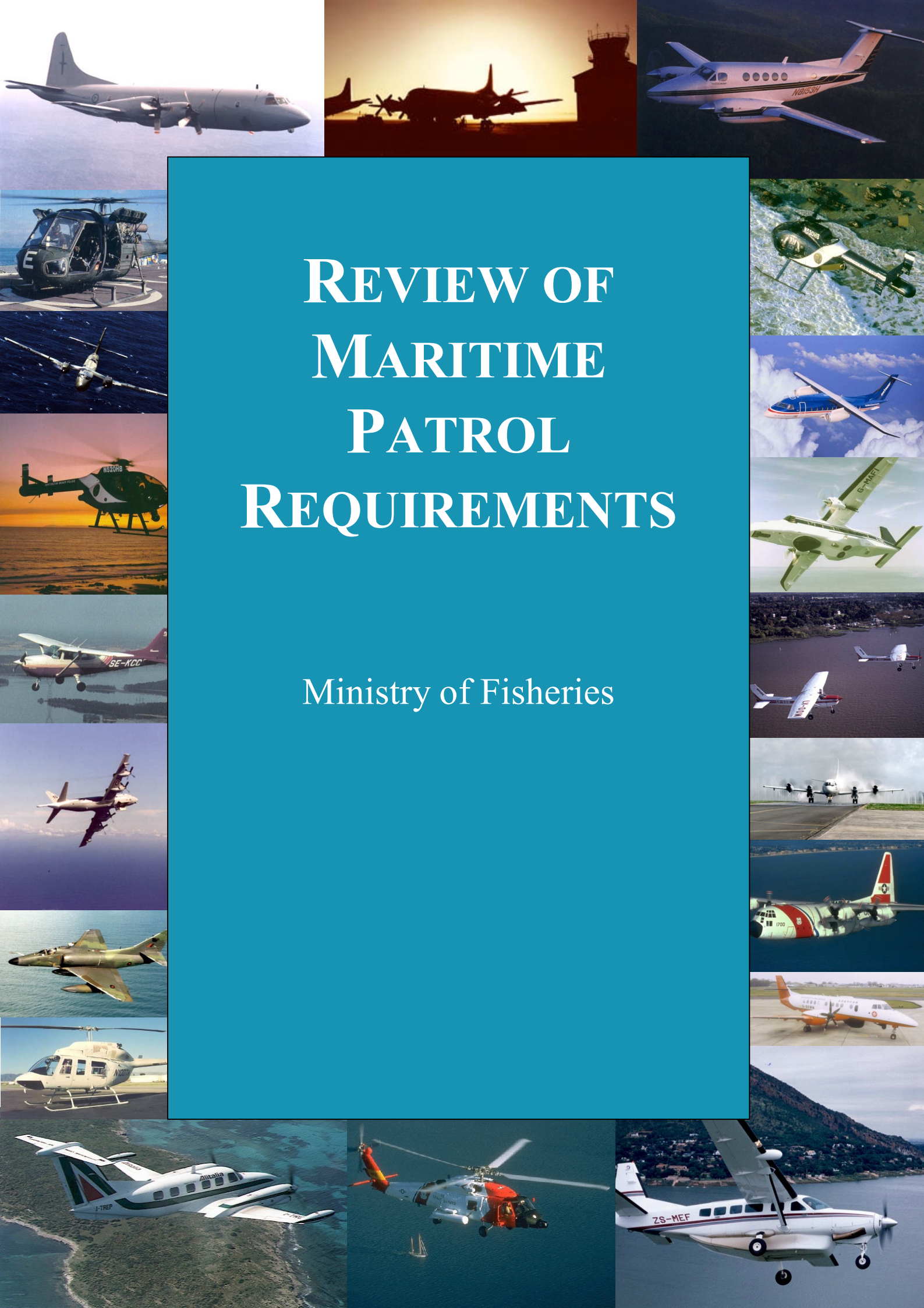


Review of Maritime Patrol Requirements

Ministry of Fisheries

MARITIME PATROL REVIEW

AIM

Identify and detail the Ministry of Fisheries' maritime patrol requirements, with particular regard to aerial surveillance.

OBJECTIVES

- **Identify the nature and extent of the fisheries to be covered by maritime surveillance.**
- **Determine the range of capabilities necessary to provide appropriate aerial surveillance cover.**
- **Outline a number of options that deliver the required range of capabilities.**

AUTHORS

The National Compliance Unit (Operations) prepared this report.

DATE

This report was presented in two phases: first draft 25 October 2000, final version 1 November 2000.

SECURITY

This document has been reclassified due to the removal of certain sensitive information.

CONTENTS

EXECUTIVE SUMMARY

Background

New Zealand's fisheries resources are its fourth largest export earner, delivering up to $1.5 billion a year to the economy, yet they are spread over the world's fourth largest Exclusive Economic Zone. This creates a challenge for maritime surveillance. Given the value of the resource and its wide extent, effective maritime surveillance must be well planned, well executed and cost effective.

For this reason, aerial surveillance is one of a number of maritime surveillance tools used by the Ministry of Fisheries (MFish) in a co-ordinated, intelligence-driven fashion, aimed at maximising compliance with fisheries laws. Other tools complimenting aerial surveillance include the satellite vessel monitoring system, scientific observers, surface patrols, land-based inspections and investigations, and satellite imagery.

Aerial surveillance coverage of New Zealand's fisheries has been carried out predominantly by Royal New Zealand Air Force (RNZAF) Orions, and by small commercial aircraft on an ad hoc basis. MFish requires patrols to have sophisticated surveillance systems to collect, store, analyse and transmit data in a way that allows the information to be used in a timely manner and to an evidential standard when required.

Analysis

This Review prioritises inshore, deepwater and international fisheries and forecasts how range, distribution and seasonal variations in these fisheries will affect surveillance requirements.

Analysis conducted for this Review shows most catch is taken relatively close to land, given the extreme ranges of New Zealand's Exclusive Economic Zone. It found that the inshore fisheries receive only 5.6 per cent of their required aerial surveillance effort, and that is by civil aircraft which possess, at best, only rudimentary surveillance systems. The deepwater fisheries do not fare much better receiving only 17.6 per cent of their required surveillance hours.

Conclusions

The analysis contained in this Review demonstrates that:

While a long-range capability is still required, a much shorter-range aircraft could patrol the majority of our fisheries.

