REPORT

Prepared for
The New Zealand King Salmon Co. Ltd.

August 2016

M.W. Cawthorn

Cawthorn and Associates

Plimmerton

Porirua 5026

Contents

REQUIREMENTS OF THIS REPORT

(a) To review background information (including past NZKS Marine Mammal Report 2012) and collect relevant updated information and;

(b) Provide an updated Marine Mammal Report on: The effects of relocating up to six existing farms to 9 proposed relocation sites; and the effects of removing the six existing farms away from the existing sites. Comment on any risks to Hector's dolphins associated with the use of steel cages and plastic circle type pens with regard to NZCPS policy 11.

1. New Zealand King Salmon PROPOSAL

Removal of up to six existing salmon farms from existing sites and relocation to eight potential sites in the Marlborough Sounds.

This document provides an updated assessment of the population status of marine mammals in the Marlborough Sounds area and potential effects on those marine mammal species from salmon farm removals and relocations previously described in a report by Cawthorn & Associates commissioned by New Zealand King Salmon (NZKS) in 2012[1].

For the purposes of this document, the proposed salmon farm sites have not been treated as single entities and thus names of farm sites do not generally occur as the effects of relocation on fur seals and cetaceans are likely to be similar at each location. However, the Waitata Reach site and the two Blowhole Point sites have been named because one of the proposed locations in the centre of a 2.5km expanse of water (Waitata) in outer Pelorus Sound differs from other proposed sites and the Waitata and Blowhole Point farms are all proposed to have plastic circle pens.

2. RATIONALE FOR RELOCATION

Optimal performance of marine salmon farms in the Marlborough region requires that the farm sites be located in areas with consistently good water flow and annual water temperatures ranging from 12°C to about 15°C. These parameters ensure optimal fish growth and health. When water temperatures exceed 17°C fish become lethargic, go off their feed growth rates slow and mortalities increase (Karen Mant NZKS. pers comm). Six of the current farm sites are located in sub-optimal, low current flow areas.

[1] Cawthorn, M.W. 2012 Marine Mammals and Salmon Farms. Report prepared for The New Zealand King Salmon Co. Ltd.

3. FARM SITES

As of April 2016, NZKS has 11 farm sites in Pelorus Sound, Queen Charlotte Sound, and Tory Channel and, as at April 2016, is operating 5 farms on these sites (see below).

Table 1 - Current NZKS Farm Sites in the Marlborough Sounds

LOCATION	FARM	CURRENT STATUS
Pelorus Sound	Waihinau	Fallowed as at Dec 2015
	Forsyth	Fallowed as at January 2016
	Waitata	Operating since Jan 2016
	Kopāua (Richmond)	Operating since May 2016
	Crail Bay x 2	Sites currently fallowed
Tory Channel	Te Pangu	Operational
	Clay Point	Operational
	Ngamahau	Operating since Oct 2015
Queen Charlotte	Ruakaka	Operational
	Otanerau	Operational April – Dec annually

(Data supplied by NZKS)

4. SALMON PRODUCTION

The approximate annual production of salmon of about 7,000 tonnes is unchanged from 2012. (K. Mant NZKS pers comm)

5. FARM STRUCTURES

All the farm sites currently in use by NZKS use steel pen structures, frequently referred to in the industry as “System Farms”. Most of these were developed by NZKS but the two most recent in Pelorus (Waitata and Kopāua) use steel hinged pens, as described below, perfected by NZKS. Although floating Polar Circle type pens have not been used in the past, it is possible that improved Polar Circle pens will be deployed at future sites including three at each of the Blowhole Point sites and five at Waitata.

6. PEN TYPES

6.1. Steel System Pens and Hinged System Pens

Single rectangular steel structures incorporating a single or paired row of 40m x 40m x 20m ± deep pens. New generation net pens have hinge-like joins to allow the structure to flex and better ride swells and waves.

6.2. Flotation

Flotation is provided by steel tubes of up to 0.9m diameter on the rigid NZKS developed pens and plastic floats under the new flexible steel pens.

6.3. Protection Netting

Tensioned 240mm stretched mesh Protection Netting encloses the entire structure underwater and may extend 2m or more above the water level. NZKS no longer uses antifouling coatings on its nets (apart from a trial currently being held at Te Pangu). Anti-bird netting is slung across the top of every salmon pen to prevent predation by gulls and other seabirds.

7. PLASTIC POLAR CIRCLE TYPE PENS

Plastic Polar Circle pens are an international industry standard. They ride open seas well and are easily moved from site to site. They are flexible circular polyethylene pipe pens hung with two layers of synthetic netting to contain fish and provide protection from predation by fur seals. The circumference of the pen is normally used to designate pen size. The plastic circle pens proposed to be deployed at the Waitata site will be approximately 235.5m circumference (~ 75m dia.) and set at 15m-20m intervals between pens. Netting is suspended from the circular float system to about 20m depth. Each pen will be surrounded with all-enclosing anti-predator netting of 3.5mm x 104mm square mesh. The wall of the predator net is firmly tensioned to NZKS industry standard by a weighted sinker-ring attached to the bottom circumference of the predator net. The interior fish holding grow-out net is attached by evenly spaced lines around its bottom circumference to the sinker ring. An even space of 1-2m is maintained under water between the grow-out net and the anti-predator net at all times, while anchored and when the pen is being moved from site to site.

