicopters were used to ferry personnel and equipment to work sites. Landing sites and aerial approaches to islands were selected, when possible, to minimise impact on seal colonies.

Radio communication with a central base in Esperance was maintained via VHF and HF radios.

4 RESULTS

4.1 Scale of impact

Oil was seen on several near-shore islands, Hood Island and Seal Rocks being the sites of impact on A. forsteri. The two sea lions that were observed with oil on their coats on Figure of Eight Island were not observed again and

thus were not captured, treated or assessed. No other sites were found where oil fouling of seals had occurred.

4.1.1 Hood Island

Most of the oil to wash onto Hood Island was found in a 300m area on the north-western side of the island. This is in the immediate vicinity of a small colony of A. forsteri. The oil accumulated in low wave energy areas and thus fouled the waters and rocks in the areas where most of the pups congregate. The areas of higher wave energy were mostly oil free.

At the time of the oil spill pupping had finished and the territorial males had left the site. The pups ranged in age from approximately two weeks to two months old. A survey conducted three days before the oil spill had counted 73 A. forsteri made up of one sub-adult male, 12 cows, 4 juveniles, 29 pups and 27 unknown age/sex class (Shaughnessy and Cheal 1991).

The initial survey of animals conducted by officers from CALM on 17th February found that all observed pups had been heavily fouled with oil. Adults were difficult to observe at close quarters as they move into the sea when approached, but no adults were observed with evidence of oil on their coats. The cows and juveniles tend to enter and leave the water in the areas of high wave activity and as these sites were not affected by oil it seems likely that impact on these age groups had been minimal.

Temporary holding pens were constructed on the island using chicken wire with tarpaulins for shade. A total of 39 pups were captured and placed in the pens, all of which were heavily oiled. As the pups do not venture to sea at this age it was assumed that the entire cohort had been captured.

A large amount of oil remained on the rocks and in the relatively protected waters of the rock pools at the time to capture of the pups.

4.1.2 Seal Rocks

The size of the A. forsteri population on Seal Rocks is larger than that of Hood Island but the degree of impact from the oil was less. No survey had been conducted at this colony during the 1990/91 breeding season to provide data on pre-oil spill population size. A survey conducted in January 1990 had counted a total of 307 fur seals, of which 187 were pups (Shaughnessy 1990). This author estimated the total Seal Rocks population to be 752.

The inspection of this colony on 21st February revealed varying degrees of impact around the island. On the eastern end of the colony a low valley of rock opens to sea. The pups in this area (sector 1) had been significantly oiled and some oil was still present on the rocks. On the mid northern end of the island (sector 2) there was no evidence of oil on the rocks, but some pups were found to be fouled with oil with others unaffected. A large group of fur seals on the Western end of the island (sector 3) was found to be unaffected by the oil and there was no evidence of oil on the rocks. There were no adult animals observed that showed evidence of oil-fouling.

From the general lack of oil that was found around the island it appeared that an oil slick had been in the immediate vicinity of the island, with some washing ashore at sector 1, but most of the oil had moved away from the island at the time of initial assessment.

Pens of the type constructed at Hood Island were set up at the three sectors (1, 2 & 3) on Seal Rocks. Forty three pups were captured and penned at sector 1, 80 pups at sector 2 and 49 at sector 3 (a total of 172 pups). As many pups as possible were captured, whether they were affected by oil or not. Some pups in sector 3 were unable to be captured due to the difficult rocky terrain and rough seas. It is unlikely that these pups were fouled with oil as impact in this sector did not appear to have occurred.

4.2 Animal handling and cleaning operation

The capture of the fur seal pups was relatively straight forward as, at this age, they tend to remain hidden under rocks. They will not attempt to swim to sea. The pups were grabbed by one or both of the rear flippers and as they only weighed between six and 15kg were readily carried to the holding pens. Thorough searches through the colony were necessary to capture all pups.

Trials were conducted on the most efficient method of cleaning the oil-fouled pups. A plastic bin of 1m x 0.5m x 0.5m was used. The pups were physically restrained in the bin and wet down with sea water. Concentrated "CT 18" was poured over the fur and massaged into the pelage. A stiff bristled hair brush was also used to augment the distribution of the detergent into the fur. The pup was then thoroughly rinsed and the procedure repeated. At this stage a significant amount of the detergent remained in the fur. "Preen" was then sprayed over the animal's coat and massaged and brushed through the fur. A thorough rinse completed the washing procedure. The "Preen" left little detergent residue in the pelage and at least 90% of the oil was estimated to have been removed. Care was taken to avoid chemical contact with the seal's eyes or mouth. Initially water for rinsing was carried in buckets and poured over the animals. Later a petrol powered water pump was used that increased the efficiency of the rinse and shortened the length of the washing procedure. The entire process took between 20 and 40 minutes, depending on the degree of fouling. A team of three people was ideal for washing one pup. It was possible to repeat the procedure to further improve the effectiveness of the wash, however, in order to minimise the amount of time spent at the colony, and hence the degree of disturbance caused, this was not considered advantageous.

After cleaning it appeared that the natural oils had also been stripped from the coat. These natural oils had been naturally replaced in the coats by day 60 after cleaning.

The pups tolerated the cleaning procedure reasonably well, and despite several minor bites to handlers, chemical sedation or restraint was not considered necessary.

Following the cleaning procedure the fur seal pups were returned to a pen and held for clinical examination, tagging, weighing, measurement of length, blood sampling and in some cases treatment. The ink marked numbers on the tags of the Hood Island animals faded over time which made identification of recaptured individuals at a later date difficult. All tags used on Seal Rocks had numbers etched in using a heating iron.

During this operation other personnel used high pressure hoses to remove the oil from the rocks to ensure that, once released, there was minimal chance of the pups becoming fouled with oil once again. This cleaning procedure was augmented by reasonable heavy seas that flushed the affected areas. No pups were released until the clean up of the local environment had been completed.

4.3 Clinical evaluation and initial treatment

4.3.1 Hood Island

All 39 pups on Hood Island were heavily oiled and were classed as 4-5 for degree of oiling. Prior to the commencement of the cleaning operation no mortalities were recorded. One pup (tag no. Y01) died in the holding pen prior to release.

During the initial clean-up operation the degree of toxicity the pups may be expected to suffer was unknown. Results from the analysis of blood were not available until after the fur seals had been cleaned and released. Advise from scientists involved in the clean up of sea otters in Alaska indicated that dehydration, low blood glucose (from shock), pulmonary emphysema and

corneal ulceration were the primary medical problems exhibited in the first three weeks following oiling (Dr. T. Williams, personal communication). As a prophylactic measure it was decided to administer lactated ringers solution via sub-cutaneous injection and dextrose solution (5%) via stomach tube. Eight fur seals were administered both lactated ringers and dextrose, 16 were treated with lactated ringers only and 14 were not treated (doses are given in table 1). The 14 untreated seals were the last to be washed and treatment was withheld as time did not permit us to do so without holding the animals in the pens for a further night. It was considered more important to release the animals and leave the colony at this stage. Chloramphenicol B. P. eye ointment was administered to all treated seals.

Clinical signs of toxicity were not evident in the seals examined during the cleaning operation. Small amounts of a mucus discharge were observed in several seal pups, however most eyes were clear and were scored at 4-5 (an arbitrary scale of 0-5 was used). No corneal ulceration was observed.

The extensive oil-fouling in this group of fur seals was likely responsible for some degree of thermoregulatory disturbance. However the relatively temperate conditions that prevailed during the operation (the oil spill occurred during the austral summer) minimised thermal challenge to the animals. During the period the fur seals were penned several were seen shivering. This may have reflected thermoregulatory disturbance or may have been associated with stress.

Generally, the clinical state of the fur seal pups from the time of capture until release was good, although the animal that died (tag no. Y01) and one other (tag nos. Y21) were moribund and weak.

4.3.2 Seal Rocks

The degree of oil-fouling of the fur seal pups on seal rocks was less than those from Hood Island. Prior to capture and washing 149 pups were assessed visually for degree of oiling using the arbitrary 1-5 scale; 15% (n=22) were entirely free of oil, 8% (n=11) were categorised as 1, 37% (n=56) as 2, 23% (n=35) as 3, 8% (n=11) as 4 and 9% (n=14) as 5. Eighty four percent of the animals classed as 4 or 5 were found in sector 1, the remainder in sector 2.

Lactated ringers solution and dextrose solution were not administered to the fur seals on Seal Rocks. Preliminary results from analysis of the blood collected from Hood Island fur seals had indicated that such treatment may not have been necessary (see section 4.4). Furthermore, the impact from oil on Seal Rocks had been less. All seals were treated with chloramphenicol B. P. eye ointment.

The washing procedure employed at Seal Rocks was the same as that used on Hood Island, but because of the large number of animals involved six separate washing teams were set up to speed up the process.

Clinical examination of all animals prior to release indicated no obvious evidence of toxicity. There was no observable clinical difference between the worst affected animals in sector 1 and those unaffected by oil in sector 3.

4.4 Haematology

Fourteen blood samples were collected from A. forsteri pups on Hood Island and thirty six samples from pups in the three sectors on Seal Rocks prior to their release (table 3). A further 13 blood samples were collected from tagged pups on Hood Island on 20th April 1991, and 21 from tagged pups in sectors 1 and 2 from Seal Rocks on 21st April 1991 (table 4). Six pups (two from Hood Island and four from Seal Rocks) were bled on both occasions. Comparisons between

the consecutive blood samples collected from these pups and between the mean pooled results of all blood samples are presented in table 5.

There are no published normal values for haematology and biochemistry of A. forsteri for comparative purposes. As such, the analysis of the blood results reported here is based principally on comparisons between samples collected in February and April. The samples collected in sector 3 in February may be close to normal values as they are likely to be relatively free of toxic effects of the oil, but may reflect stress from the clean-up operation (animals were penned overnight prior to blood sampling). Unfortunately no sector 3 animals were bled in April, the samples collected from the moderately affected sector 2 animals at this time may represent close to normal values.