A gap analysis reveals that in terms of the current surveillance effort:

1. ***There is a substantial gap between the aerial surveillance hours required by MFish and what it currently receives from both the RNZAF and ad hoc civilian service providers.***

2. ***The gap identified in MFish's surveillance requirements is not spread uniformly, but has the greatest impact in the fisheries that occur close to land (that is, within 90 nm).***

The Review identifies a number of options relating to the gap in MFish's surveillance capability:

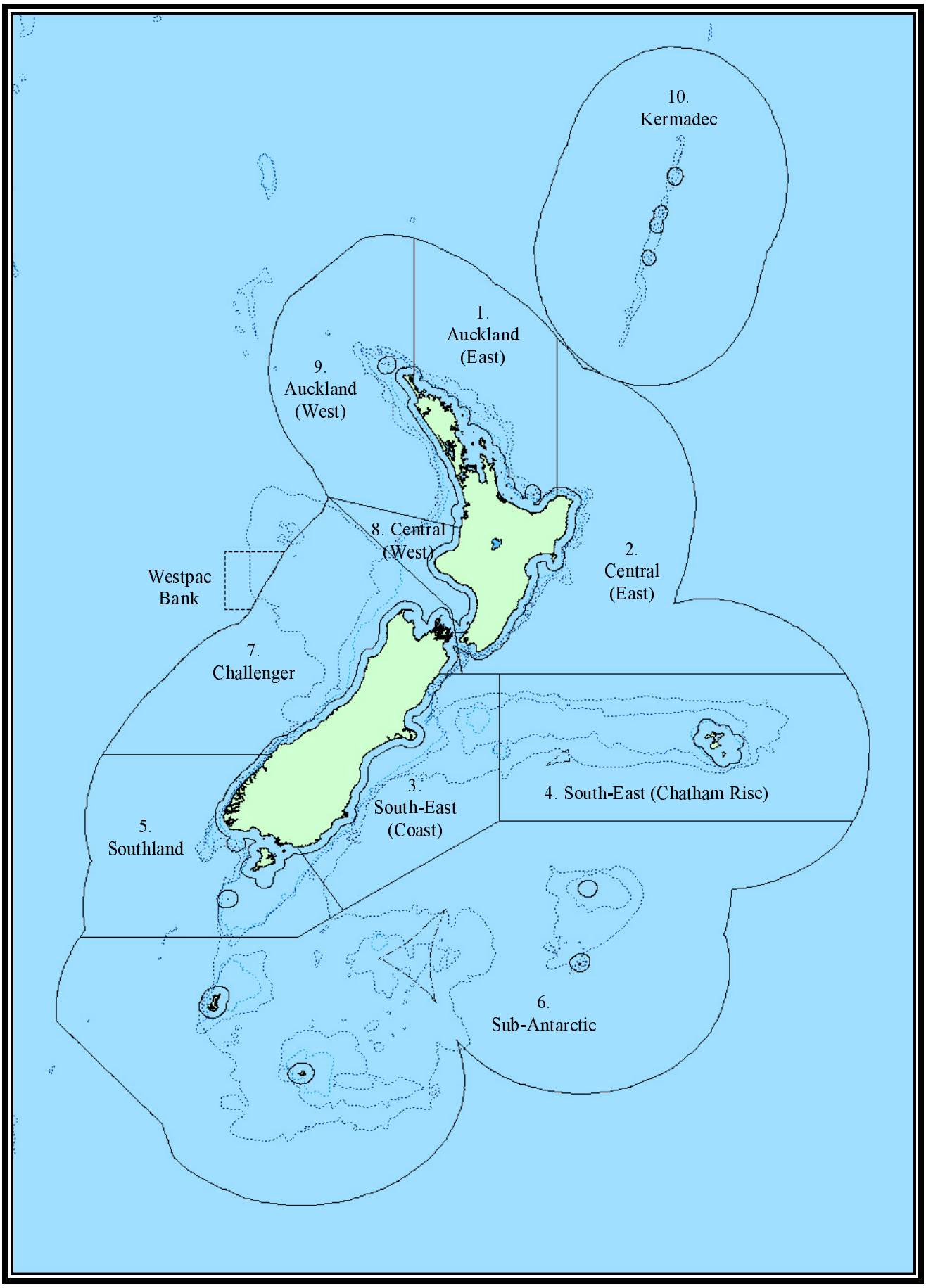
1. Do nothing: allow the current surveillance levels to remain as they are
   Outcome: issues not resolved.

2. Increase the use of the RNZAF Orions
   Outcome: major gaps would still exist in MFish's surveillance capability, particularly in the inshore fisheries.

3. Increase use of the civil aviation sector
   Outcome: the use of a non-dedicated civilian surveillance capability, if it exists, would be an attempt to introduce a stop gap solution.

4. Contract a dedicated service provider
   Outcome: this option can meet all requirements and would do so in the most cost-efficient manner. Sub options are explored in "Conclusions".

NEW ZEALAND FISHERIES WATERS



FISHERIES BACKGROUND

NEW ZEALAND'S FISHERIES

New Zealand's fisheries are one of its most valued resources. Traditional Maori cultural ties with fisheries are strong, and their fishing rights are recognised in law and linked to the Treaty of Waitangi. Maori have the right to a commercial stake in New Zealand's fishing industry and a role in its management. Maori also have important non-commercial, customary fishing rights.

Fishing is a popular leisure activity for as many as one in five New Zealanders. There are a variety of reasons why so many people participate in recreational fishing. They include informal food supplementation; for a challenging sport; a quiet recreational pursuit; or to enjoy the outdoors. The value of recreational fishing as a whole, for the five most popular species (snapper, kahawai, rock lobster, blue cod and kingfish), has been estimated to be $219 million[1].

New Zealand's commercial fisheries are its fourth largest export earner, with a harvest of approximately 650,000 tonnes a year from wild fisheries and aquaculture. The value of this harvest ranges from $1.2 to $1.5 billion a year. The fishing industry estimates that its total contribution to the New Zealand economy is $4.5 billion. The industry directly provides employment for 10,250 and indirectly employs a further 16,100[2].

However fisheries are a limited resource. Most people accept that if we want to sustain our fisheries for future generations to use and enjoy, we need to manage them responsibly. This management includes operating an effective compliance regime, of which surveillance is an integral part.

New Zealand, with the fourth largest exclusive economic zone (EEZ) in the world and an area of 1.3 million square nautical miles (nm), places tough and unique demands on fisheries surveillance. The 200 nm EEZ ranges from the Sub-Tropical latitudes of the north to the Sub-Antarctic where commercial fishers encounter some of the worst possible sea conditions. The furthest point of the EEZ is approximately 620 nm from the nearest airfield. Seasons and other environmental conditions also create considerable variation.

New Zealand's surveillance responsibilities also extend beyond its EEZ. Under the United Nations Convention on the Law of the Sea (UNCLOS) New Zealand has rights and obligations to manage and conserve its resources within its EEZ and to control the fishing activities of New Zealand-flagged vessels and its nationals on the high seas. These obligations are enlarged in the United Nations Fish Stocks Agreement (UNFSA)[3], the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), and the recently agreed Western and Central Pacific Fisheries Convention (WCPFC)[4].

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[1] Value of New Zealand Recreational Fishing, by the South Australian Centre for Economic Studies, November 1999.
[2] The Seafood Industry: its importance to New Zealand's economy, by McDermott Fairgray Group to the Seafood Industry Council Ltd, October 2000.
[3] The full title is the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law Of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.
[4] The full title is the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

New Zealand implements its international obligations through domestic legislation such as the Fisheries Act 1983, the Fisheries Act 1996, the Territorial Sea, Contiguous Zone and Exclusive Economic Zone Act 1977, the Antarctic Marine Living Resources Act 1981, and the Driftnet Prohibition Act 1991.

Quota Management System

The Fisheries Acts 1983 and 1996 also define the quota management system (QMS) which is the heart of New Zealand's fisheries management framework. The QMS was introduced in 1986 and controls the total commercial catch from all the main fish stocks found within the EEZ. It was introduced to:

- prevent over fishing, which had reached dangerous levels in some inshore fisheries, and with certain species such as snapper
- improve the economic efficiency of the fishing industry.