A walkway for staff surrounds each pen just above sea level. The grow-out pens containing fish are extended above the water to form a ‘jump-net’, approximately 1.4m high, which prevents salmon jumping out of the grow-out pen. Pens are protected from seal incursions at the sea surface by vertical extension of the anti-predator net, 1.5m-2.0m high, preventing seals from climbing over the structures into the fish pens. Each plastic circle pen is covered by anti-bird netting to prevent fouling and incursions by seabirds.

8. TENSIONING OF CIRCLE PEN NETTING

In a 2012 report to NZKS this author suggested, on the basis of a personal communication, that "flexible" Polar Circle type pens did not readily allow for adequate net tensioning through the base of the nets resulting in a high incidence of seal attacks and dolphin entanglements" (in Australian waters). However, the continuing development of pens for open seas and improvements to net tensioning has allayed the above concerns. Correct tensioning of the inner grow-out nets and the predator netting is vital for the exclusion of fur seals from plastic circle pen structures. Detailed experimentation on salmon cage performance and materials was conducted in Tasmania and published in 1999.[2] One method suggested to achieve the correct shape of the grow-out net is to taper the meshes of the grow-out pen netting panels to the base, while those of the predator net remain uncut to hang vertically. Those forming the flat, taut base of the predator net are cut like "pie wedges" to fit the circular base. The result is that the grow-out pen is slightly conical and hangs clear inside the predator netting. The heavy sinker-ring is attached around the circumference of the predator net base. The base of the grow-out pen in turn is attached by evenly spaced connections to the sinker-ring maintaining a clear buffer zone between it and the exterior predator net preventing seals from pushing the two nets together to attack the enclosed salmon. With the nets tensioned in this way, seals cannot get access to the fish either when the plastic circle pen is anchored or being towed between sites (M. O'Malley pers com).

9. SECURING NET PENS

All net pens, many of which are subject to strong current flows, have 20–30 screw anchors which are wound into the seabed with minimal disturbance to the substrate. The total length of most anchor warps is about 100m from the floating structure to the sea bed. This length allows good holding and accommodates the tidal changes.

10. CURRENT CONSERVATION STATUS OF MARINE MAMMALS

DOC New Zealand uses the New Zealand Threat Classification System (NZTCS) to establish the conservation status for all marine mammals and other species.

Table 2 - Threat Status listings for marine mammals mentioned in text

[2] Schotte, R and Pemberton, D. 1999. Development of a stock protection system for flexible oceanic pens containing finfish. FRDC Project No. 99/361. 85pp.

Common Name	NZ Threat Classification (Baker et al. 2013)	IUCN Listing (www.redlist.org)
Humpback whale*	Migrant	Endangered
Southern right**	Nationally vulnerable	Least concern
Killer whale***	Nationally critical	Data deficient
Bottlenose dolphin	Nationally endangered	Data deficient
Dusky dolphin	Not threatened	Data deficient
Common dolphin	Not threatened	Least concern
Hector's dolphin****	Nationally endangered	Endangered
NZ fur seal	Not threatened	Least concern

* Humpback whale Oceania population.

** Southern right whales were moved from Nationally Endangered to Nationally Vulnerable in response to a recently published population increase (see 11.1)

*** Killer whale. Following research by Eisert et al. (2015) this classification may need to be reviewed.

**** Hector's dolphin. Since the revision in population size the threat classification of this species may be reviewed in 2018.

11. NUMBERS AND SEASONALITY OF MARINE MAMMALS IN THE AREA

11.1. New Zealand fur seals

Fur seals are the principal predator on caged salmon in New Zealand. At the time of first human arrival in New Zealand in the 13th century, the fur seal population possibly numbered at least 2 million[3]. Fur seals occupied non-breeding haulouts and breeding colonies around the entire country, on all the offshore and outlying islands, from the Three Kings north of the North Island to the Chatham Islands in the east and all the subantarctic islands.

Fur seals were an important food source for Maori and at the Chatham Islands were taken sustainably by Moriori for both food and clothing. Five centuries later, Europeans discovered New Zealand and large scale commercial sealing began. By the mid-19th century the population had been reduced to commercial non-viablity. Sealing ceased and the population began the slow climb to recovery.

[3] Cawthorn, M.W. 2012. ibid.

Full protection of fur seals and all other marine mammals was promulgated under the Marine Mammal Protection Act 1978. In 1981 the first attempt to make a comprehensive population estimate of New Zealand fur seals resulted in an estimate of 55,000 with the comment "probably increasing"[4] The population is currently expanding, particularly around mainland New Zealand and on the offshore islands. Based on this knowledge it was speculatively suggested the New Zealand-wide population size could be between 100,000 to 200,000 animals[5]. From 1970-71 to 1995, the Cook Strait-Marlborough fur seal population increased at rates estimated up to 25% per year and began infiltrating the outer Marlborough Sounds, Queen Charlotte, Kenepuru and Pelorus Sounds and was described as being in a vigorous 're-colonisation' phase[6].