Haemoglobin (Hb) and packed cell volumes (PCV) were highest for animals from Hood Island, with decreasing levels from fur seals at sector 1, 2 and 3 consecutively. It is unclear if this represents true haemoconcentration in the Hood Island animals as there was no statistically significant difference (t test) for Hb or PCV between the samples collected in February and April for any of the groups of animals. The degree of variation in the Hb and PCV was small.

A highly significant decrease (t test; $p < 0.0005$) in white blood cells (WBC) occurred between February and April. This decrease was primarily accounted for by a decrease in the percentage and absolute numbers of neutrophils present. Concomitant to this there was a highly significant increase (t test; $p < 0.0005$) in lymphocytes for all groups of animals. There was a significant increase (t test; $0.01 < p < 0.025$) in the number of eosinophils for the Hood Island animals, but not for those on Seal Rocks. Assuming the samples collected in April are closer or equal to normal values than the February samples, then at the point of release the fur seals demonstrated a leucocytosis, neutrophilia, monocytosis, lymphopenia and eosinopenia. These findings are typical of changes induced by acute stress.

Total plasma protein and total serum protein levels were significantly higher in April than February (t test; $p < 0.0005$) for all groups of fur seals; an increase in the circulating serum globulins being the protein fraction responsible for the increase.

Aspartate aminotransferase (AST), Gamma glutamyltransferase (GGT) and urea did not vary significantly in any of the oiled fur seals in this study. Alanine aminotransferase (ALT) decreased significantly (t test; $0.005 < p < 0.01$) for the overall pooled blood samples from February to April. This decrease was significant for the fur seals from Seal Rocks, but not for those from Hood Island. The degree of changes were on a relatively small scale.

Alkaline phosphatase (alk phos) levels decreased significantly for all groups of seals (t test; $p < 0.0005$). These changes were significant for seals from Hood Island and Seal Rocks.

Creatinine phosphokinase (CK) levels were highly variable and appeared to increase for all sub-groups of seals between February and April. Hood island was the only site were the increase was significant (t test; $0.01 < p < 0.025$). Creatinine (creat) decreased significantly between February and April on Hood Island (t test; $p < 0.0005$) and increased significantly over that period on Seal Rocks (t test; $0.01 < p < 0.025$). The magnitude of the changes at both sites was small.

Similarly, glucose (gluc) underwent a significant 40% reduction in values on Hood Island (t test; $p < 0.0005$) and a significant 44% increase on Seal Rocks (t test; $p < 0.0005$) over the period from February to April.

A highly significant increase in blood cholesterol levels occurred with all sub-groups of seals (t test; $p < 0.0005$) concomitant to significant decreases in serum sodium (Na) and potassium (K) (t test; $p < 0.0005$).

A decrease of up to 42% in circulating bilirubin (bil) was highly significant at all sites (t test; $p < 0.0005$).

Plasma cortisiol levels were highly variable and generally decreased over time. A. forsteri pups on Hood Island were the only group of animals to demonstrate a statistically significant decrease in cortisol (t test; $0.01 < p < 0.0025$). Plasma iron (Fe) levels, which are also used as a general indicator of stress, tended to increase in most sub-groups over time, Hood Island animals once again being the only group to show a significant increase (t test; $0.01 < p < 0.0025$).

Analysis of levels of serum hydrocarbons via a specialised assay have not been completed and will be reported in due course.

4.5 Survivorship and mortality

4.5.1 Hood Island

Mortality of pups on Hood Island is known to be at least 13% as five of the 39 tagged pups (nos. H01, H02, H10, H17 and H28) were found dead during the period from the oil spill until the final visit in July 1991. This estimate of mortality is almost certainly an underestimate as pup carcases were found among the rocks below the high water storm level and thus other carcases may well have been washed into the sea and not retrieved. The mortality level on 20th April is known to be less than 33% as 26 of the original 39 live pups were counted around the island. At this stage the pups were highly mobile and were competent swimmers, it is therefore likely that we underestimated live pup numbers and thus 33% mortality would be an overestimate.

It is not possible to differentiate which of the mortalities occurred as a direct result of fouling with oil or from the disturbance caused by the clean-up operation from those which occurred from unrelated causes. Only one of the carcases retrieved from Hood Island had been used for blood sampling (H10); this animal showed unremarkable haematology and biochemistry.

Unfortunately only one carcase was in a sufficiently fresh state for post-mortem examination. There were no remarkable findings during this examination.

H02 and H17 were both weighed on two occasions since their release prior to their death. Both pups had significant weight loss (table 1). This may have been due to toxic effects of the oil and/or from a failure to feed to from their mothers.

4.5.2 Seal Rocks

Meaningful counts of pups on Seal Rocks were not attempted during the visits conducted after the clean-up operation as the animals were too mobile for meaningful data collection.

Six untagged pups died as a result of asphyxiation and crushing in a capture pen. A large group of animals had been left unattended overnight in this pen (in sector 3).

A further five pup carcases were found during the visits to Seal Rocks. One of these animals (S43) had exhibited a 31% mass loss over an 18 day period post release. Two other pups (S28, S127) had exhibited mass gain, the remaining two pups (S46, S105) were not recaptured live after the release (table 2).

These mortalities account for a minimum of a 6.4% mortality. The carcase of S127 was found on a mainland Australian beach adjacent to Seal Rocks. It is likely that this animal died on Seal Rocks and was washed into the sea. This removal of pup carcases from the island leads to an underestimate of mortality.

S46 had been blood sampled at release. Two percent of the leucocytes were banded neutrophils, but the remaining blood parameters were unremarkable.

None of the carcases found on Seal Rocks were sufficiently fresh to facilitate meaningful post-mortem examination.

4.5.3 Mass as an index of body condition

At the time of release there was no significant difference between the mean mass of the seal pups on Hood Island, Seal Rocks and the unaffected A. forsteri pups on Libke Island. The pups from sector 1 on Seal Rocks were significantly lighter than those from Libke Island (t test; $p < 0.0005$).

Thirteen days after release the Hood Island pups decreased in mass whilst the pups in the three sectors from Seal Rocks increased in mass (figure 1, table 6). At this point all sub-groups of seal pups were significantly lighter than the unaffected pups on Libke Island (t test; $p < 0.0005$).

The mean mass of all oil-fouled groups of fur seals decreased significantly between 13 and 18 days after release.

Assessment of mean pup mass 56 and 133 days after release resulted in no significant difference in mean mass between pups affected by the oil and those not affected (figure 1).

DISCUSSION

The present study provides some of the first quantitative data assessing impact of oil on fur seals. In the context of dealing with an environmental disaster such as this one we were fortunate that the only age class of animals involved were those that were readily captured, contained and handled and that follow-up during the pre-weaning period was possible. This allowed maximum potential for an experimental assessment of the degree of impact. In many other cases access to impacted animals is difficult and handling procedures are

complicated by the necessitated use of chemical restraint and the need to remove the animals, albeit temporarily, from their natural environment.

Fur bearing marine mammals (ie fur seals and sea otters) are most vulnerable to oil-fouling as the fur coat is an ideal matrix for retaining oil. A high mortality was reported for oil contaminated sea otters as a result of the Exxon Valdez oil spill in 1989 (Williams and Davis 1990). Geraci and Williams (1990) noted sea otters affected by oil experience problems via systemic toxic effects from ingestion of oil while grooming or from ingestion of contaminated prey, intolerance to interruptions in feeding, energetic imbalance and from behavioural problems associated with displacing them from their normal home range. Many of these factors did not apply to the A. forsteri pups described in this study as they were not displaced from their normal environment, their food source was still maternally derived and presumably not contaminated and grooming behaviour does not involve an oral component. Some level of energetic perturbation was likely to have occurred as oil has been shown to decrease the insulative value of the pelt by as much as 50% (Kooyman et al 1976), but this would have been minimised by the temperate weather that accompanied the oil spill. St Aubin (1990) predicted that spilled oil would have its greatest impact on young pinnipeds in cold, ice-bound waters.

The clinical assessment of contaminated fur seals during the clean up operation gave little indication of significant, acute toxicology. Furthermore, analysis of haematology and blood biochemistry reflected mainly a general physiological stress rather than significant, systemic, toxic challenge. This was mainly reflected in the stress leucogram. The reason for the relative hyperproteinemia that developed between February and April is unknown. This was not a response to dehydration (there was no change in haemoglobin and packed cell volume) and was specifically a hyperglobulinemia. Immunoelectrophoresis was not conducted to determine the globulin fraction that had increased. The changes were not great and may have been associated

with an immune response to low-grade chronic inflammation. However, haematology and blood chemistry are known to undergo major developmental changes during an animal's early life. The small, but significant and consistent changes in protein levels and several of the enzymes may be explained by the two months that separated the blood collection procedures. This is almost certainly true of the decrease in levels of alkaline phosphatase (Alk Phos). Changes in cholesterol may be explained by variations in the composition of ingested milk over time. Many pinnipeds experience an increase in milk fat content during lactation. The indicators of stress, cortisol and plasma iron, did not vary significantly between February and April. This is likely a reflection of acute stress being manifest in the capture and weighing operation itself. Further analysis of blood will be done at a later date when results of systemic hydrocarbon levels are known. These data will be the subject of a scientific publication and will be submitted in due course.

The cleaning procedure and the chemicals used in this study were effective for the removal of oil. There were no observed deleterious side-effects from the cleaning agents.

The overall impact on the fur seals on Hood Island and Seal Rocks does not appear to have been great. An accurate assessment of mortality was not possible but was probably less on Seal Rocks than Hood Island. Even so mortality at these sites is unlikely to have had a significant enough impact on the affected cohort to affect the overall viability of the colony. A thorough census will be conducted at both sites in February 1992 to collect data on pup production as an index of colony health. A. forsteri colonies along the south coast of Australia appear to be increasing in size and number and this minor perturbation should have little effect.