Input controls

Prior to 1986 fisheries management in New Zealand was based primarily on vessel, gear and area restrictions, known as input controls. The main disadvantage with controlling inputs is that controls on one input can usually be avoided by substituting another input. Over fishing is not necessarily prevented. For example, a restriction on the number of rock lobster pots allowed could be circumvented by using the pots more often, or using faster, more powerful boats could circumvent a restriction on the size of boats.

Input controls can actually have a negative effect, by impeding the development of more efficient technology and making the New Zealand fishing industry less competitive.

While input controls are still used to manage some specific fisheries the majority of New Zealand's fisheries are managed by output controls.

Output controls

The approach used with the QMS is to directly limit the total quantity taken by the commercial fishing industry so that there are sufficient fish available for non-commercial uses and for the conservation of the resource. These are known as output controls. (The needs of recreational fishers and Maori interests are allowed for before commercial quota levels are set.)

Within the commercial catch limit, ownership of quota determines access. Quota is a right to harvest a particular species in a defined area. Quota can be traded (bought, sold, or leased). The QMS is designed to ensure sustainable use of the fisheries resources while allowing economic efficiency in the industry. The quota system is also being used to deal with Maori claims to commercial fisheries.

The Government has a responsibility to ensure that 20 per cent of all commercial quota is transferred to the Treaty of Waitangi Fisheries Commission in recognition of Maori rights to the commercial fishery. The quota is being distributed to iwi through the Treaty of Waitangi Fisheries Commission.

NB. *Appendices 1, 2 and 3 provide further detail on the inshore, deepwater and international fisheries respectively. Appendix 4 outlines the enforcement parameters in which any surveillance capability will be required to operate.*

AERIAL SURVEILLANCE BACKGROUND

The scope of New Zealand's maritime interests is vast both in terms of the volume of activity and the size of the area it encompasses. Effective monitoring of these interests is of considerable importance to the security of the country, the management of natural resources and the preservation of the marine environment.

Under international law New Zealand has an obligation to protect and conserve the fishery resources under our control. It is therefore the aim of the MFish to strive to achieve compliance with legislative measures by all those that operate in New Zealand's areas of maritime interest and to deter any would-be offenders. New Zealand must also have the ability to apprehend and bring to justice those who fail to comply with those measures, whether this ability is through the court systems or by diplomatic means.

In the fisheries context aerial surveillance has a number of important roles that support New Zealand's responsibilities as a maritime nation. Indeed, aerial surveillance helps to protect and maintain the integrity of the New Zealand EEZ and contributes toward the country's various international obligations.

Aerial surveillance has the following benefits:

- The ability to search large tracts of ocean quickly
- A covert and overt surveillance platform to monitor fishing activities by day or night
- Quality assurance and a cross-check for the other fisheries surveillance tools
- A platform to monitor the activities of vessels that are not covered by the other tools
- A large variety of electronic sensors and equipment available at varying costs and capabilities
- The ability to transfer information to and from shore based authorities providing ease of command, control and co-ordination
- The production of photographs, videos, computer data and written records for use in subsequent prosecutions
- Considerable flexibility allowing re-tasking at short-notice

By the very nature of New Zealand's geography, fisheries protection has to overcome significant difficulties in order to monitor activity and achieve compliance. The extremes range from the need to monitor large areas of coastline that is often inaccessible by land, to areas of ocean that are great distances from New Zealand and indeed any other land. In this context aerial surveillance is an extremely valuable tool.

History

Aerial surveillance of New Zealand waters has, in one form or another, existed for over 60 years. For much of this time the surveillance was focused more on New Zealand's security needs. The declaration of a 200 nautical-mile Exclusive Economic Zone (EEZ) around New Zealand in 1977 brought the country new found benefits in having exclusive rights to the fishery resources within this zone. With these benefits came new responsibilities; having declared the EEZ, New Zealand accepted the challenge of protecting the marine environment and sustainable utilisation of the natural resources within these new boundaries.

At the time, vessels from the Distant Water Fishing Nations (DWFNs) such as the Soviet Union, Japan and Korea made up a large proportion of the fleet exploiting New Zealand's fisheries resources. Faced with the task of monitoring large numbers of these vessels operating within an EEZ of 1.3 million square nautical miles, maritime patrol took on an increasing level of importance.

THE ROYAL NEW ZEALAND AIR FORCE

The primary provider of aerial surveillance in New Zealand is the Royal New Zealand Air Force (RNZAF). This situation was formalised in 1990 by a Memorandum of Understanding between the then Ministry of Agriculture and Fisheries (MAF) and the New Zealand Defence Force. This specified the arrangements for co-operation in the provision and management of fisheries aerial and surface surveillance, with the actual detail pertaining to the aerial component contained in a Departmental Agreement between MAF and the Ministry of Defence.

Depending on the situation, various types of aircraft have been used in this role over the years. The A-4K Skyhawks, Andovers, C-130H Hercules and the F-27 Friendship have all been used at some point in time to carry out fisheries protection duties. However, the primary aircraft used for this task is the P-3K Orion. Appendix 6 gives further details on the Orion.

Level of Commitment

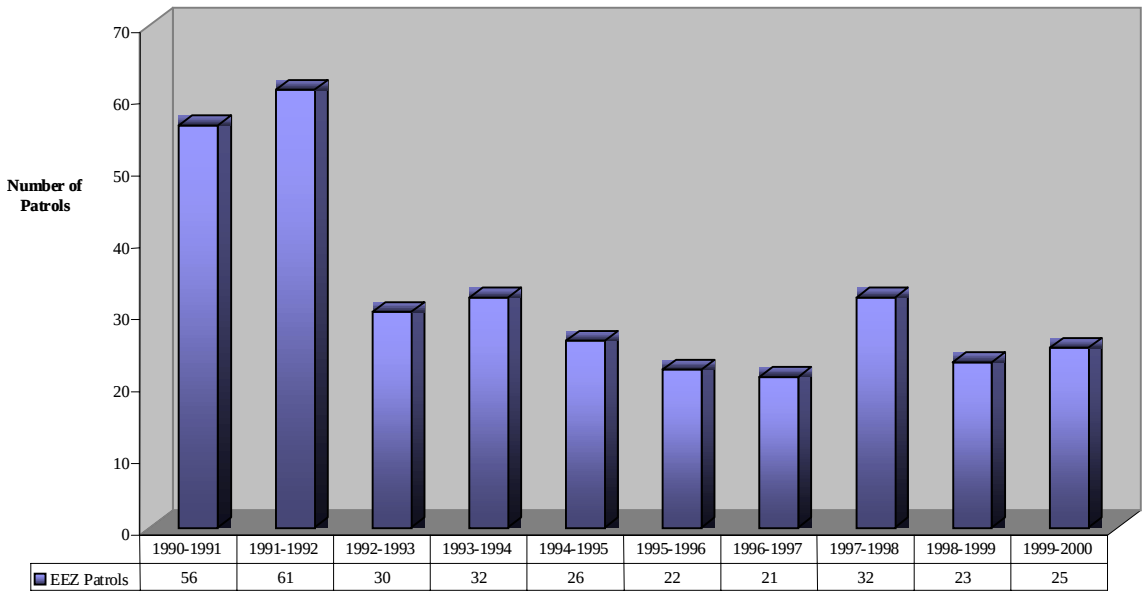
Currently, fisheries protection tasks formally receive 24 Orion flights annually. This equates to two patrols a month with the aircraft being on station for up to eight hours on each patrol. The remaining time in a patrol is spent transiting between the base and the designated patrol area. The close working relationship between the Ministry of Fisheries and the RNZAF allows for a great deal of flexibility with this allocation and the way the aircraft is tasked. If the need arises, the RNZAF can often get an aircraft airborne at short notice to fulfil a request by the Ministry.