The largest breeding colony in Cook Strait is at Stephens Island where the population in 1994 was estimated to be about 1352, with 200-300 pups born annually.[7] During a count of sexes and age classes of fur seals at the Trio Islets in January 2007, between D'Urville Island and the Chetwode Islands, 51 pups were recorded suggesting an established breeding colony exists on this group[8]. This count is the last to have taken place in this area as fur seals are officially classified as 'Not Threatened'[9] nationally and ongoing census effort is not deemed a priority by DOC.

New Zealand fur seals congregate at breeding colonies from mid-November to mid-January to pup and mate. Female seals normally give birth to a single pup which is suckled by its mother for about 8 months and weaned in the spring. Post-weaning juvenile seals will roam considerable distances from their natal colonies. Wherever possible, fur seals will haulout on accessible coasts as close to their food sources as possible. In the Marlborough Sounds fur seals have established non-breeding haulouts on accessible promontories close to salmon farms, such as Parea Pt. on the western side of Otanerau Bay and in some instances will climb onto farm structures[10].

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[4] Wilson, G.J. 1981. Distribution and abundance of the New Zealand fur seal *Arctocephalus forsteri*. New Zealand Fish. Res. Div. Occas. Publ. 20.

[5] Taylor, R. 1992 "Straight through from London: the Antipodes and Bounty Islands, New Zealand" Heritage Expeditions.

[6] Baird, S.J. 2001. New Zealand fur seals – summary of current knowledge. NZ Aquatic Environment and Biodiversity Report # AEBR 72. 50p.

[7] Cawthorn, M.W. 2012. ibid.

[8] Boren, L. pers. comm. 2012

[9] Baker, C.S. et al. 2016. Conservation status of New Zealand marine mammals, 2013. Dept. of Conservation. New Zealand Threat Classification Series 14.

[10] Cawthorn, M.W. 2012. ibid.

12. WHALES

12.1. Southern right whales

The pre-whaling population size of southern hemisphere southern right whales may have been around 70,000-100,000. These whales were greatly depleted by 19th century whaling and have been protected since the early 1930s. However, illegal takes of this species in the 20th century slowed recovery of southern hemisphere stocks. Nevertheless, breeding populations in Australia, South Africa and Brazil/Argentina have made a strong recovery with annual increase rates of 7-8% and together may now total over 16,000. The most recent abundance estimate of the population size of southern right whales in New Zealand waters was 2,169 whales with an annual increase rate of 5% for females and 7% for males[11]. Southern right whales move inshore with calves in winter and spring and to offshore foraging areas in summer. Southern right whales are occasionally seen in Cook Strait/Marlborough Sounds waters in low numbers (1-4). Despite promising signs of recovery, the distribution of southern right whales in New Zealand waters is concentrated in the subantarctic[12].

12.2. Humpback whales

The Southern Hemisphere unexploited population of humpback whales may have numbered 75,000-100,000 before whaling[13]. During the period of most intensive commercial whaling from the 1920s–1950s whales from the South West Pacific Ocean (IWC breeding stock E) were taken throughout their range from tropical breeding grounds around New Caledonia and Tonga to the Antarctic feeding grounds. The overexploited stocks crashed (in New Zealand) in 1960. Despite a brief period of illegal whaling by the Soviet high seas whaling fleet through the 1960s and 1970s humpback stocks have shown strong evidence of recovery at rates of 10% or more being recorded in South African, Australian and South American waters. Despite these increases, the Oceania stock - including New Zealand – was estimated to total 4,329 whales only. Since 2004, DOC has conducted annual counts of humpback whales during the winter migration north through Cook Strait. Over the 12 years of surveys the average number of whales recorded per annum is 58 (range 15-137). Of all baleen whales, humpbacks are the species most frequently involved in entanglements with craypot buoy lines. In July 2011 a single humpback, already entangled in craypot buoy lines, and with floats attached to its tail by DOC staff, entered Tory Channel and became further entangled when the floats became caught in a mussel rope buoy line at the Hitau Bay mussel farm.

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[11] Berkenbusch, K, E.R. Abraham, L.G. Torres. New Zealand marine mammals and commercial fisheries. New Zealand Aquatic Environment and Biodiversity Rept. No. 119. December 2013. MPI.

[12] Carroll, E.L. et al. (2014), Reestablishment of former wintering grounds by New Zealand southern right whales . Marine Mammal Science, 30: 206-220. doi:10.1111/mms.12031

[13] IWC Status of Whales https://iwc.int/status 2016

It was successfully released by farm staff[14]. It should be noted that craypot buoy lines, made fast to the pot on the seafloor and free floating vertically, without tension, to one or two buoys at the surface, are not comparable to fish farm moorings that are constantly under tension between anchors in the sea floor substrate and the substantial structure floating at the surface. Any unencumbered whale encountering fish farm moorings is most unlikely to become 'entangled'.

13. DOLPHINS

13.1. Killer whales

Killer whales are the most cosmopolitan of all cetacean species being found particularly in coastal and high productivity waters from low to high latitude waters in both hemispheres. Killer whales are top predators feeding on marine mammals, seabirds, sharks, rays and fish. They forage for rays along rocky shores on both sides of Cook Strait and in the Marlborough Sounds.

Studies of killer whales show that groups are organized into stable family units composed of a dominant female, her offspring and their offspring. Thus family pods can contain up to 4 generations.