A significant factor that led to minimising impact was the relatively short delay between the oil spill and the commencement of an effective clean up operation. An operational commitment to rapidly supply personnel and

equipment to the affected sites was central to this. Furthermore, it appears that the approach to minimise disturbance to the colony by treating the animals quickly and keeping subsequent visits to a minimum frequency and duration was effective. Even though much of the stress caused and probably a significant amount of the mortality was a direct result of our intervention it is quite probable that mortality would have been higher if this approach was not taken.

There was a high level of expectation from the public (elucidated through the media) for affected pups to be removed from the colony and treated and rehabilitated at a centre set up for this purpose. It is my belief that such a course of action would have resulted in a higher mortality rate of pups through our inability to provide sufficient nutrition, the additional stress of such an exercise and the problems associated with displacement of animals from their natural environment.

6 ACKNOWLEDGMENTS

The success of this operation has been due to a great many people, only a few of whom are nominated here. Officers from the CALM, particularly Bernie Haberley, Peter Collins, Greg Pobar and Peter Lambert, were involved in most aspects of the data collection, as were many dedicated volunteers from Esperance, in particular Rob Stewart. The helicopter crew from the west Australian police air wing, particularly Clive Mayo, were extremely obliging in flying at difficult times and in marginal conditions to ensure that people and equipment had access to the islands.

Drs Terrie Williams and Randy Davis were tremendously supportive in supplying information, suggestions and encouragement based on their work on the Exxon Valdez oil spill. Terrie Williams also kindly organised the analysis of blood for hydrocarbon levels.

Dr Sue Beetson from Vetpath supplied rapid results from collected blood and assisted in data interpretation.

Alistair Cheal kindly drew the line drawing on the front of this report.

7 LITERATURE CITED

GALES, N. J. 1990. Abundance of Australian sea lions Neophoca cinerea along the southern Australian coast, and related research. Report to the Western Australian Department of Conservation and Land Management, South Australian National Parks and Wildlife Service and the South Australian Wildlife Conservation Fund.

GERACI, J. R. AND WILLIAMS, T. D. 1990. Physiological and toxic effects on sea otters. In Sea Mammals and Oil: Confronting the Risks. Eds. Geraci, J. R. and St. Aubin, D. J. Academic Press, New York. Pp 211-220.

KOOYMAN, G. L., GENTRY, R. L., AND MCALLISTER, W. B. 1976. Physiological impact of oil on pinnipeds. Report to Northwest Fisheries Centre, National Marine Fisheries Service, USA.

SHAUGHNESSY, P. D. 1990. Distribution and abundance of New Zealand fur seals Arctocephalus forsteri in Western Australia. Report to the Western Australian Department of Conservation and Land Management.

SHAUGHNESSY, P. AND GALES, N. 1990. First survey of fur seals and sea lions in Western Australia and South Australia. Australian Ranger Bulletin 5(4): 46-49.

SHAUGHNESSY, P. D. AND CHEAL, A. J. 1991. Survey of New Zealand fur seals in the Recherche Archipelago, February 1991. Report to the Western Australian Department of Conservation and Land Management.

ST. AUBIN, D. J. 1990. Pysiological and toxic effects on pinnipeds. In Sea Mammals and Oil: Confronting the Risks. Eds. Geraci, J. R. and St. Aubin, D. J. Academic Press, New York. Pp 103-123.

WILLIAMS, T. M., AND DAVIS, R. W. 1990. Sea otter rehabilitation program: 1989 Exxon Valdez oil spill.International Wildlife Research, USA.

Table 1. General data on treated pups from Hood Island

Table 1. Mass and length data on pups from Hood Island

Tag No.	Sex	length (cm)	Degree of oiling	Eye score	Treatments at release	Blood collection*	Comments at release	Mass at release (kg)	Mass on first reweigh	No. of days reweighing	Change in mass/days weighing Total	Change in mass/days weighing per day	Mean mass change since release	Comments on first reweigh	Mass on second reweigh	No. of days reweighing	Change in mass/days 1&2 Total	Change in mass/days 1&2 per day	Mean mass change from release	Comments on second reweigh	Mass on third reweigh	No. of days reweighing	Change in mass/days 1&3 Total	Change in mass/days 1&3 per day	Mean mass change from release	Comments on third reweigh	Mass on fourth reweigh
H01	F	68	4,5	5	nil		Died before release	7																			
H02									7																		
H03	M	70	4,5	5	nil			9.5	10.5	13	1	0.077	10.53		5.5	20				Found fresh dead-Pilot							
H04	M	70	4,5	5	nil			8																			
H05	F	69	4,5	5	60ml ringers	PGR		8.5	9.5	13	1	0.077	11.76														
H06	F	65	4,5	5	50ml ringers			10.5	10	13	-0.5	-0.04	-4.76														
H07	M	82	4,5	5	80ml ringers	G		13							9.5	20	-1	-0.05	-9.52		8.8	58	0.3	0.0052	3.53		
H08	M	84	4,5	5	100ml ringers			13						Reweighted, not caught							8.3	58	-2.2	-0.038	-20.95		
H09	M	69.5	4,5	5	nil			9						Reweighted, not caught							13.6	58	0.8	0.0103	4.82		
H10	F	73	4,5	5	60ml ringers	PGR		10																			
H11	M	75	4,5	5	100ml ringers	PGR		10						Found dead													
H12	M	74	4,5	5	80 ml ringers	PGR		9.5	10.5	13	0.5	0.038	5.00	Sucking from cow	9	20	-1	-0.05	-10.00								
H13	F	75	4,5	5	400ml dextrose 100ml ringers			7.5													11.0	58	3.4	0.0586	40.00		
H14	M	74	4,5	5	500ml dextrose 100ml ringers	PGR		11	12.5	13	1.5	0.115	13.64														
H15	M	77	4,5	5	100ml ringers	G		11																			
H16	F	76	4,5	5	100ml ringers	PGR		9													14.2	58	5.2	0.0552	29.09		
H17	F	65	4,5	5	500ml dextrose nil			8.5	8.5	13	-2	-0.15	-23.53														
H18	F	78	4,5	5	100ml ringers			10							5	20	-3.5	-0.175	-41.18	Very skinny							
H19	F	71	4,5	5	500ml dextrose 100ml ringers	G		9	6	13	-3	-0.23	-33.33		6	20	-2	-0.1	-20.00							found dead	
H20	F	77	4,5	4.5	500ml dextrose 100ml ringers			11	11.5	13	0.5	0.038	4.55														
H21	M	85	4,5	3	300ml dextrose 100ml ringers	PGR	Very weak	14	9.5	13	-4.5	-0.35	-32.14		10	20	-1	-0.05	-8.09								
H22	F	73	4,5	4	500ml dextrose 60ml ringers	PGR		9.5							8.5	20	-5.5	-0.275	-39.29	Conjunctivitis							
H23	F	70	4,5	4	nil			10	6.5	13	-3	-0.23	-31.58		8	20	-3.5	-0.175	-36.84								
H24	F	66	4,5	5	nil		Seen with mother on same day	9	7	13	-2	-0.15	-22.22	Reweighted, not caught	13.5	20	3.5	0.175	35.00								
H25			4,5		nil				6						7.5	20	-1.5	-0.075	-16.67								
H26	F	71.5	4,5	5	100ml ringers 500ml dextrose	PGR		10	9	13	-1	-0.08	-10.00		11	20	1	0.05	10.00	Reweighted, not caught Looks skinny							11.2
H27	F	73	4,5	5	60ml ringers	PGR		8	6.5	13	-2.5	-0.19	-27.78		6	20	-3	-0.15	-33.33								
H28	M	84	4,5	5	nil			7.5																			
H29	F	78	4,5	3	100ml ringers	G		10	11.5	13	1.5	0.115	15.00	Found dead, c. 2 days													
H30	F	74	4,5	5	60ml ringers	PGR		8.5	9	13	0.5	0.038	5.88														
H31	M	77	4,5	5	60ml ringers	PGR		11.5							10.5	20	2	0.1	23.53								
H32	M	78.5	4,5	4	60ml ringers	PGR		10.5	12	13	1.5	0.115	14.29								11.3	58	2.8	0.0483	32.94		
H33	F	67.5	4,5	5	60ml ringers			8	7.5	13	-0.5	-0.04	-6.25		9.5	20	-1	-0.05	-9.52		11.2	58	0.7	0.0121	6.67		11.4
H34	M	78	4,5	5	60ml ringers			11							6	20	-2	-0.1	-25.00		11	58	3	0.0517	37.50		
H35	F	72.5	4,5	4	nil			12	13.5	13	1.5	0.115	12.50							Reweighted, not caught Looks skinny							
H36	F	73	4,5	5	60ml ringers	PGR		11	11	13	0	0	0.00														
H37	F	68	4,5	5	nil			10							13	20	2	0.1	18.18								
H38	M	71.5	4,5	5	nil			11.5							10	20	0	0	0.00	Sucking from cow							
H39	M	68	4,5	5	nil			10													11	58	1	0.0172	10.00		
MEAN		73.7						9.87	9.19		-0.5	-0.04	-5.18		8.74		-1.03	-0.05	-10.23		11.56		1.56	0.03	17.46		
S.D.		6.07						1.93	2.38		1.84	0.14	17.93		2.03		2.34	0.12	22.56		1.93		1.84	0.03	20.33		