Apart from the formal allocation of hours to fisheries work Orion crews often carry out surveillance while undertaking other tasks. For example, when an Orion is sent north to patrol the EEZs of some of the South Pacific countries, it will patrol New Zealand waters when leaving and re-entering the EEZ. The crews also remain vigilant when involved in military exercises, training and working for other government agencies.

With the allocated patrols the Ministry has considerable input into the planning of each patrol and remains in close contact with the RNZAF through out its duration.

Over the past 10 years the number of patrols each year has varied due to operational needs, aircraft availability and serviceability. The most significant change in the levels occurred between the financial years of 1991/1992 and 1992/1993 when the number of patrols dropped from 61 to 30 respectively. Leading up to the end of 1992 the average number of patrols dedicated to fisheries surveillance each year was over 50. This fell dramatically in 1993 to a point where this task has received an average of 26 patrols a year for the last eight years (Figure 1).

Number of EEZ Patrols Carried Out by the RNZAF



	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
EEZ Patrols	56	61	30	32	26	22	21	32	23	25

Figure 1.

A major contributing factor to the post 1992 reduction in RNZAF fisheries patrols was the phasing out of the Air Force's fleet of F27 Friendship aircraft. The RNZAF purchased three Fokker F27 Friendship Mk 120 aircraft from Air New Zealand in 1980 for the purpose of training its Navigators and Air Electronic Operators (AEOP). The 20-year-old airliners were extensively refurbished by Air New Zealand to carry out the tasks of navigation and air electronics training, search and rescue and maritime surveillance of the Southern Coastal regions.

The F27s, operating out of Wigram, often patrolled the inshore fisheries around Banks Peninsula, Hokitika and the West Coast of the South Island. The F27 was limited in its surveillance role due to a number of factors. One was that the avionics fit on the aircraft was primarily geared towards its training role and as such, fisheries patrols were only conducted in daylight and relied on 'overt' means for vessel identification. Another drawback was that the aircraft was designed as a short-range commuter airliner and this combined with the need to be at low-level for much of a patrol meant that the aircraft had limited range in the maritime surveillance role. In spite of the shortcomings of the F27 it did provide a useful presence in the inshore areas that were not often covered by the much larger Orions.

At the end of 1992 the Friendships were withdrawn from service and eventually disposed of when Wigram was closed in 1995. The maritime surveillance role the Friendships carried out was not re-allocated to other units.

Conclusion

In 1992 there was a marked decline in the level of resources committed by the RNZAF to fisheries protection. The net effect of this reduction of effort has been that the inshore areas have not had any recognised aerial surveillance coverage from the RNZAF for the past eight years. Offshore coverage levels have remained reasonably static.

Distribution of RNZAF Patrols amongst Fisheries Management Areas (FMA)

The Exclusive Economic Zone of New Zealand has, for the purposes of managing fisheries under the Quota Management System, been divided up into 10 areas known as Fisheries Management Areas (FMA). The chart on page 4 shows the distribution of the 10 FMAs. See also Appendix 7 for a chart illustrating the boundaries of these areas and giving a detailed breakdown of RNZAF patrol effort in each FMA.

Figure 2 demonstrates the distribution of RNZAF patrols among the FMAs over a 10-year period.

Distribution of RNZAF Patrol Coverage 1990-2000

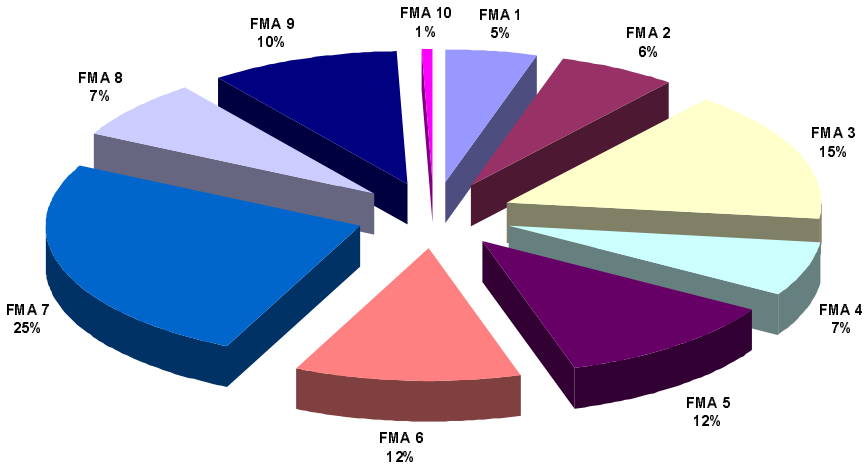


Figure 2

Despite a slight surge in the patrol effort expended in these areas in the 1997-1998 financial year, the general trend has been a sharp reduction followed by a levelling out of the number of patrols per year to current levels.

To a large extent the distribution of the patrol effort reflects some of the major fisheries in New Zealand waters and some of the areas most vulnerable to intrusion by foreign, unlicensed vessels. The Challenger area (FMA7) for example, includes the West Coast Hoki grounds, the areas closed to certain trawlers and the western approaches to New Zealand. This is therefore an area of high activity and as such much of the patrol effort is expended in this FMA.

The remaining areas received similar levels of coverage with the exception of the Kermedecs (FMA10) and the South-East (Coast) (FMA3).

The Kermedecs are an area of very little activity by New Zealand fishing fleet due to current restrictions and dedicated patrols in that area are rare. However, this area does receive indirect monitoring on a regular basis through the Orion patrols that head north to the Pacific Islands.

A large proportion of the patrol effort in the South-East (Coast) FMA was carried out by the F27, so in spite of the relatively high proportion shown in the Figure above FMA3 has, since the end of 1992, received only eight per cent of the Orions time in the past eight years.

CIVILIAN AERIAL SURVEILLANCE

Local compliance teams from MFish have employed civilian aircraft as a means of conducting aerial surveillance, but this has mostly occurred on an ad-hoc basis. While the specific type of aircraft employed vary, the common roles fulfilled by these aircraft have retained a certain measure of consistency. In particular, the following roles are worth noting:

- Small fixed-wing aircraft have been used to locate general areas in which inshore commercial activity occurs, supporting fisheries surveillance efforts conducted on the surface. This has enabled the identification of fishing vessels that would have otherwise proven difficult, especially since vessels operating inshore are not required to carry or operate an ALC.
- Helicopters and fixed-wing aircraft have been employed to patrol long stretches of coastline that have proven extremely difficult to access due to a lack of suitable roads. These patrols have also enabled the gathering of intelligence, such as identifying known poachers, and as a means of identifying illegal fishing activities within closed areas, during closed seasons, or through the use of restricted fishing methods.
- Small fixed-wing aircraft have occasionally been used to detect offences in which commercial fishers have sought to gain an advantage by falsely reporting their fishing areas. This type of offending has been difficult to detect because information needs to be covertly gathered without alerting the suspected fishers, allowing them to incriminate themselves by making false declarations on their fishing returns.
- Small fixed-wing aircraft and helicopters (civilian and police) have been employed to investigate areas of interest, providing opportunities to acquire photographs of specific places and/or premises.