The inter-generational bonds within pods are permanent. In the Southern Hemisphere, different morphological types have been referred to as "types A, B, C, D". Only type A killer whales have been considered resident in New Zealand waters with types B,C and D found in the Southern Ocean and Antarctica. Through the use of photo - identification surveys, the New Zealand killer whale population has been estimated, to be about 132 in 1997[15]. Based on their distribution, Visser suggested there are 3 sub-populations of 'type A' killer whales around New Zealand[16]. However, recent research provides photographic evidence for long-distance migrations of Type C killer whales between the Ross Sea and Northland waters and seasonal site fidelity at these widespread destinations. The best example of this is of one female recorded on 6 occasions between 2001and 2015 off Whangarei, the Bay of Islands and McMurdo Sound in the Ross Sea[17]. A large proportion of the type C whales (33-55%) in the Eisert et al study bore the marks of cookie cutter sharks (Isistius sp) which are currently assumed to be limited to waters north of 55°S[18] further possible evidence of polar migration by New

[14] Cawthorn, M.W. 2012. ibid.

[15] Visser, I. in:Berkenbusch, K., Abraham, E., Torres, L. (2013).

[16] Visser, I.(2000b). Orca (*Orcinus orca)* in New Zealand waters. Unpubd. PhD dissertation. Auckland University.

[17] Eisert, R. et al. (2015) Seasonal site fidelity and movement of type-C killer whales between Antarctica and New Zealand. IWC/SC/66a/SM9 13pp.

[18] Eisert, R.et al. (2015) ibid.

Zealand killer whales. Until the taxonomy and genetics of killer whales is properly determined it may be preferable to refer to these animals as one type.

13.2. Dusky dolphins

The Dusky dolphin is a southern hemisphere species with wide distribution and genetically distinct populations off the west coasts of South America, southwest Africa and New Zealand. Abundance estimates are available for only a small part of the species' range, preventing a global population assessment and determination of population trends. In New Zealand this species occurs year-round over the continental slope and shelf usually in waters of 2,000m depth or less. They are a highly energetic, gregarious species forming pods of 6-20 individuals that occasionally aggregate into super-schools of several hundred. Dusky dolphin behaviour and distribution around the coasts of New Zealand in general and Marlborough specifically is described in this author's report to NZKS[19]. From April to July a sub-group of dusky dolphins travels from Kaikoura waters to Admiralty Bay in the Marlborough Sounds it utilizes as a specific seasonal foraging habitat.

Dusky dolphins have been recorded throughout the inner and outer Marlborough sounds where they can be seen foraging and feeding on small schoolfish. When NZKS took over the Craill Bay farm in June 2011, plastic circle nets were being used with Dyneema protection netting. Dyneema is an exceptionally strong, lightweight, synthetic fibre which must be heavily tensioned to be effective. In July 2011, at the Craill Bay farm during salmon harvesting, one dolphin identified as a dusky, was caught in the protection netting but not recovered. Two months later in August 2011, as the farm was being decommissioned, a second dusky dolphin was found in the protection netting. In June 2012, at Waihinau farm during maintenance, a dusky dolphin was found dead under the floor of the predator net. The animal was sent to Massey University where species identity was confirmed and the the cause of death determined as drowning. The above are the only recorded deaths of this species

13.3. Common dolphins

Common dolphins are the most frequently encountered dolphin species in New Zealand waters being distributed along the entire coastline of the North and South Islands and Stewart Island. They range as far south as the subantarctic islands and east to the Chatham Islands. This species exhibits seasonal inshore-offshore movements that have been related to seasonal prey availability. In the Marlborough Sounds region, common dolphins are seen in the vicinity of D'Urville Island, Admiralty Bay, outer Pelorus Sound, Tory Channel and around the northern entrance to Queen Charlotte Sound. However these observations are not as frequent as those for dusky or bottlenose dolphins.

[19] Cawthorn, M.W. (2012) Marine mammals and salmon farms. (9.3)- pg 24

13.4. Bottlenose dolphins

Bottlenose dolphins are widespread and abundant in tropical and temperate habitats. Although considered an inshore species, bottlenose dolphins are also found considerable distances from shore in the open ocean. There are morphological differences between the two ecotypes, the offshore dolphins being significantly larger than, inshore bottlenose dolphins. These offshore animals are frequently seen along the eastern part of the Chatham Rise (MWC pers. obs). This species is found throughout the New Zealand EEZ with three separate coastal populations in Bay of Islands, Cook Strait/Marlborough Sounds and Fiordland.

These populations are genetically distinct with little or no maternal or gene flow or exchange between them. Population estimates for the three subpopulations include Bay of Islands 483 (95%c.i. 358-653), Cook Strait/Marlborough Sounds 211 (95%c.i. 195-230), Fiordland 205 (95%c.i. 192-219). The Cook Strait/Marlborough Sounds population, extending south to Westport, is considered semi-resident, with high migration rates and an unknown number of transient animals[20]. Further information on distribution can be found in Cawthorn 2012.[21]

13.5. Hector's dolphins

Hector's dolphins are regularly sighted in the Marlborough region. Between 15 January 2009 and 16 May 2011, 24 observations of 142 Hector's dolphins, in groups ranging from 1-50 individuals recorded in the DOC Sounds Area Database, suggest Hector's dolphins are most frequently seen in the middle reaches of Queen Charlotte Sound and are concentrated in the area around Blumine Island. These dolphins are possibly a sub-group of a sub-population of about 950 found in nearby Clifford and Cloudy Bays, just a few nautical miles east of Queen Charlotte Sound.