* P-EDTA vacutainer, R-serum vacutainer, O-Potassium oxalate vacutainer

Table 2. General data on treated pups from Seal Rocks

Tag No.	Sector #	Sex	length (cm)	Eye score	Blood collection	Mass at release (kg)	Mass on first reweigh	No. of days between weighings	Change in mass/age Total	Change in mass/age per day	Change in mass since release	Mass on second reweigh	No. of days b/w weighings 1&2	Change in mass/age Total	Change in mass/age per day	Change in mass since release	Mass on third reweigh	No. of days b/w weighings 1&4	Change in mass/age Total	Change in mass/age per day	Change in mass since release	Comments on third reweigh	Mass at fourth reweigh	No. of days b/w weighings 1&5	Change in mass/age Total	Change in mass/age per day	Change in mass since release
801	Sector 1	F	87	5	G	8						5.5	18	-0.5	-0.03	-8.33	12.5	56	4.5	0.08	75.00						
802		F	69	5	G	7.5	11	13	3.5	0.269	46.67	10	18	2.5	0.139	33.33											
803		F	73	4	PGR	8	12	13	4	0.308	50.00	12	18	4	0.222	50.00	12.1	56	4.1	0.07	51.25		14.2	133	6.7	0.05	88.93
804		F	68	5	PGR	7.5	10.5	13	3	0.231	40.00						11.4	56	3.8	0.07	52.00		14	133	6	0.045	75.00
805		F	68	5	G	8.5						10	18	0.5	0.194	53.85							10.9	133	3.4	0.026	45.33
806		F	76	5	PGR	8	11	13	3	0.231	37.50																
807		F	71	5	G	9	12	13	3	0.231	33.33	10	18	1	0.056	11.11											
808		M	73	5		8	8.5	13	3.5	0.269	58.33	7.5	18	1.5	0.083	25.00	8.6	56	0.9	0.01	13.33		9.1	133	3.1	0.023	61.67
809		M	80	5		10.5											11.7	56	1.2	0.02	11.43		10	133	5.5	0.041	52.38
810		F	74	5	G	8						8	18	-1	-0.06	-11.11							12	133	3	0.023	33.33
811		M	73	4	PGR	9	10	13	1	0.077	11.11	12.5	18	3.5	0.194	38.89	13.2	56	4.2	0.08	46.67		14.6	133	5.6	0.042	62.22
812		M	77	5	PGR	11	13	13	2	0.154	18.18						12.8	56	1.8	0.03	16.36		12.9	133	1.3	0.01	11.82
813		M	74	4	G	10	12	13	2	0.154	20.00						12.7	56	2.7	0.05	27.00						
814		M	78	5	PR	10	11	13	1	0.077	10.00						11.3	56	1.3	0.02	13.00		13.8	133	3.8	0.029	38.00
815		M	81	5	PGR	10.5	14	13	3.5	0.269	33.33	13	18	2.5	0.139	23.81	13.1	56	2.6	0.05	24.76		14.9	133	4.4	0.033	41.90
816		F	70	5	PGR	9.5	10.5	13	1	0.077	10.53	10	18	0.5	0.028	5.26											
817		M	75	5	G	10						8.5	18	-1.5	-0.08	-15.00	8.5	56	-3.5	-0.06	-35.00						
818		M	78	5	PGR	12	11	13	-1	-0.08	-8.33	9	18	-3	-0.17	-25.00							14.1	133	2.1	0.016	17.50
819		M	74	5	PGR	9.5																					
820		M	75	5	G	8.5	9	13	0.5	0.038	5.88	9	18	-0.5	-0.03	-5.88											
821		F	71	5		8	9.5	13	1.5	0.115	18.75	8.5	18	0.5	0.028	6.25	10.7	56	2.7	0.05	33.75						
822		M	81	5	PGR	11						7.5	18	-3.5	-0.19	-31.82											
823		F	71	5		7	8.5	13	1.5	0.115	21.43																
824		F	71	5	G	8	7.5	13	-0.5	-0.04	-6.25	7	18	-1	-0.06	-12.50	9.1	56	1.1	0.02	13.75		8.9	133	1.8	0.014	22.50
825		M	78	4	PGR	9	10	13	1	0.077	11.11	11.5	18	2.5	0.139	27.78	13.2	56	4.2	0.08	46.67	Still very oily	13.8	133	4.8	0.035	51.11
826		F	77	5		10	12.5	13	2.5	0.192	25.00																
827		F	78	5	PGR	11	13.5	13	2.5	0.192	22.73						13.4	56	2.4	0.04	21.82						
828		F	66	5		6	8	13	3	0.231	50.00											found dead					
829		F	69	5		7																					
830		M	79	5		11.5	10.5	13	-1	-0.08	-8.70	12.5	18	1	0.056	9.70	13.7	56	2.2	0.04	19.13						
831		M	79	5		11	11	13	0	0	0.00	9.5	18	-1.5	-0.08	-13.64	10.7	56	-0.3	-0.01	-2.73		15.3	133	4.3	0.032	39.09
832		F	77	5		10	8.5	13	-0.5	-0.04	-5.00						7.8	56	-2.2	-0.04	-22.00						
833		M	72	5		10	10	13	0	0	0.00	8.5	18	-1.5	-0.08	-15.00											
834		F	73	5		10						7.5	18	-2.5	-0.14	-25.00											
835		M	78	5		8.5						12.5	18	4	0.222	47.06											
836		F	78	5		9	10	13	1	0.077	11.11						13.7	56	4.7	0.08	52.22						
837		M	70	5		7.5	9	13	1.5	0.115	20.00	8.5	18	1	0.056	13.33											
838		F	71	5		8.5	11	13	2.5	0.192	29.41						12.1	56	3.6	0.06	42.35		13.1	133	4.6	0.035	54.12
839		F	78	5		11	15	13	4	0.308	36.36						11.4	56	0.4	0.01	3.64						
840		M	73	5		8.5																					
841		F	72	3		9	11.5	13	2.5	0.192	27.78	8.5	18	-0.5	-0.03	-5.56	10.4	56	1.4	0.03	15.56		10.8	133	1.8	0.012	17.78
842		F	71	4		9						11.5	18	2.5	0.139	27.78											
843		F	70	2		8	8.5	13	-1.5	-0.12	-18.75	5.5	18	-2.5	-0.14	-31.25						found dead					
844	Sector 2	F	73	5		8	12.5	13	3.5	0.269	56.25																
845		F	76	5	PGR	10											11.5	56	1.5	0.03	15.00		12.5	133	2.5	0.019	25.00
846		F	73	5	PGR	10																found dead					
847		M	69	5		8.5																					
848		M	72	5	PGR	9.5																					
849		M	76	5	G	9																					
850		F	80	5	PGR	11	14	13	3	0.231	27.27						13.3	56	2.3	0.04	20.91						
851		M	77	5	PGR	10																					
852		M	75	5	PGR	10	9	13	-1	-0.08	-10.00	9	18	-1	-0.06	-10.00											
853		F	77	5	PGR	9.5	12.5	13	3	0.231	31.58																
854		F	78	5		10											11	56	1	0.02	10.00						
855		M	80	5	PGR	11.5																	13	133	1.5	0.011	13.04
856		M	78	5	PGR	11	11.5	13	0.5	0.038	4.55						11.3	56	0.3	0.01	2.73						
857		M	80	5	PGR	11																	16	133	5	0.038	45.45
858		F	81	5	PGR	11.5						10	18	-1.5	-0.08	-13.04											
859		F	84	5	PGR	14	13.5	13	-0.5	-0.04	-3.57						15	56	1	0.02	7.14						
860		F	74	5		9	8.5	13	-0.5	-0.04	-5.56	7.5	18	-1.5	-0.08	-16.67											
861		F	82	5		13																	9	133	0	0	0.00
862		F	74	5		11																					
863		F	76	5		10						6.5	18	-3.5	-0.19	-35.00							15.3	133	4.3	0.032	39.09
864		F	74	5		10	9	13	-1	-0.08	-10.00	13	18	3	0.167	30.00							10	133	0	0	0.00
865		F	77	5		11						11.5	18	0.5	0.028	4.55											
866		F	81	5		13											15.8	56	2.8	0.05	21.54						
867		F	72	5		9																					
868		F	70	5		9	7.5	13	-0.5	-0.04	-6.25						8.3	56	0.3	0.01	3.75		8.2	133	0.2	0.002	2.50
869		M	81	5		12	10	13	-2	-0.15	-16.67	13	18	1	0.056	8.33											
870		M	72	5		10																					
871		M	73	5		8.5																					
872		M	75	5		12						14	18	2	0.111	16.67											
873		F	68	5		7.5																					
874		M	82	5		12	14	13	2	0.154	16.67	14	18	2	0.111	16.67											
875		M	80	5		10.5																	17.9	133	7.4	0.056	70.48
876		F	78	5		11																	15.9	133	4.9	0.037	44.09
877		M	80	5		12.5	15	13	2.5	0.192	20.00						14.2	56	1.7	0.03	13.60						
878		M	78	5		12																					
879		M	78	5		11.5	12	13	0.5	0.038	4.35	10	18	-1.5	-0.08	-13.04							13.1	133	1.6	0.012	13.91
880		M	80	5		14																					
881		F	68	5		8	9	13	1	0.077	12.50												17.5	133	9.5	0.071	118.75
882		F	81	5		12																	17.8	133	5.8	0.044	48.33
883		M	77	5		9																					
884		M	81	5		13											9.5	56	0.5	0.01	5.56						
885		M	80	5		12											13.7	56	0.7	0.01	5.38		15.9	133	2.9	0.022	32.31
886		M	76	5		8						13.5	18	1.5	0.083	12.50							13.9	133	1.9	0.014	15.83
887		M	73	5		11						11.5	18	3.5	0.194	43.75							10.6	133	2.6	0.021	25.06
888		F	78	5		11											8.2	56	-1.8	-0.03	-16.36						
889		M	75	5		10						12	18	1	0.056	9.09							15.5	133	4.5	0.034	40.91
890		F	79	5		11	13	13	2	0.154	18.18																
891		F	78	5		10											12	56	1	0.02	9.09		15.1	133	4.1	0.031	37.27

Table 2. (Continued)