The level of civilian-conducted aerial surveillance varies greatly between the North and South islands, and among the district offices. Figures 3 and 4 indicate the variation among the district offices, and between the North and South Islands, respectively.

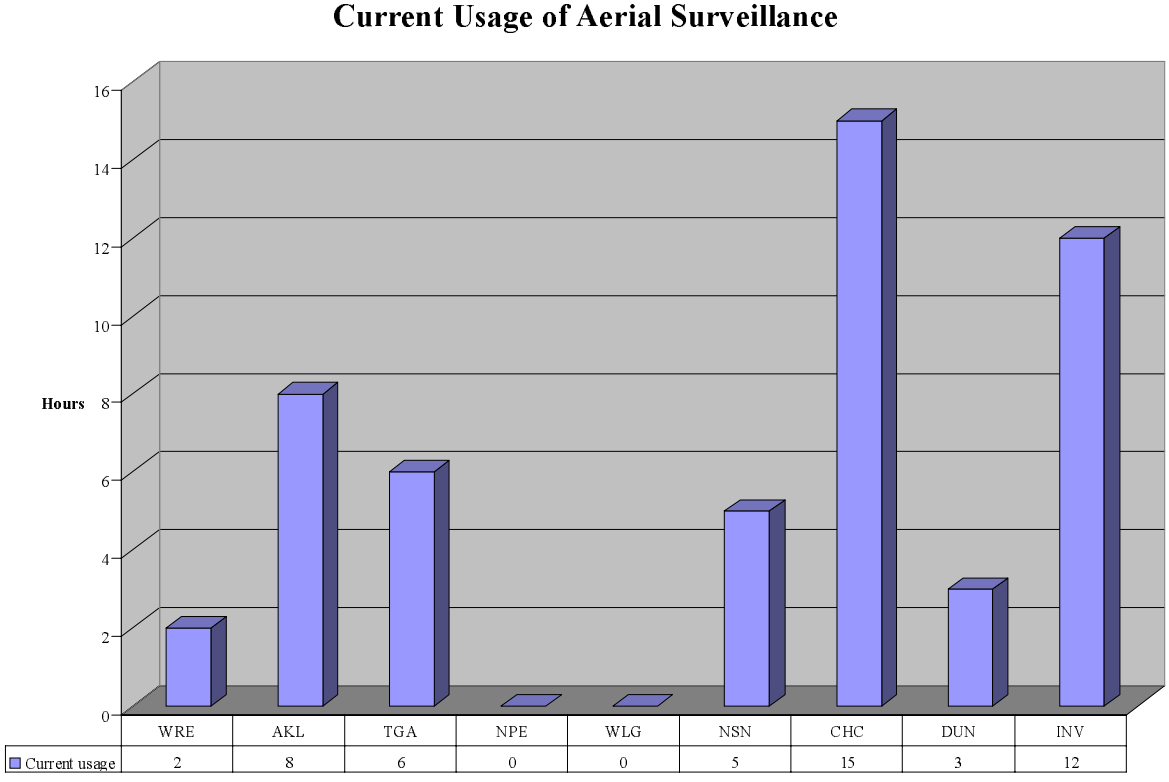


Figure 3.

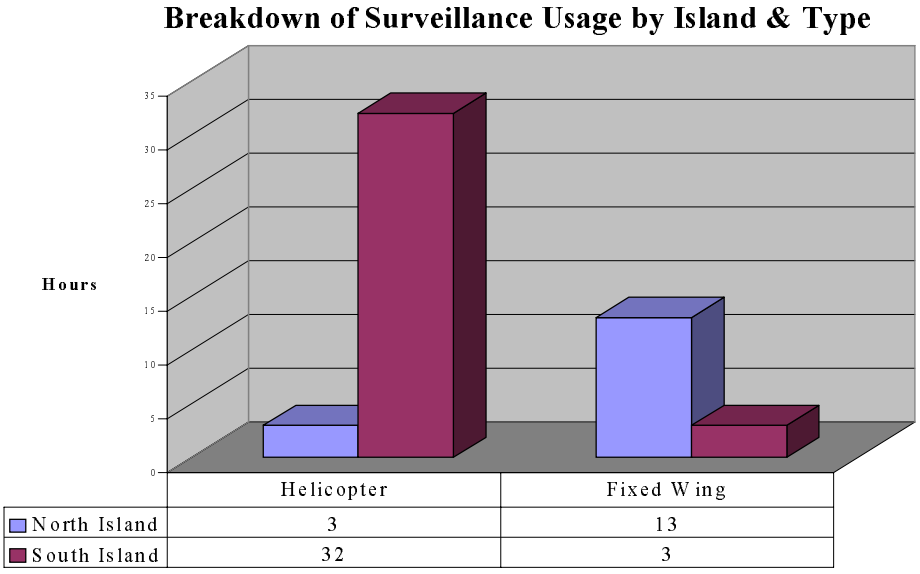


Figure 4.

The perceived availability of suitable aircraft appears to be a significant factor affecting the extent of aerial surveillance undertaken by the district offices. A high proportion of the civilian inshore surveillance conducted by MFish is therefore not targeted on the basis of a prioritisation or assessment of threats but rather, on available aerial assets. The South Island, containing only four of the nine main district offices, conducted 35 hours of aerial surveillance while the North Island conducted a mere sixteen hours. The South Island's significantly higher use of aerial surveillance is attributable to the fortuitous presence and involvement of a commercial helicopter pilot also employed by MFish as a Fishery Officer.

Conclusion

MFish's current deployment of civilian aerial surveillance in the inshore area is uncoordinated, under-utilised, and planned according to available aerial assets rather than generated by particular priorities. From this point of view, the use of civilian aerial surveillance requires urgent review.

PREVIOUS ASSESSMENTS

The provision of aerial surveillance services considered purely from a fisheries perspective has been extensively traversed in the past:

In 1989 the Ministry (then the Ministry of Agriculture and Fisheries) assessed the fisheries surveillance needs and the available surveillance capacity and presented proposals to establish a commercial aerial surveillance contract to provide EEZ and inshore fisheries surveillance. Such a service would have been complementary to the longer range capability of the RNZAF and allow for that capacity to provide an improved level of surveillance of the EEZ boundary and beyond.

In 1990 the Minister of Fisheries recommended to the Cabinet Policy Committee that the aerial surveillance responsibilities be clarified with MAF responsible for surveillance within the EEZ and the NZ Defence Force responsible for the protection of the integrity of the EEZ and areas of interest beyond. The arrangements would be implemented with a transfer of $4m from Vote: Defence to Vote: Fisheries to enable MAF to call tenders for the provision of up to 2400 hours of fisheries aerial surveillance services. At that time the all inclusive costs of contract surveillance was in the order of $1700 per hour compared to a marginal operating cost of nearly $8000 per hour for a P3 Orion.

Civilian contractors provide fisheries and other aerial surveillance services in other jurisdictions including the UK, Australia and Canada.

In July 1990, the Prime Minister, the Right Hon Geoffrey Palmer, wrote to the Ministers of Fisheries and Defence expressing concern at an apparent impasse between departments over the conduct of aerial fisheries surveillance in the EEZ. The Prime Minister expressed concern that:

- The importance that the Defence Force be seen to be used on work like this
- The potential impact on the role of the RNZAF in fisheries surveillance in the South Pacific
- While in purely accounting terms a civilian contract service may appear to be the answer to the requirements, wider considerations need to be taken into account.