Based on a combination of aerial and boat-based line-transect surveys conducted between 1998 and 2001, the total population size of South Island Hector's dolphin was estimated at 7,270 (CV: 16.2%) individuals, including an estimated 5,388 (CV:20.6%) individuals on the South Island west coast. [22]

However, results from a more recent series of aerial survey programmes specifically designed for sampling the east and west coasts of the South Island (ECSI) were reported to the Ministry for Primary Industries (MPI) in 2014 .[23] These aerial surveys constitute

[20] Berkenbusch, K., E.R. Abraham, L. G. Torres (2013)

[21] Cawthorn, M.W.(2012). Marine Mammals and Salmon Farms.

[22] Slooten, E.et al (2004). Aerial surveys for coastal dolphins: abundance of Hector's dolphins off the South Island west coast, New Zealand. Marine Mammal Science 20 (3): 477-490.

[23] McKenzie, D.I.; Clement, D.M. (2014). Abundance and Distribution of ECSI Hector's dolphin. New Zealand Aquatic Environment and Biodiversity Report No. 123. 79p.

the only study to date with substantial effort in offshore regions (> 4nmi from the coast) for Hector's dolphin along the entire east and north coastal waters of the South Island. Hectors dolphin abundance was estimated to be 9,130 (CV: 19%) in summer and 7,456 (CV:18%) in winter. It appears therefore, that a portion of the discrepancy between this 2014 study and previous survey results are likely to be due to more extensive offshore coverage. Similarly, a 2004 boat-based abundance survey of Hector's dolphin in Clifford and Cloudy Bay produced an estimate of 160 animals[24], while a 3 year aerial survey from 2009 -12 resulted in an estimated summer abundance of 951, almost six times that of the 2004 survey. This number has been validated by the 2014 report which estimated abundance in Clifford and Cloudy Bays at 953 Hector's dolphins[25]. These data have been independently peer-reviewed and endorsed as robust by the Scientific Committee of the IWC[26].

14. EFFECTS OF FARM REMOVAL AND RELOCATION

14.1. NZ Fur Seals

Fur seals are interested in salmon farms for one reason alone, to secure a supply of high quality food for the least energy expended. They are intelligent, wily and persistent foragers that continually test the protection measures around the farms. Young animals learn by example, observing the attempts of mature seals to break in to the grow-out pens by climbing onto the salmon cage structures or, if access is denied them by any method, they will haul out on the closest rocky coastline to the farm. If a salmon farm is moved, seals will follow it and resume predation attempts at the first opportunity. As a result, fur seals dominate the incident reports recorded at each of NZKS's farms (Refer Table 3 &

Table 4Error! Reference source not found.).

14.2 Seal predation on farmed salmon

[24]Dawson, S.; Slooten, E.; DuFresne, S.; Wade, P.; Clement, D. (2004). Small-boat surveys for coastal dolphins: line transect surveys for Hector's dolphins (*Cephalorynchus hectori)*. Fishery Bulletin 102(3): 441-451

[25] McKenzie, D.L; Clement, D.M. (2014). Abundance and Distribution of ECSI Hector's dolphin. New Zealand Aquatic Environment and Biodiversity ReportNo.123. Ministry for Primary Industries.

[26] NZ Government Press Release 05 August 2016.

Seal predation on farmed salmon is not only a local problem. It occurs in the Marlborough Sounds, Stewart Island, Tasmania, Canada, Chile, Ireland, Norway, Scotland and the United States[27]. Fur seals appear to have become habituated or at least de-sensitised to the noise associated with shipping and vessel traffic and are not readily deterred by floating farm structures, lights, noise or human presence. In the Marlborough Sounds and Big Glory Bay, Stewart Island, fur seals frequently haul out to rest on salmon cage pontoons, walkways and barge structures and anecdotal reports from the same area have been received of fur seals attempting to haul out on mussel raft floats. Their interest in farms is simply to get a feed with the least expenditure of effort. To catch salmon, seals will patrol cages to try to find a weakness or hole in the predator or cage netting. If no hole exists the seals will attempt to gnaw through the tough predator netting until a hole is big enough to allow them access to the grow-out net they will also tear open. If they can find external access they will clamber up onto the cage superstructure and dive in amongst the fish. Alternatively, they harass salmon in cages causing them to school up and swim rapidly around the pens. The seals will then push any slack cage netting inward, biting fish as they swim past. Those fish which are not bitten can remain stressed, potentially resulting in reduced growth, inferior quality and/or death, resulting in large financial losses. Since it began operations, NZ King Salmon has had marine farming and coastal permits to operate salmon farms in the Marlborough Sounds. Since 2014, fur seals have occupied all of the farm sites at some stage. Seals have also established non-breeding haulouts on accessible promontories close to the farms, such as Parea Pt. on the western side of Otanerau Bay, where their depredations caused substantial damage to salmon pens and stock. Initially, seal attacks on caged salmon were sporadic, however with increasing seal numbers attacks became commonplace forcing NZ King Salmon to install large 'predator nets' that fully enclose the salmon cages and, most of the time, exclude fur seals.