Tag No.	Sector #	Sex	Length (cm)	Eye score	Blood collection	Mass at release (kg)	Mass on first reweigh	No. of days between weighings	Change in mass/legs mass change Total	per day	since release	Mass on second reweigh	No. of days b/w weighings 183	Change in mass/legs mass change Total	per day	from release	Mass on third reweigh	No. of days b/w weighings 184	Change in mass/legs mass change Total	per day	from release	Comments on third reweigh	Mass at fourth reweigh	No. of days b/w weighings 185	Change in mass/legs mass change Total	per day	from release
$92		M	78	5		11																					
$93		M	70	5		9.5											10.3	56	-0.8	-0.01	-7.27		14.3	133	3.3	0.024	26.09
No tag		F	66	5		5											10.8	56	1.3	0.02	13.68		14.3	133	4.7	0.035	48.47
$94		M	65	4		14																					
$95		F	75	5		9											13.9	56	-0.1	0	-0.71						
$96		F	79	5		12.5											8.7	56	-0.3	-0.01	-3.33						
$97		M	83	5		12.5																					
$98		F	78	5		8											15.7	56	3.2	0.06	25.60						
$99		M	78	5		8.5											9.5	56	1.5	0.03	20.00						
$100		F	81	5		9.5	13.5	13	4	0.308	42.11	11.5	18	3	0.167	35.29	13	56	4.5	0.08	52.94						
$101		F	75	5		9																					
$102		F	77	5		10.5	15	13	4.5	0.346	42.86	13.5	18	3	0.167	28.57	11.9	56	1.4	0.03	13.33						
$103		M	81	5		12.5											14.5	56	2	0.04	16.00						
$104		M	80	5		10.5																					
$105		F	81	5		11				Found dead																	
$106		M	83	5		12.5																					
$107		M	77	5		10						8.5	18	-3.5	-0.19	-35.00										
$108		M	80	5		11											9.1	56	-0.9	-0.02	-8.00		13.5	133	3.5	0.026	35.00
$109		F	77	5		11.5											12.5	56	1.5	0.03	13.64						
$110		F	78	5		9																					
$111		M	81	5		11						14.5	18	3.5	0.194	31.82	11.2	56	2.2	0.04	24.44						
$112		M	78	5		8	10	13	2	0.154	25.00																	
$113		M	73	5		7.5																					
$114		F	78	5		10.5																					
$115		M	78	5		9.5	10	13	0.5	0.038	5.26	8	18	-1.5	-0.08	-15.79	6.7	56	-3.8	-0.07	-36.19		8.2	133	-2.3	-0.017	-21.90
$116		F	78	5		10											7.3	56	-2.2	-0.04	-23.16		10	133	0.5	0.004	5.26
$117		M	80	5		12																					
$118		M	71	5		9																					
$119		F	73	5		10											8.6	56	-2.4	-0.04	-26.67						
$120		M	82	5		12.5											12.2	56	2.2	0.04	22.00						
$121		F	79	5		9																					
$122		M	78	5		11	11.5	13	0.5	0.038	4.55												16.7	135	7.7	0.058	85.56
$123	Sector 3	F	74	5	PGR	10																	14.4	133	3.4	0.041	48.09
$124		M	76	5	PGR	8.5	11.5	13	3	0.231	35.29	8.5	18	0	0	0.00							13.3	133	3.3	0.025	38.00
$125		F	75	5	PGR	9						8.5	18	0.5	0.028	5.56							10.7	133	2.2	0.017	25.88
$126		F	81	5	PGR	12						9	18	-3	-0.17	-25.00											
$127		M	81	5	PGR	13	15	13	2	0.154	15.38				Found dead													
$128		M	75	5	PGR	9																					
$129		F	78	5	PGR	11	12	13	1	0.077	9.09	12	18	1	0.056	9.09											
$130		M	78	5	PGR	12						8	18	-4	-0.22	-33.33											
$131		F	82	5	PGR	13	15	13	2	0.154	15.38						11.8	56	-0.4	-0.01	-3.33						
$132		F	77	5	PGR	10.5																					
$133		F	81	5	PGR	12																					
$134		F	77	5	PGR	10	10	13	0	0	0.00												13.9	133	3.9	0.029	31.67
$135		M	80	5		11.5	8.5	13	-2	-0.15	-17.39	11	18	-0.5	-0.03	-4.35											
$136		F	73	5		8.5																					
$137		F	75	5		9.5	9	13	-0.5	-0.04	-5.26																
$138		M	78	5		9.5																					
$139		F	77	5		10											12.6	56	3.1	0.06	32.63						
Overall mean			76.07	4.93		9.99	11.10		1.37	0.11	15.44	10.01		0.30	0.02	4.45	11.37		1.29	0.02	14.29		13.42		3.53	0.03	37.04
Mean for Sector 1			73.70	4.79		8.99	10.68		1.81	0.12	19.40	9.95		0.42	0.02	6.62	11.29		1.99	0.04	23.63		13.03		3.86	0.03	43.94
Mean for sector 2			77.04	4.96		10.41	11.55		1.20	0.09	12.09	11.08		0.56	0.03	5.48	11.38		0.74	0.01	6.92		13.79		3.38	0.03	33.45
Mean for Sector 3			77.53	5.00		10.53	11.71		0.79	0.06	7.50	9.87		-1.00	-0.06	-8.01	12.10		1.35	0.02	14.65		13.27		3.10	0.02	30.19
Overall standard deviation			4.09	0.31		1.77	2.09		1.68	0.13	19.02	2.39		2.26	0.19	24.29	2.95		2.03	0.04	22.95		2.59		2.25	0.02	25.84
S. d. for sector 1			3.86	0.51		1.55	1.82		1.57	0.12	19.46	2.13		2.24	0.12	25.74	2.12		2.13	0.04	25.61		2.04		1.84	0.01	21.13
S. d. for sector 2			3.94	0.11		1.73	2.29		1.85	0.14	18.32	2.86		2.34	0.13	23.82	2.83		1.82	0.03	18.26		3.05		2.59	0.02	28.41
S. d. for sector 3			3.72	0.00		1.49	2.48		1.73	0.13	17.02	1.54		2.02	0.11	17.23	0.71		2.47	0.04	25.43		2.55		0.82	0.01	3.78

Table 3. Results of analysis of blood collected on Hood Island and Seal Rocks in February 1991