He directed that discussions take place between the two parties to produce a memorandum of understanding defining who might do what in the future, to establish a practical relationship which works and to seek a greater degree of co-operation.

In the early 1990's the issue of aerial surveillance, and particularly MFish's requirements, were considered in a number of reports. The following accounts describe each report and give a summarised version of their conclusions.

1. *Satellite and Aerial Surveillance in New Zealand Fisheries* – circa 1990.
   This report relates primarily to the development of the technology that later became the forerunner of the vessel monitoring system, and discusses aerial surveillance in terms of its integration with satellite surveillance. It set out the fisheries requirements for aerial surveillance. After analysing the various fisheries of interest, the report reached the conclusion that fisheries surveillance required 1572 hours of programmed and 468 hours of response aerial surveillance.

2. *Aerial Fisheries Surveillance Requirements* – circa 1992.
This report was essentially an update of the fisheries requirements detailed in the 1990 report. It was used in discussions between the then MAF Fisheries and the New Zealand Defence Force, and used in the development of the interdepartmental agreement between the two organisations. The conclusions of this report were that 1474 hours of programmed and 324 hours of response aerial surveillance were required to meet fisheries requirements.

3. *MAF Fisheries – Airborne Fisheries Surveillance* – December 1994.
This was a very fulsome report prepared on private contract by two serving RNZAF officers. The report covered New Zealand fisheries, management and compliance issues, airborne surveillance roles and the operational capabilities required to fulfil the roles identified. The conclusion of this report was that while the Orions were doing their role well they only provided 17.6% of the hours fisheries required. This equated to 192 hours out of a total deepwater requirement of 1087.2 (or put another way 24 flights annually out of a total requirement of 202). The authors of the report were strongly of the view that the most cost-effective and efficient way to manage the shortfall was to use a private contractor.

OTHER SURVEILLANCE TOOLS

VESSEL MONITORING SYSTEM

The MFish vessel monitoring system (VMS) manages and integrates three types of position report from fishing vessels that are sent to the National Compliance Unit (Operations):

- satellite automatic location communicator (ALC) reports,
- self-reported positions from vessel operators,
- sighting reports from aerial and surface surveillance and Observers at sea.

The Fisheries (Satellite Vessel Monitoring) Regulations 1993 require an ALC to be fitted to (and continually operated by) the following classes of vessels:

- All foreign licence and foreign charter fishing vessels (including fish carriers and other support vessels),
- All domestic fishing vessels over 28 metres in overall length,
- Any domestic fishing vessel that fishes for orange roughy or scampi, at any time during the fishing year.

Domestic and foreign flagged vessels operating under special approvals outside the EEZ are required to carry and operate ALCs. This condition has been a significant deterrent to vessels fishing illegally inside the New Zealand EEZ and claiming the catch was taken on the high seas.

Currently all 120 monitored vessels are using Inmarsat C/GPS transceivers. The interval between the transmission of a GPS derived position (the polling rate) is generally two hours. The polling rate can be reprogrammed by a poll command from the Fisheries Communication Centre (FCC) to set the rate to any interval between five minutes and 24 hours. The VMS therefore has a real time picture of the identity and position of all vessels that are operating a registered ALC.

By comparing two or more positions transmitted from an ALC onboard a vessel (in time and distance) the speed a vessel is travelling at can be assumed. By matching vessel speed to the navigation pattern a "fishing signature" is created. By matching this signature with the vessel type it is possible to ascertain whether it is possible that the vessel could be fishing.

The positions of vessels monitored by a VMS are therefore a "known". But without independent verification, the activity of monitored vessels remains an assumption, and the positions and identity of any vessels not carrying an ALC an unknown.

Vessel monitoring systems and aerial surveillance are symbiotic. ALC data provides the tool for the early detection of possible offences and the timely and efficient planning of aerial surveillance, which is an essential tool for the validation of ALC data. Only by comparing VMS position data with the known identities, activities and positions of vessels sighted by aerial surveillance, can the following be detected and investigated:

- Vessels (foreign intruders) not carrying ALCs,
- The illegal transfer of an ALC from one vessel to another (masquerading),
- Vessels activity (to evidential standard).

A potential development in the near future is the possibility that the inshore fishing fleet (some 1500 vessels) will be obliged to carry and operate ALCs.

SURFACE PATROLS

Surface patrols are another surveillance tool used by MFish, providing a further opportunity to collect information on the location and the activities of fishing vessels. While New Zealand's inshore surface patrols have, for the most part, been infrequent and improvised, its deep-water patrols have traditionally been conducted by two means: the Royal New Zealand Navy (RNZN), and the observer program operated by MFish.

Apart from these two forms of surveillance, there is currently no other substantial, organised surface patrolling in New Zealand fishery waters. The New Zealand Police Force has vessels, but these are very rarely employed in scheduled surface patrols dedicated to fisheries surveillance. The New Zealand Coastguard is a voluntary organisation focusing primarily on search and rescue activities but which has, on occasion, provided operational support. MFish has a surface surveillance capacity comprising small inshore patrol craft but this already limited capacity has been further reduced by the recent sale of Nelson District Office's vessel 'Taranui'.

Naval Support

RNZN supply MFish with periodic summaries (usually of about a three month duration), indicating the general activities of their vessels which might be in a position to support MFish operations. Due to the detailed requirements of these patrols and the tight schedules maintained, Fisheries surveillance is seldom considered during the planning stage.

Although Fisheries work has not been a top priority, the Navy does accommodate specific requests when it has vessels in the vicinity. The Navy's willingness to assist the Fisheries surveillance effort has resulted in occasions when MFish objectives have been met. For example, in November 1998 the frigate HMNZS Te Kaha was en-route to the Sub Antarctic Islands within New Zealand's EEZ and had been designated various tasks regarding those Islands and their impending 'world heritage status.' On this voyage, the HMNZS Te Kaha managed to board and inspect a number of fishing vessels, and establish visual contact with others (attempts to board were aborted due to unfavourable weather conditions). Thus, even though the frequency of these voyages might be considered low, the duration enables the Navy to inspect a number of fishing vessels. While voyages of this type are rare, this kind of coverage is comprehensive and effective when it occurs. It is worth noting that general Naval activity occurring within New Zealand's EEZ potentially enhances those particular patrols tasked with assisting the fisheries surveillance effort.

In addition to its scheduled patrols, RNZN vessels can be used to pursue, board, and detain illegally fleeing fishing vessels, producing a high deterrence factor and demonstrating their status as an important component within the existing compliance arsenal. MFish needs to retain an effective capacity for pursuit in case, for example, a vessel flees the New Zealand EEZ with an observer on board. In this instance, a frigate could be used to pursue and arrest such a vessel in flight, whereas an aircraft, while useful in maintaining contact, is incapable of apprehending a vessel. RNZN vessels that are seen to be patrolling areas, such as the CCAMLR waters, also provide tangible evidence that New Zealand is upholding its commitment to its international treaties.

The patrols conducted by the RNZN are a powerful surveillance tool. However their effectiveness is often restrained by their restricted coverage, by the significant time delays in reaching multiple

destinations, and by the concerns over the regular availability of those vessels. The continued availability of the Navy's vessels is necessary in order to respond to unique situations as they arise, to produce a useful deterrent effect, and to enforce compliance. These surface patrols are best utilised in an integrated role within the existing surveillance framework, and their continued availability is recommended

An improvement in the co-ordination between RNZN and MFish might enhance this potentially very powerful surveillance capability by enabling fisheries' needs to be identified prior to the formulation of the Navy's schedule, and to be incorporated into the initial planning.