Table 3 - Seal Incidents* NZ Salmon Farms 2014-2016

Year	Waitata	Ngamahau	Kopāua (Richmond)	Forsyth	Ruakaka	Te Pangu	Clay Point	Otanerau	Waihinau	Crail Bay x 2
2014	-	-	-	0	1	7	1	0	5	-
2015	-	2	-	17	6	9	6	3	22	-

[27] Quick, N.J., Middlemas, S.J, Armstrong, J.D. 2004. A survey of anti-predator controls at marine salmon farms in Scotland. Aquaculture 230 (2004) 169-180.

2016	67	18	0	0	9	7	12	0	0	-

Table 4 - Number of Incidents - Number Seals Involved

Year	Period	No Incidents	No Seals Involved	Seal Deaths
2014	25/07 – 27/12	14	20	1
2015	29/01 – 21/12	65	85	2
2016	08/01 – 14/08	113	208	1

(Data Table 3 &

Table 4 supplied by M. Preece NZKS)

Others

01/ 7 / 2015 Waihinau Dolphin (unid.) in fallow part of farm released alive.

*'Incidents' refers to any incursion into a farm (including entry into predator nets, grow-out nets, climbing onto floating farm structures, barges etc.)

14.3 Seal mitigation methods

Predation by seals on caged stock in salmon farms is an international problem that has the potential to cost the industry in lost revenue every year the problem persists. Various techniques, described below, have been used internationally to dissuade seals from harassing fish and ripping holes in cage netting, which can result in wholesale loss of stock, or climbing the cage structure to gain access to salmon in the pen. These techniques include:

1. increasing net strength and tension by weighting to prevent seals pushing the net inward to bite fish through the mesh;
2. rigging vertical 1.5m-2.0m jump nets around the cage perimeters to prevent seals climbing in and bird netting over the top of cages;
3. installing electric fences around the perimeter of the structure to prevent seals climbing the pontoons;
4. acoustic seal scarers, or "scrammers", i.e. acoustic devices that emit sounds of changing pitch, frequency and volume within seals' hearing range to deter seals from approaching cages[28];. seal crackers ("Thunderflash' type fireworks) to scare seals away;
5. disposal of 'morts' i.e. dead salmon off-site;
6. feeding lithium-laced salmon to seals to induce vomiting and a distaste for the fish;
7. placing life-size models of seal 'predators'(such as replica sharks and killer whales) around farms to deter seals from approaching;
8. trapping and translocation of problem seals away from the farm;
9. shooting identified problem seals;
10. improving barrier/ perimeter netting;
11. improving farm maintenance practices such as increasing frequency of net inspections and repairs.

Over the past three decades all of the above mitigation methods have been thoroughly tested overseas and 75% of them in New Zealand. While some methods had merit, they were temporary solutions only. A good example is #9, 'trapping and relocation'. Trapping and relocation of recidivist salmon killing seals was tried. A large male fur seal was trapped three times in a purpose built 'drop-door' trap at the Te Pangu farm site. It was marked and relocated each time to Carter's Beach near Westport where it was released. On the first occasion it took 15 days to return. The second time it was caught it took 8 days to return, and the third time, three and one half days to return to the same site at Te Pangu. The same result to relocations was experienced in Tasmania where a 2008 study found 'Relocation provides short-term relief from seal interactions but does not mitigate the interaction problem in the longer term"[29]. Methods neither used in New Zealand nor recommended are: the use of lithium emetics, 'scarecrow'

[28] Harris, R.N, et al. 2014 The effectiveness of a seal scarer at a wild salmon net fishery. ICES Journal of Marine Science,71(5),1913-1920.

[29] Robinson, S.et al. 2008. Mitigating fur seal interactions: relocation from Tasmanian aquaculture farms. Aquatic Conservation: Marine and Freshwater Ecosystems

models of predators attached to the farms, and shooting of problem seals, which is illegal in New Zealand unless officially sanctioned by DOC.

Instead, ongoing improvement to barrier netting systems and operating practices by NZ King Salmon staff continue to be the major contributor to excluding seals from farms and keeping seal damage to a minimum. For NZ King Salmon, the continuing development of a very effective working partnership with the Sounds Area office of DOC has been a key to its ongoing seal management success. NZ King Salmon operates under a Permit to "Take" New Zealand fur seals issued under the Marine Mammals Protection Act 1978 (MMPA). The Nelson/ Marlborough Conservancy of DOC issued the latest 15 year permit in cognisance of the improvements made by the company over the term of the original permit, specifically in relation to technological improvements of exclusion nets, and the introduction of a formal training curriculum for staff for handling seal incursions. The company set up a seal policy incorporating training and a regular reporting system for managers and staff at all its farms that have proven to be particularly important in winter when seals move into the sounds from Cook Strait. This has allowed a system of information sharing with DOC leading to effective self-management as NZ King Salmon works to continually improve seal-mitigation measures. Provided any new farm structures are defended with the same type of predator nets as currently used, the same operating procedures are maintained, and the current procedure of installing all encompassing strong protection netting around the entire farm is continued, the proposed farm structures should not be adversely impacted by New Zealand fur seals at any of the proposed sites

14.4 Mitigation recommendations

Interactions between marine mammals and finfish farms are inevitable and can be detrimental to both marine mammals and the aquaculture industry. In New Zealand, the greatest threat is from fur seals constantly seeking a way into farm cages. Those methods which do work involve continual improvement to pen structural design, the use of properly tensioned protection nets surrounding each pen[30], appropriate net design, constant vigilance by farm staff, appropriate feeding systems, site management and farm management practices, such as retention of all net and cordage debris, plastic strapping and other domestic rubbish for disposal ashore and constant gear maintenance. Farm staff should be instructed in the identification and safe handling of both live seals and cetaceans. These methods have become NZ King Salmon normal operating procedure.