Tag No.	Hb g/L	PCV L/L	MCHC g/L	WBC x10^12/L	N %	N x10^9/L	Bands %	Bands x10^9/L	L %	L x10^9/L	M %	M x10^9/L	E %	E x10^9/L	TP g/L	Protein g/L	AST U/L	ALT U/L	Alk Phos U/L	GGT U/L	CK U/L	Urea mmol/L	Creat umol/L	Gluc mmol/L	Chol mmol/L	Bil umol/L	Na mmol/L	K mmol/L	Na/K ratio	Cortisol nmol/L	S. Prot g/L	Alb g/L	Glob g/L	A/G ratio	Ca mmol/L	P mmol/L	Fe mmol/L
H05 (Hood Island)	149	0.47	319	8.3	72	5.97	0	0.74	12	0.99	6	0.49	1	0.08	62	31	43	759	48	211	10.1	133	6.8	4	17	144	4.1	35	256	57	32	25	1.27	2.55	2.06	18
H10			314	5.3	75	3.97	0	0	23	1.21	2	0.1	0	0	66	79	31	525	35	486	8.7	123	7.8	2.6	17	146	4.1	35	205	65	35	30	1.16	2.52	0.79	21
H11	129	0.39	324	5.5	66	3.63	2	0.11	29	1.59	2	0.11	1	0.05	60	53	31	629	43	176	117		9.1	3.1	11	148	4.2	35	179	58	34	24	1.41	2.68	2.4	27
H12	120	0.37	319	4.8	67	3.28	2	0.09	20	0.98	10	0.49	1	0.04	64	15	16	385	49	256	6.9	167	6.3	2.4	16	140	4.5	31	183	61	34	27	1.26	2.6	2.08	28
H14	129	0.41	312	7.7	73	5.62	0	0	22	1.69	4	0.3	1	0.07	64	16	27	538	49	200	12.1	165	5.9	2.7	13	148	4.5	32	196	63	34	29	1.17	2.62	2.08	21
H16	138	0.43	320	9.6	81	7.77	0	0	13	1.24	4	0.38	2	0.19	64	39	29	506	30	488	13.5	149	7	3.3	23	149	4.6	32	360	62	35	27	1.29	2.58	1.88	23
H21	133	0.42	319	12.6	84	10.58	2	0.25	10	1.26	3	0.37	1	0.12	56	84	33	598	91	369	15.5	177	8.3	1.9	8	143	4	35	499	55	34	21	1.61	2.57	1.83	13
H22	137	0.43	320	11.9	78	9.28	0	0	16	1.9	5	0.59	1	0.11	60	34	38	601	62	358	13.2	149	6.6	2.6	9	149	4.2	35	335	58	34	22	1.54	2.57	2.15	21
H27	131	0.4	328	8.6	75	6.45	2	0.17	16	1.37	6	0.51	1	0.08	56	39	37	558	46	461	11	124	6.9	2.3	10	146	4.3	33	388	57	34	23	1.47	2.6	2	16
H28	121	0.39	306	9.9	72	7.12	1	0.09	14	1.38	12	1.18	1	0.09	64	38	34	1120	84	254	9.8	154	7.4	3.1	11	149	4.9	30	535	61	32	29	1.1	2.63	2.12	11
H30	131	0.41	317	6.1	80	4.88	1	0.06	9	0.54	10	0.61	0	0	70	66	55	390	119	441	17	131	8.7	4	13	148	4.9	30	299	64	36	28	1.28	2.62	1.96	16
H31	123	0.38	308	15.8	78	12.32	2	0.31	9	1.42	9	1.42	2	0.31	60	68	53	374	30	306	9.3	131	7.5	2.6	26	147	4.5	32	219	59	35	24	1.46	2.58	1.53	24
H32	132	0.43	308	17.3	83	14.35	3	0.51	8	1.38	6	0.86	1	0.17	60	45	22	651	85	382	12.5	151	6.4	3.2	10	150	4.6	33	482	55	32	23	1.39	2.58	2.08	18
H36	140	0.44	317	5.1	82	3.16	1	0.05	32	1.63	5	0.25	0	0	72	84	69	691	65	318	15.6	222	8.9	4.1	10	151	5.3	28	383	66	35	31	1.12	2.67	2.02	26
S03 (Sector 1)	120	0.35	342	7.5	83	6.22	0	0	15	1.12	1	0.07	1	0.07		104	29	220	50	987	11.9	118	5.3	3	12	153	5.5	27	106	77	32	45	0.71	2.52	0.56	24
S04	146	0.43	339	10.2	80	8.16	0	0	17	1.73	2	0.2	1	0.1	70	107	36	158		990	13	106	3.9	4.5	11	154	5.8	26	322	68	31	37	0.84	2.44	0.88	16
S06	133	0.38	350	7.2	70	5.04	0	0	22	1.58	5	0.36	3	0.21	76	37	41	1042	69	433	8.4	102	4	4.2	12	152	5	30	50	72	36	36	1	2.57	1.89	27
S11	131	0.39	336	14	79	11.06	0	0	17	2.38	2	0.28	2	0.28		50	33	754	77	539	10	122	4.6	2.4	15	151	4.9	30	179	62	35	27	1.29	2.65	1.68	18
S12	126	0.42	300	11.1	77	8.54	0	0	21	2.33	8	0.88	4	0.44	72	52	90	1397	93	427	11.7	114	6.6	3	15	152	4.7	32	128	70	36	34	1.06	2.62	1.77	37
S14	102	0.29	352	4.5	59	2.65	0	0	35	1.57	1	0.04	5	0.22	72	74	53	1235	26	1558	12.9	108	4.5	3.4	11	155	4.6	32	191	65	34	31	1.1	2.53	1.54	23
S15	125	0.42	301	12.5	81	10.12	6	0.75	10	1.25	2	0.25	1	0.12		142	52	301	60	4200	12.4	114	5.9	3.2	14	149	4.6	32	188	80	34	46	0.73	2.36	0.36	28
S16	126	0.38	332	13.8	76	10.48	0	0	10	1.38	5	0.69	9	1.24	68	43	31	574	82	529	8.9	124	4.5	3	6	151	4.7	32	253	60	33	27	1.22	2.57	1.85	15
S18	139	0.42	333	8.6	81	6.96	0	0	14	1.2	4	0.34	1	0.08	64	95	27	763	80	1708	12.2	103	6.3	3.1	10	149	5	29	65	82	41	41	1	3.03	1.21	20
S19	117	0.35	334	8.2	62	5.08	0	0	28	2.29	4	0.32	6	0.49	76	166	44	30	35	1061	10.5	102	4.8	5.1	15	146	5.3	27	75	70	34	36	0.94	2.43	1.3	51
S22	128	0.37	348	9.3	77	7.16	0	0	20	1.86	2	0.18	1	0.09	76	101	44	754	65	1427	9.2	111	4.3	2.5	12	155	5.4	28	123	67	36	31	1.16	2.67	1.83	5
S25	137	0.43	318	11.4	78	8.89	0	0	18	2.05	2	0.22	2	0.22	64	56	31	535	42	566	8.2	114	5.6	1.8	14	154	5	30	202	62	35	27	1.3	2.47	1.66	16
S27	125	0.36	347	13.5	71	9.58	0	0	29	3.7	6	0.81	3	0.4	66	34	17	391	78	323	10.9	122	3.1	2.4	10	149	5.3	28	235	57	33	24	1.37	2.58	1.84	17
S45 (Sector 2)	118	0.37	319	8.9	51	4.53	1	0.08	39	3.47	4	0.35	5	0.44	74	54	51	855	70	375	3.6	112	3.4	4.3	11	150	5.4	27	130	69	36	33	1.09	2.73	1.82	26
S46	117	0.36	325	11	74	8.14	2	0.22	19	2.09	5	0.55	0	0	74	40	33	455	50	420	9.1	117	3	3.2	12	152	5.1	29	175	70	37	33	1.12	2.69	1.93	17
S48	132	0.42	314	10.2	58	5.91	1	0.1	27	2.75	8	0.81	6	0.61	66	39	40	928	50	330	6.1	128	4	3	10	152	5.3	28	140	61	34	27	1.25	2.62	2.03	25
S50	130	0.4	325	10.2	52	5.3	1	0.1	40	4.08	5	0.51	2	0.2	72	39	33	723	54	528	9.5	130	5	3.6	9	153	5.5	27	155	66	34	32	1.06	2.75	2.09	30
S51	122	0.36	339	7.8	72	5.61	0	0	24	1.87	4	0.31	0	0	66	59	30	1039	23	967	8.7	102	4.1	3.9	13	153	5.1	30	181	65	34	31	1.1	2.55	1.72	24
S52	134	0.4	335	17.9	69	12.35	1	0.17	24	4.29	4	0.71	0	0	72	49	41	539	156	478	17	113	3.1	1.8	10	154	4.8	32	350	65	36	29	1.24	2.65	1.83	17
S53	122	0.35	348	7.4	77	5.69	0	0	22	1.62	1	0.07	0	0	66	52	28	693	81	499	7.5	88	6.2	3.4	12	150	4.9	30	108	62	34	28	1.21	2.69	1.62	27
S55				7.3	78	5.69	0	0	17	1.24	4	0.29	1	0.07		48	38	675	63	381	7.9	104	5.1	2.4	13	151	5.3	28	159	70	33	37	0.89	2.7	1.53	18
S56	119	0.36	347	9.3	51	4.74	0	0	33	3.06	4	0.37	12	1.11	72	35	36	844	54	437	5.8	112	3.9	4.9	11	152	5.1	29	105	65	35	30	1.16	2.77	1.67	28
S57	115	0.35	328	9.6	75	7.2	0	0	20	1.92	4	0.38	1	0.09	80	111	55	180	95	575	7.1	88	5.2	3.4		142	4.9	28	142	75	37	38	0.97	2.4	0.18	30
S58	114	0.34	335	7	72	5.04	0	0	23	1.61	3	0.21	2	0.14	74	48	61	973	84	360	11.1	90	6.5	3.3	10	150	4.3	34	121	71	36	35	1.02	2.78	1.97	24
S59	118	0.35	337	7.1	80	4.26	0	0	31	2.2	2	0.14	7	0.49	74	76	39	917	57	880	4.2	104	5.9	2.9	11	148	4.7	31	83	69	37	32	1.15	2.68	1.89	24
S123 (Sector 3)	123	0.37	332	12.6	70	8.82	0	0	25	3.15	3	0.37	2	0.25	72	54	42	570	44	1420	12.5	148	4.3	2.6	12	154	5.2	29	188	69	35	34	1.02	2.58	1.97	40
S124	128	0.38	337	12.5	76	9.5	0	0	20	2.5	1	0.12	3	0.37	64	38	30	697	31	212	11.3	120	4.5	3.7	14	155	5.1	30	109	63	33	30	0.9	2.54	1.86	25
S125	131	0.37	354	8.6	58	4.98	0	0	36	3.09	5	0.43	1	0.08	60	20	22	683	65	234	8.8	123	4.4	2.4	6	154	5	30	154	56	33	23	1.43	2.56	2.09	17
S126	112	0.31	361	8.8	76	6.68	0	0	20	1.76	3	0.26	1	0.08	68	39	37	523	40	309	6.3	111	4.6	2.3	8	154	5.3	29	186	66	36	30	1.2	2.63	2.03	31
S127	122	0.36	338	12.6	73	9.19	0	0	16	2.01	7	0.88	4	0.5	62	26	34	424	37	215	8.7	138	3	2.3	10	155	5.6	27	210	60	35	25	1.38	2.51	2.06	22
S128	135	0.44	306	9.4	80	7.52	0	0	17	1.59	1	0.09	2	0.18	66	38	15	474	70	208	24.2	111	4.8	4.8	12	157	4.9	32	159	65	33	32	1.03	2.71	2.03	31
S129	124	0.36	344	10	62	6.2	0	0	31	3.1	6	0.6	1	0.1	62	31	32	580	46	548	10.1	130	4.3	3.2	10	158	4.9	31	155	60	35	25	1.4	2.6	2.07	40
S130	121	0.35	346	10.2	67	6.83	0	0	26	2.65	4	0.4	3	0.3	64	58	41	303	25	472	6.8	122	4	2	14	153	5.4	28	190	63	36	27	1.33	2.58	1.57	27
S131	121	0.37	327	11.6	64	7.42	0	0	27	3.13	2	0.23	7	0.18	60	28	33	510	63	205	8.5	124	3.4	3.4	9	154	5.3	29	142	56	32	24	1.33	2.61	2.05	17
S132	84	0.23	365	6.3	70	4.41	0	0	27	1.7	2	0.12	1	0.06	76	199	52	811	15	7130	16.2	131	5.5	2.6	13	153	5.7	26	151	75	37	38	0.97	2.51	1.15	34
S133	125	0.37	338	13	85	11.05	0	0	10	1.3	1	0.13	4	0.52	74	28	26	474	57	381	14.6	127	3.5	4.4	6	152	5.1	29	237	73	35	38	0.92	2.75	2.1	29
S134	117	0.36	325	13.8	55	7.59	0	0	38	5.24	4	0.55	3	0.41	70	34	30	371	36	282	9.6	121	2.7	2.5	8	153	5.3	28	132	66	36	30	1.19	2.73	1.67	31
Overall mean	126	0.38	330	9.87265	71.5	7.1171	0.73	0.0745	21.4	2.028	4.2	0.4153	2.35	0.225	67.91489	56.3	37.5	618.04	59.2	730	12.6	124.6	5.282	3.137	11.86	150.7	4.937	30.2	205.45	64.922	34.6	30.3	1.16902	2.61	1.7349	23.765
Overall S.D.	10.8	0.04	15.6	3.10304	9.03	2.6137	1.61	0.1681	8.39	0.925	2.54	0.2919	2.48	0.254	6.310205	36.7	13.6	271.01	26	1109	15.37	24.08	1.593	0.814	3.69	3.686	0.44	2.5	109.38	8.4245	1.74	5.72	0.19987	0.11	0.4688	8.123
Hood Is. mean	132	0.41	316	9.18571	74.7	7.0271	1.79	0.17	16.6	1.327	5.93	0.5471	0.93	0.094	62.85714	47.9	37	594.64	59.7	335	19.3	152	7.257	2.993	13.79	147	4.471	32.6	321.36	59.929	34	25.9	1.32357	2.6	1.9271	20.071
Seal Rocks mean	123	0.37	335	10.1324	70.2	7.1511	0.32	0.0384	23.2	2.294	3.54	0.3654	2.89	0.274	70.06061	62.3	37.8	624.14	59	879	10.06	114.9	4.535	3.192	11.14	152.1	5.114	29.3	181.59	68.811	34.8	32	1.11054	2.61	1.6622	25.162
Sector 1 mean	127	0.38	333	10.1385	74.9	7.6877	0.46	0.0577	19	1.803	3.38	0.3569	3	0.305	72.4	81.6	40.6	627.23	63.1	1133	10.63	112.3	4.677	3.2	12.08	151.5	5.077	29.5	162.85	68.615	34.6	34	1.05538	2.57	1.3977	22.846
Sector 2 mean	122	0.37	332	9.475	65.8	6.205	0.5	0.0568	26.6	2.517	4	0.3917	3	0.263	71.61818	54.2	39.6	709.92	69.8	517	8.05	107.2	4.617	3.342	11.09	150.5	5.033	29.4	154.08	67.333	35.3	32.1	1.105	2.67	1.7087	24.167
Sector 3 mean	120	0.36	339	10.7833	69.7	7.5158	0	0	24.4	2.802	3.25	0.2483	2.67	0.253	66.5	49.4	32.9	535	44.1	988	11.45	125.5	4.083	3.033	10.17	154.2	5.233	29	187.75	64.333	34.7	29.7	1.17583	2.61	1.8042	28.057