Observer Programme

The other significant type of surface patrolling is conducted through the MFish observer program, which typically has between 35 and 50 observers at its disposal. This provides about 20 per cent coverage of all deep-water commercial fishing vessels operating within the NZ EEZ. While the main focus of the observer program is to provide an independent account of a single vessel's catch and to collect scientific data, observers also record visual sightings of identifiable vessels during their voyages. This information is useful as a means of confirming VMS reports, adding a quality assurance to existing surveillance. Observers are also in a unique position to receive information on the past activities of vessels from dialogue with crew. A number of prosecutions have followed from information gathered by the observer program. In Operation HAWK, for example, observer information contributed to the Fu Yuan No.4 being seized and arrested after it was discovered illegally fishing within New Zealand's 12 nm territorial waters.

Although a single observer presents only a limited vision of all deep-water fishing activity, the program as a whole provides a more comprehensive picture. Despite lacking the authority of arrest and the powers required to seize a vessel, the mere presence of observers aboard fishing vessels may encourage compliance. Since the primary role of observers is scientific rather than surveillance, observers may spend a considerable amount of time below deck watching factory proceedings, or dealing with other issues. In this respect the observer programme resembles the Navy's surface patrols because both have priorities other than Fisheries surveillance, yet are vital to the achievement of compliance objectives when utilised with a larger MFish surveillance picture.

SATELLITE IMAGERY

Satellite imagery is a surveillance technology that MFish sometimes uses but it does not replace any of the other surveillance tools.

The two major uses of satellite imagery are:

- vessel detection,
- determination of environmental conditions.

Vessel detection: while possible using various commercially available technologies, such as synthetic aperture radar, is still very expensive, very time consuming, and often produces less than convincing results. RadarSat, for instance, provides coverage of a 50 x 50 kilometre area for approximately Aus$5,000, although discounts for bulk purchases are offered. Given the size of the New Zealand EEZ (1.3 million square nautical miles) this technology is not suitable for general area surveillance for vessel detection. The costs also escalate for quicker turnaround of obtaining the image, its processing and transmission to the client. Even then there is little flexibility of fine tuning the timing of an image given the limitations of polar orbiting satellites.

Even if a vessel is suspected of operating in a specific location, the relatively low resolution of the image will have little evidential value, and be unable to identify the vessel or its activity.

Determination of environmental conditions: this use of satellite imagery is more practical and less costly. An example is satellite sea surface temperature imagery, available via the Internet, which indicates favourable ocean conditions for tuna fisheries. This data can be overlaid with ALC position reports or other intelligence of suspected activity and can assist with surveillance patrol planning. This type of data was successfully utilised to find driftnet fishing vessels operating close to the New Zealand EEZ in the early 1990's. Similarly, satellite derived ice imagery is used to assist surveillance planning in Antarctic waters.

Commercial satellite imagery continues to improve and it is worthwhile monitoring progress, but expectations must be managed.

THE LAYERED APPROACH TO SURVEILLANCE

Fisheries surveillance is (or should be) intelligence driven. The MFish definition of intelligence is:

> "*the product resulting from the collection, evaluation, analysis and interpretation of all available information*".

The intelligence process articulates the issues to be addressed, the questions to be answered, and their relative priorities. These in turn drive the collection of information from a wide variety of sources, which include:

- aerial and surface surveillance patrols
- automatic location communicators (ALCs) via the VMS
- Observers
- inspections of vessels in port by Fishery Officers
- other agencies in New Zealand and overseas
- vessel, client and authorisation registers
- catch and position returns from fishing industry
- informants

An important point to note is that no single source will provide all the information desired. However, these various sources do complement each other and have their uses depending on the circumstances. For example, ALC position reports indicate where a particular vessel is and its possible activity. But the VMS by itself cannot prove that the vessel is actually fishing nor what it is catching. Observers, however, can provide this information, but it is not always practical to deploy them and they are also very expensive (hence only 20 per cent of the deepwater fleet is covered by Observers in a year). These sources complement each other, as does aerial surveillance, which can gather evidence of what activity a vessel is conducting regardless of whether it is operating an ALC or not.

A number of tools are used to collate and analyse various aspects of this information. The tools include:

- Vessel Monitoring System (VMS)
- Secure Intelligence Database (SID)
- Various Geographical Information Systems (GIS)

Some analysis can be automatically conducted, for example, the VMS automatically conducts a 'time and space" analysis of any vessel sighting with any relevant ALC position reports and highlights any discrepancies. Other analyses require specialised analysts to interpret the information and draw appropriate conclusions.

Often it is only after the various "layers" of information have been overlaid and compared that offences can be detected. A representation of this type of analysis is shown in figure 5.