[30] Arnold, H. 1992. Experimental predator control measures on marine salmon farms in Shetland. Report by Holly Arnold for Greenpeace U.K. Submission to Planning and Coordinating Committee of the Marine Action Plan. UNEP.

15 Humpback and right whales

Humpback and right whales are unlikely to be affected by the relocation of any farms. Both species are seasonal (autumn and winter) visitors to Cook Strait waters and make relatively few incursions into the Marlborough Sounds via Tory Channel or the northern entrance to Queen Charlotte Sound. Once in the Sounds, they usually cruise about for a few days before departing for open water. About 80% of all humpback feeding is done in the southern ocean where the principal prey is krill. During migration past the New Zealand coast humpbacks have been infrequently observed feeding opportunistically on small schoolfish and lobster krill (MWC pers.obs). Little or no feeding occurs during the northward migration when passing through Cook Strait[31]. The likelihood of humpbacks targeting salmon farm sites as feeding areas while on migration is so low as to be insignificant.

Typically, humpbacks that have become entangled in craypot buoy lines or other similar slack floating lines generally did so by accident rather than from curiosity.

Southern right whales are opportunistic 'skim feeders', taking copepods and krill at or near the surface (MWC pers obs) and are observed in the Marlborough Sounds either as singletons or, very rarely, in the company of a calf. Right whales are highly manoeuvrable animals that have no history of entanglement in floating structures in New Zealand waters.

The possible positioning of a farm in mid-channel in Waitata Reach should, in my opinion, pose few if any problems to either humpbacks or right whales as there will be more than adequate space around any such structure for them to navigate without danger of entanglement in moorings or other lines, a factor further reduced by NZKS standard operating practices requiring the monitoring and securing of all lines and the constant collection of loose lines and debris. Southern right whales have a habit of rubbing their skin against anchor warps but to date there is no history of entanglements. Anchor cables are constantly taut and therefore present minimal to negligible risk of entanglement.

Dolphins attracted to a farm to prey on small benthic food species and midwater schoolfish in the vicinity of the cage walls will quickly find pens which have been moved.

The effects on marine mammals from moving salmon farms from one location to another should prove no more than a temporary inconvenience to the cetaceans and pinnipeds associated with those farms.

[31] Gaskin, D.E (1982) The ecology of whales and dolphins. Heinemann Ed. Books

16 RISKS TO MARINE MAMMALS

While there can never be zero risk to marine mammals from the large floating structures which make up salmon farms, in my opinion, the risks are low. Compared to Queen Charlotte Sound, Tory Channel is a narrow, occasionally restricted waterway. Moving farms into this area will increase the potential risk of some interaction with large whales, however, given the low number of right and humpback whales seen in the channel the risk of a whale blundering into a large floating structure remains very low. Dolphins and seals are unlikely to be affected. Some of the reasons for this are:

- while humpback and southern right whales are slowly increasing in the New Zealand region the population numbers of these animals remain very small and the likelihood of their annual occurrence in Tory Channel and Queen Charlotte Sound will remain very low;
- farms are continuously manned;
- dolphins and seals are by now well accustomed to the presence of farms and appear unaffected by the levels of underwater noise produced by farms and the vessels servicing them;
- Commercial and recreational set netting, using unattended monofilament nylon nets, is a permitted activity under the Fisheries Act 1996 in various parts of the Marlborough Sounds (i.e. Pelorus Sound and the outer Sounds).
- Set netting is prohibited in Queen Charlotte Sound and Tory Channel to protect the small population of Hector's dolphins present there.
- Set nets pose a much larger entanglement threat to marine mammals in the Marlborough Sounds than well constructed and well managed salmon farm predator nets[32].
- at night parts of the structures are lit providing visual and acoustic reference for any animal nearby;
- continuing training programmes and increasing experience of farm staff;
- effective maintenance of operations and reporting procedures;
- the continuing improvements in protection systems surrounding all farms.

For NZKS, a particularly important feature of marine mammal risk reduction has been its continuing working partnership with the DOC Sounds area office that has been a key to its continuing seal management success.

[32] Baxter, A. .2012. Statement of Evidence in Chief of Andrew Stephen Baxter for the Minister of Conservation in relation to marine mammals. Paras 62-63 pg 14,. Crown Law Wellington.

17 ASSESSMENT OF RISK FROM FARM RELOCATION

In the absence of any long term systematic observational data of all cetacean species and seals in the Marlborough Sounds area, any assessment of risks to marine mammals associated with the relocation of salmon farms has to be subjective.