Table 4. Results of analysis of blood collected on Hood Island and Seal Rocks in April 1991

Tag No.	Hb g/L	PCV L/L	MCHC g/L	RBC x10^12/L	N %	N x10^9/L	Bands %	Bands x10^9/L	L %	L x10^9/L	M %	M x10^9/L	E %	E x10^9/L	TP g/L	Protein	AST U/L	ALT U/L	Alk Phos U/L	GGT U/L	CK U/L	Urea mmol/L	Creat umol/L	Gluc mmol/L	Chol mmol/L	Bil umol/L	Na mmol/L	K mmol/L	Na/K	Cortisol nmol/L	S. Prot g/L	Alb g/L	Glob g/L	A/G ratio	Ca mmol/L	P mmol/L	Fe mmol/L
H04 (Hood Is.)	142	0.43	330	6.50	53	3.78	2	0.13	31	1.86	8	0.48	6	0.36	72		79	34	439	48	1043	7.8	120	5	5.6	7	144	4.3	34	180	68	35	33	1.06	2.5	1.73	19
H05	118	0.39	303	9.90	53	5.24	1	0.09	39	3.76	6	0.59	2	0.19	82		46	34	327	60	814	8.3	117	3.4	6.5	11	144	3.9	36	245	75	35	40	0.87	2.61	1.82	14
H06	111	0.34	326	8.20	58	4.75	1	0.06	29	2.37	6	0.49	6	0.49	76		63	17	256	116	889	12.4	99	4	6.5	10	145	3.9	37	140	71	35	36	0.97	2.44	1.66	31
H07	142	0.48	310	10.00	31	3.10	0	0	60	6	5	0.5	4	0.4	80		28	25	357	63	231	10.5	117	5.8	6.7	7	142	3.8	37	150	72	35	37	0.94	2.64	2.13	28
H30	111	0.34	326	6.80	65	4.29	0	0	25	1.65	4	0.26	6	0.39	72		32	27	291	64	279	7.4	114	3.8	6.3	9	144	3.9	36	210	67	35	32	1.09	2.57	1.76	50
H32	121	0.37	327	7.70	62	4.77	0	0	35	2.69	2	0.15	1	0.07	72		29	29	452	78	263	4.1	120	4.8	6.5	7	143	4.4	32	295	68	33	35	0.94	2.52	1.74	29
H33	113	0.34	332	8.50	60	5.10	0	0	25	2.12	8	0.51	9	0.76	72		44	44	337	41	371	9.5	123	4.7	5.4	7	144	4.6	31	315	66	36	30	1.2	2.57	2.12	38
H37	134	0.44	306	7.10	57	4.04	0	0	38	2.76	5	0.21	1	0.07	72		51	30	489	63	1234	6.8	116	4.1	6.2	8	141	4.3	32	335	70	34	36	0.94	2.56	1.81	22
?	130	0.43	300	7.50	68	4.35	0	0	39	2.92	2	0.15	1	0.07	72		61	33	356	58	916	9.2	121	3.8	5.1	8	142	4.3	33	105	68	36	32	1.12	2.56	2.15	25
?	145	0.48	302	8.10	61	3.72	0	0	34	2.07	2	0.16	6	0.05	72		56	31		43	470	10.1	93	3.8	6.4	8				70	72	34	38	0.89			27
?	117	0.37	316	7.80	56	3.80	0	0	43	3.26	2	0.15	5	0.38	78		30	36	592	48	511	14.9	113	4	6.3	6	145	3.8	40	180	67	38	29	1.31	2.74	2.06	39
?	105	0.40	337	5.80	45	2.61	0	0	53	3.07	2	0.11	0	0	68		21	22	170	112	196	16.4	117	5.1	7.1	9	147	4.3	34	405	62	33	29	1.07	2.6	1.7	11
S02 (Sector 1)	111	0.35	312	8.56	54	4.56	0	0	42	3.57	1	0.08	3	0.25	72		75	32	389	32	1357	8.6	130	6.9	5.8	9	143	4.5	31	74	70	35	35	1	2.59	2.01	26
S04	137	0.43	318	7.50	62	3.90	0	0	43	3.22	4	0.3	1	0.07	78		43	18	369	85	587	24.7	105	8.6	6.1	8	143	4.6	31	250	78	35	41	0.85	2.72	2.37	19
S06	113	0.37	305	5.90	67	3.95	0	0	20	1.18	4	0.23	0	0.53	68		19	21	297	78	257	9.9	112	5.6	5.9	8	144	4.2	34	295	63	32	31	1.03	2.5	1.98	9
S13	112	0.35	320	7.80	46	3.49	0	0	48	3.84	2	0.15	4	0.3	74		73	45	263	66	1501	8.8	110	7.1	5.6	12	143	3.9	36	125	76	37	39	0.94	2.31	1.35	21
S17	107	0.31	345	6.80	58	3.94	0	0	39	2.65	1	0.06	2	0.13	84		57	34	285	62	1462	6.5	148	6.3	5.4	7	142	4.4	32	210	68	34	34	1	2.57	1.98	8
S24	116	0.36	305	9.10	60	5.46	0	0	30	2.73	3	0.27	7	0.63	66		57	18	882	66	778	8.5	124	4.9	6.3	8	141	4.2	33	140	77	37	40	0.92	2.71	1.87	17
S25	119	0.35	340	8.80	40	3.52	0	0	54	4.75	4	0.35	2	0.17			32	39	339	54	352	10.6	123	8.9	5.3	9	144	4.1	35	160	71	36	35	1.03	2.63	1.83	52
S31	134	0.43	944	8.50	52	4.42	0	0	46	3.91	1	0.08	1	0.08	62		17	20	366	54	194	11.4	124	5.3	4.3	9	143	4.5	31	175	60	34	26	1.31	2.48	1.8	17
S41	122	0.40	305	8.40	52	4.36	0	0	42	3.53	3	0.25	3	0.25	84		39	33	416	71	428	8.8	118	4.8	5.4	8	143	4.2	34	120	75	37	38	0.95	2.59	1.88	14
S45 (sector 2)	119	0.38	307	10.10	43	4.24	0	0	51	5.15	3	0.3	4	0.4	80		30	39	442	75	237	8.8	120	6.2	4.8	7	140	4.4	31	125	69	33	36	0.92	2.63	1.98	22
S50	154	0.49	311	6.80	46	3.12	1	0.06	47	3.19	4	0.27	2	0.13	82		40	24	468	61	428	17.4	117	6.6	6.2	9	144	4.7	30	180	82	36	46	0.78	2.6	2.11	11
S56	131	0.40	327	8.30	43	3.99	0	0	46	4.27	2	0.18	0	0.63	72		26	29	399	66	224	6.9	126	6	3.9	6	142	4.9	33	155	62	35	27	1.3	2.59	2.2	31
S60	123	0.37	332	10.30	67	6.90	0	0	28	2.88	3	0.3	2	0.2	68		45	21	260	26	311	4	127	6.8	5.1	10	140	3.7	37	235	68	34	32	1.06	2.49	1.8	21
S80	104	0.31	335	8.40	65	4.62	1	0.06	35	2.94	5	0.42	4	0.33	72		202	56	303	14	6745	7	117	7.4	6.1	10	141	4	35	80	70	36	35	1	2.38	0.8	45
S84	62	0.27	341	7.80	48	3.74	0	0	48	3.74	3	0.15	2	0.15	68		20	25	517	56	210	7.4	144	6.9	5.1	7	142	4.3	33	87	63	35	28	1.25	2.63	1.84	15
S85	156	0.46	339	7.00	25	1.75	0	0	71	4.97	3	0.21	1	0.07			41	21	513	88	317	13.7	112	6.9	5.8	8	142	3.7	38	120	73	36	37	0.97	2.68	1.92	110
S102	111	0.36	306	7.70	64	4.92	0	0	24	1.84	5	0.38	7	0.53	74		124	45	449	60	4660	6.7	102	7	6.8	8	140	4.1	34	57	71	33	38	0.86	2.48	1.78	33
S103	134	0.40	335	4.50	67	3.01	1	0.04	28	1.26	3	0.09	2	0.09	78		25	26	865	44	287	7.6	137	7.9	4.6	9	137	3.9	35	185	72	35	37	0.96	2.58	1.33	21
S107	107	0.34	315	7.00	58	4.13	0	0	34	2.38	4	0.28	3	0.21	78		50	30	288	58	832	9.5	105	8.3	5.7	10	141	4	35	115	72	35	37	0.84	2.47	1.49	18
Overall mean	124.27	0.39	336.15	7.78	52.91	4.08	0.21	0.01	38.97	3.14	3.30	0.26	3.61	0.27	75.10		54.00	30.65	414.42	65.50	1084.21	9.94	118.38	5.70	5.84	8.44	142.64	4.19	33.81	171.91	69.97	34.85	35.15	1.01	2.57	1.83	29.53
Overall S.D	15.33	0.05	109.67	1.35	10.21	0.84	0.48	0.03	11.38	1.13	1.67	0.14	2.60	0.21	5.72		45.37	8.91	177.20	25.41	1859.21	4.65	12.19	1.30	0.77	1.37	1.95	0.37	2.79	84.99	5.01	1.46	6.50	0.14	0.10	0.33	18.56
Hood Is. mean	127.23	0.40	318.62	7.65	53.15	4.01	0.31	0.02	36.85	3.00	3.85	0.30	3.85	0.26	74.31		43.69	30.15	386.08	71.08	565.31	9.82	113.31	4.32	6.15	7.92	143.92	4.09	34.82	220.38	69.00	34.86	34.15	1.03	2.59	1.96	25.31
Seal Rocks mean	122.35	0.38	352.15	7.89	52.75	4.13	0.15	0.01	40.70	3.24	2.96	0.23	3.45	0.27	75.67		60.38	30.95	430.62	62.05	1405.43	10.00	121.52	6.55	5.66	8.78	141.90	4.24	33.33	141.90	70.57	34.86	35.76	0.96	2.54	1.79	27.29
Sector 1 mean	119.00	0.37	366.22	7.90	53.44	4.18	0.00	0.00	40.44	3.24	2.56	0.20	3.56	0.27	76.00		63.20	29.60	371.30	61.70	1613.10	11.62	121.00	8.21	6.55	8.00	142.80	4.41	32.30	163.00	70.30	34.90	35.50	0.98	2.55	1.86	26.30
Sector 2 mean	125.09	0.39	322.64	7.87	52.18	4.08	0.27	0.02	40.91	3.23	3.27	0.26	3.36	0.27	75.40		57.82	32.18	484.55	62.36	1216.64	8.54	121.18	6.85	5.75	8.64	141.09	4.08	34.27	121.91	70.82	34.82	34.86	0.99	2.57	1.73	30.64

Table 5. Comparison of blood resluts collected in February and April 1991

Tag No.	Blood collection date	Hb g/L	PCV L/L	MCHC g/L	WBC x10^9/L	N %	N x10^9/L	Bands %	Bands x10^9/L	L %	L x10^9/L	M %	M x10^9/L
H30	21-Feb-91	181	0.41	317	6.10	80	4.88	1	0.06	9	0.54	10	0.61
	20-Apr-91	111	0.34	326	6.90	65	4.29	0	0	25	1.86	4	0.26
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
H32	21-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	20-Apr-91	121	0.37	327	7.70	62	4.77	0	0	36	2.80	2	0.15
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S34	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	137	0.48	310	7.60	52	3.90	0	0	43	3.22	4	0.3
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S36	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	119	0.35	340	6.80	40	3.52	0	0	54	4.75	4	0.35
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S12	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S14	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	131	0.40	327	6.90	43	3.89	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean variation (%)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean	Feb-91	125.57	0.39	321.72	8.67	71.47	7.12	0.78	0.07	21.41	2.03	4.20	0.42
	Apr-91	124.27	0.39	330.15	7.79	52.81	4.08	0.21	0.01	38.97	3.14	3.30	0.26
	% age variation	-1.03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	127.29	0.40	316.62	7.65	53.16	4.01	0.31	0.02	38.65	3.00	2.86	0.30
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	122.85	0.38	352.16	7.88	52.75	4.13	0.16	0.01	40.70	3.24	2.96	0.23
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 1 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	118.00	0.37	300.22	7.80	53.44	4.13	0.00	0.00	40.44	3.24	2.58	0.20
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 2 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	125.09	0.39	322.84	7.87	52.18	4.06	0.27	0.02	40.81	3.29	3.27	0.26
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Tag No.	Blood collection date	E %	E x10^9/L	TP Protein g/L	AST U/L	ALT U/L	Alk Phos U/L	GGT U/L	CK U/L	Urea mmol/L	Creat umol/L	Gluc mmol/L	Chol mmol/L
H30	21-Feb-91	0	0	70	66	55	880	119	441	17	131	6.7	4
	20-Apr-91	4	0.38	72	92	27	201	94	276	7.4	114	5.0	6.8
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
H32	21-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	20-Apr-91	1	0.07	72	29	29	452	79	268	4.1	120	4.8	6.6
	% age variation	[illegible]	[illegible]	[illegible]	-21	[illegible]	-31	-8	-27	+87	+21	+29	103
S34	23-Feb-91	[illegible]	[illegible]	[illegible]	107	[illegible]	156	[illegible]	990	13	100	2.9	4.5
	21-Apr-91	1	0.07	78	43	[illegible]	680	65	697	24.7	105	0.0	6.1
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S36	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	2	0.17		82	30	330	[illegible]	382	10.8	128	6.9	6.8
	% age variation	[illegible]	[illegible]	-100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S12	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S14	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean variation (%)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean	Feb-91	2.35	0.22	67.01	56.38	37.55	616.04	58.18	729.84	12.00	124.58	5.28	3.14
	Apr-91	3.61	0.27	75.10	54.00	30.65	414.42	65.50	1084.21	9.94	119.30	5.70	6.04
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	3.85	0.26	74.31	43.89	30.15	388.08	71.00	565.91	9.92	113.81	4.92	6.15
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	3.46	0.27	75.67	40.36	30.65	430.82	82.06	1405.48	10.00	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 1 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	3.56	0.27	76.00	63.20	29.60	371.30	61.70	1013.10	11.02	121.90	6.21	5.65
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 2 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	3.96	0.27	76.40	67.82	32.18	484.56	62.36	1218.64	8.54	121.18	6.05	5.75
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Tag No.	Blood collection date	Bil umol/L	Na mmol/L	K mmol/L	Na/K	Cortisol nmol/L	[illegible] Prot g/L	Alb g/L	Glob g/L	A/G ratio	Ca mmol/L	P mmol/L	Fe mmol/L
H30	21-Feb-91	19	148	4.9	30	289	64	34	28	1.29	2.42	1.86	18
	20-Apr-91	9	144	5.0	36	210	87	35	32	1.00	2.57	1.76	50
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
H32	21-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	20-Apr-91	7	148	4.4	32	295	88	63	35	0.94	2.52	1.74	20
	% age variation	[illegible]	[illegible]	+2	+3	-31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S34	23-Feb-91	[illegible]	[illegible]	5.8	26	322	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	8	148	4.8	31	250	78	35	41	0.95	2.72	2.97	19
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S36	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	9	144	4.1	35	180	71	36	35	1.08	2.03	1.80	62
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S12	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S14	23-Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21-Apr-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean variation (%)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall mean	Feb-91	11.86	150.07	4.94	30.20	205.46	84.02	34.01	50.31	1.17	2.61	1.73	23.76
	Apr-91	8.44	142.64	4.18	33.91	171.01	90.97	34.85	55.16	1.01	2.57	1.83	26.53
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	7.82	143.82	4.09	34.92	220.90	80.00	34.05	34.15	1.03	2.50	1.90	26.81
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	6.79	141.90	4.24	[illegible]	141.90	70.57	34.00	35.78	[illegible]	[illegible]	1.79	27.29
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 1 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	5.90	142.90	4.41	[illegible]	[illegible]	[illegible]	[illegible]	35.50	0.96	[illegible]	1.86	20.30
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sector 2 mean	Feb-91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr-91	8.84	141.09	4.06	34.27	121.81	70.82	34.82	36.00	0.96	2.57	1.73	33.64
	% age variation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 6. Mass (kg) and sample size of pups weighed on Hood Island, Seal Rocks and Libke Island.

Date	Seal Rocks-tota	Sector 1	Sector 2	Sector 3	Hood Island	Libke Island
Release	9.99 (n=139)	8.99 (n=43)	10.41 (n=79)	10.53 (n=17)	9.97 (n=37)	10.73 (n=13)
Day 13	11.1 (n=58)	10.68 (n=31)	11.55 (n=20)	11.71 (n=7)	9.19 (n=21)	12.19 (n=40)
Day 18	10.01 (n=50)	9.35 (n=26)	11.08 (n=18)	9.67 (n=6)	8.74 (n=17)	
Day 56	11.37 (n=53)	11.29 (n=23)	11.38 (n=28)	12.1 (n=2)	11.29 (n=22)	12.01 (n=40)
Day 133	13.42 (n=44)	13.02 (n=16)	13.7 (n=25)	13.27 (n=3)	14.2 (n=22)	13.76 (n=40)

Figure 1. Changes in mass of fur seal pups