Table **5** has been assembled on the basis of the author's personal experience in the region over the past 5 decades and should be interpreted only as a relative guide. For example, Tory Channel presents the highest risk to whales because it is a narrow, restricted waterway with multiple ferry movements and the presence of near shore aquaculture farms which may increase in number. Seals are the least affected because of their familiarity with vessels and marine structures throughout the Sounds and their ability to climb ashore if necessary. It should be noted that all risks associated with relocation of marine farms remain very low.

Table 5 - Risks to marine mammals associated with relocation of salmon farms

Area	Risk level*	Large Whales**	Dolphins	Fur seals
Nearshore	xxx	xxx	xx	x
Offshore	xxx	xxx	xx	x
Tory Channel	xxxx	xxxx	xxx	x
Queen Charlotte	xxx	xxx	xx	x
Steel pens	xxx	xxx	xx	x
Plastic circles	xxx	xxx	xx	x
Blowhole North #34	xx	xx	x	xx
Blowhole South #122	xx	xx	x	xx
Waitata mid channel #125	xxxx	xxxx	xx	x
Richmond Bay South #106	xxx	xxx	xx	x
Horseshoe Bay #124	xxx	xxx	xx	x
Tipi Bay #42	xxxx	xxxx	xxx	x
Te Weka Bay #47	xxx	xxx	xx	x
Tio Point #154	xxxx	xxxx	xxx	x
Motukina #82	xxxx	xxxx	xxx	x

* Risk level: [x to xxxx = Negligible to Low] [# to #### = Moderate] [+ to ++++ = High]

** Humpback and right whales

18 COMMENTS REGARDING NZCPS POLICY 11: PROTECTION OF INDIGENOUS BIOLOGICAL DIVERSITY IN THE COASTAL ENVIRONMENT

The purpose of this policy is "to protect indigenous diversity in the coastal environment" by in part:

(a) avoiding adverse effects of activities on:

i. indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists, and
ii. taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened.

No other parts of Policy 11 are considered relevant to marine mammals

For a listing of these species see where three species, Hector's dolphin, bottlenose dolphin and Killer whale fit e above criteria.

Hector's dolphin:

Following publication of the recent comprehensive surveys of this species which significantly increase the population estimates for the east coast of the South Island, including Marlborough[33], the Hector's dolphin population in this area is likely to be reviewed in 2018. However, the population size of this slow reproducing, indigenous species will remain low, in marine mammal terms, for some time and the threat status should, in my view, remain precautionary. Set netting, a recognized threat to Hector's dolphin, is prohibited by regulation in Queen Charlotte Sound and Tory Channel to safeguard this species. As far as I am aware, there has been only one recorded mortality of a Hector's dolphin in a salmon farm at Ruakaka in 2005.

Bottlenose dolphin:

The Cook Strait / Marlborough Sounds population size of this species has been estimated at 211 (95% c.i.195-230). The range of this group extends south to Westport, with high migration rates and an unknown number of transient animals[34]. DOC records list two bottlenose dolphins were reported taken at the Crail Bay farm in 2011. However, the

[33] McKenzie, D.L, Clement, D.M. (2014) .Abundance and Distribution of ECSI Hector's dolphin. New Zealand Aquatic Environment and Biodiversity Report No.123. Ministry for Primary Industries.

[34] Berkenbusch, K, Abraham, E.R., Torres, L.G.(2013). New Zealand Marine Mammals and commercial fisheries. NZ Aquatic Environment and Biodiversity Report No.119. December 2013, MPI

identification of the first could not be confirmed and the second record was of an animal taken before the farm was taken over by NZ King Salmon.[35]

Killer whales:

Killer whales are frequently observed in the Marlborough Sounds and have been recorded in Crail Bay and outer Pelorus Sound, Waihinau Bay, Queen Charlotte Sound. They appear annually off the NZ fur seal rookeries at Stephens Island and the Trio Islands. They come inshore to prey on rays and are top level carnivores known to take small dolphins. They are highly manoeuvrable and have never been recorded in any salmon farm incident reports. However they are not immune to entanglement. Two killer whales were found entangled in and subsequently released from crayfish pot buoy lines in two separate incidents at Kaikoura in 2011 and Coromandel in 2012.

In my view, the criteria in NZCPS Policy 11 (i) and (ii) will be more than adequately met by NZ King Salmon's farm operating practice policy.

19 CONCLUSIONS

Effects of removal and relocation of salmon farms on marine mammals

Relocation of salmon farms in the Marlborough Sounds is likely to have an insignificant effect on marine mammals in the area. Salmon farm structures form inverted "reefs" which inevitably attract small schoolfish. Fur seals will move with the farms if it is to their advantage. Dolphins will rapidly locate any farms moved and resume feeding in the vicinity on schoolfish attracted to the structures if they choose to. As stated above, the effects of moving farms on marine mammals associated with them should be no more than a temporary inconvenience to already established behaviour.

20 ACKNOWLEDGEMENTS

Katrin Berkenbusch (Dragonfly) and Deanna Clement (Cawthron Inst).

Mark Gillard, Karen Mant and Mark Preece (NZKS) for technical information.

Andrew Baxter (DOC) for welcome constructive criticism of the document.

Paul Creswell (MPI Nelson) for administrative assistance. Rachel Somervell and Frances Lojkine for their patience.

[35] Baxter, A.S. 2012 Statement of Evidence in Chief for the Minister of Conservation in relation to marine mammals. Crown Law. 9 August 2012