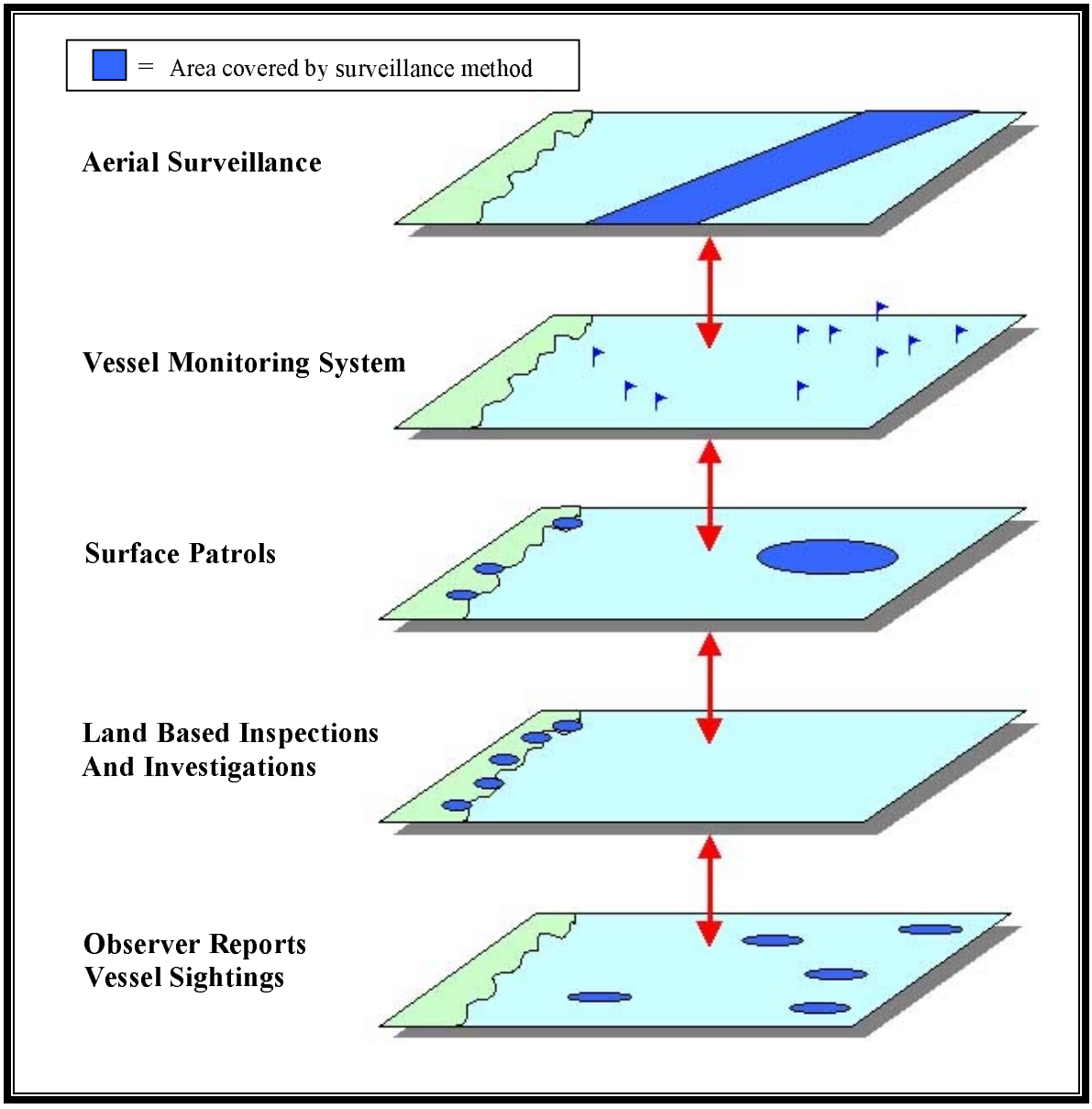


Figure 5

This technique is not only useful at the tactical level, such as offence detection, but can also be used for strategic purposes such as resource deployment.

These tools, used in an integrated manner, provide powerful support for decision making; they pinpoint areas of concern, and enable the prioritisation and targeting of limited and costly surveillance resources.

OVERSEAS EXPERIENCES

The following are brief summaries of the aerial surveillance solutions employed by other countries. For more detail on the capabilities of other countries see Appendix 8 Country Reports.

AUSTRALIA

Australian Fisheries waters covers an area of over 3.45 million square miles. Responsibility for managing the fisheries resources in this area is delegated to the Australian Fisheries Management Authority (AFMA) and the various state fisheries management agencies.

AFMA relies on other agencies to resource aerial surveillance. A large proportion of the aerial surveillance effort is carried out by private contractors, which are managed by Coastwatch, a branch of the Australian Customs Service.

Coastwatch was established with the aim of 'centralising' the surveillance programme and acts as a service provider to various Government agencies with a need for either surface or aerial surveillance. Due to the requirements of the various agencies Coastwatch patrols are often 'multi-tasked' to improve their cost-effectiveness and efficiency.

In addition to their duties for Customs and other agencies the Coastwatch aircraft carryout both routine and non-routine fishery protection patrols using a varied fleet of aircraft such as the DHC-8, PBN2B Islander and the Cessna F-406. The current contractors to Coastwatch are National Jet Systems, which provides 13 fixed wing aircraft and Reef Helicopters Ltd, which operates a Bell Longranger IV.

To supplement this effort the Royal Australian Air Force (RAAF) provide 250 hours annually for fishery protection tasks, which are mainly flown by Orion aircraft covering the more remote areas of the Australian Fishing Zone.

UNITED KINGDOM

Aerial surveillance of the 280,000 square miles of ocean under the jurisdiction of the United Kingdom has under gone some recent changes in the way it is structured and carried out. Up until 1998 the responsibility for EEZ patrols was divided among member countries, with specific agencies given responsibility for deciding how it was to be under-taken.

Scotland:

The Scottish Fisheries Protection Agency (SFPA) has the aim of securing the enforcement of UK, EU and International fisheries laws within the Scottish EEZ. SFPA carries out a co-ordinated enforcement role in the air, at sea and on land. In terms of aerial surveillance SFPA employs two aircraft to provide a deterrent presence, monitor activity and to make effectively use its vessel time by co-ordinated use of surveillance information. SFPA uses two Reims Cessna Caravan II F-406 twin-engine patrol aircraft operated by contractor Directflight Ltd in concert with four offshore and three inshore patrol vessels.

England and Wales:

In England and Wales responsibility for control and enforcement of the relevant fisheries waters lies with the Ministry of Agriculture, Fisheries and Food (MAFF) Sea Fisheries Inspectorate assisted by the Royal Navy. MAFF does not have its own fleet of aircraft and instead contracts out this service to a commercial company. Up to 1998 this task was performed by FR Aviation Ltd using Dornier 228 and PBN Islander aircraft. On 1 September 1998, the contract was awarded to Directflight Ltd, with a change to the Reims Cessna F-406. The Norwich-based company has provided the SFPA with the same service since 1992 with operations from Prestwick Airport. The Royal Navy's Fisheries Protection Squadron also provides assistance in fulfilling the aerial surveillance requirements of MAFF.

Northern Ireland:

The Department of Agriculture for Northern Ireland (DANI) has only a minor component of aerial surveillance for monitoring its fisheries waters. The predominant patrol is by its sole vessel, with occasional assistance from the aerial surveillance assets of the UK's military arms.

CANADA

Canada's geography effectively concentrates most of its fisheries resources on the Atlantic Coast. There are only very limited fishing operations on the Pacific Coast and in the Arctic region to the north. This situation has allowed the Canadian authorities to focus much of their aerial surveillance resources on to just one coastline, the Atlantic Coast, which covers an area of about 500,000 square miles of ocean.

The Canadian authorities, led by the Department of Fisheries and Oceans (DFO), uses two agencies to fulfil the requirement to monitor fishing activities within and beyond its EEZ; Provincial Airlines Limited AMSD, which has the main role, and the Canadian Armed Forces, which plays a smaller.

Provincial Airlines Limited AMSD employs three Beech King Air B200 platforms modified with search radar, infra red detection equipment and a data management system. Provincial Airlines Ltd provides DFO with up to 4,500 hours of patrol time each year under contract and these patrols can be conducted either during daylight hours or at night. Based for the most part on the East Coast an aircraft is sometimes dispatched to British Columbia on the Pacific Coast during summer to monitor the salmon and ground fish fisheries.

The Canadian Armed Forces sometimes uses a Lockheed CP-140A Arcturus, and, less frequently, the CP-140 Aurora of which there are three and 18 in service respectively. The Arcturus and Aurora are essentially P-3 Orions but with different avionics suites. The Arcturus is a stripped down version utilised for crew training and fisheries patrols, while the Aurora is fitted with the avionics of the S-3 Viking and is a dedicated ASW platform. These aircraft are tasked with carrying out the longer-range patrols from time to time.

Comparison of International Aerial Surveillance Resources and Utilisation

Country	Approximate size of EEZ (converted to square miles)*	Agency responsible	Number of Aircraft available (Fixed-wing MPA only)	Approximate number of Patrol hours flown per annum
Australia	3,450,000	Coastwatch (National Jet Systems) RAAF	3 x DHC-8 200 6 x BN-2B 1 x AC500 3 x F-406 20 x P-3C	15,450[1] 250
Canada	500,000[2]	Provincial Airlines Air Force	3 x B200 18 x CP-140 3 x CP-140A	3000-5000 1000
India	780,000	Coast Guard Navy	17 x Do-228 101 8 x Tu-142M 5 x Il-38 15 x BN-2B/T 16 x Do-228 101	Unknown Unknown
Ireland (Republic of)	132,000	Air Corps	2 x CN 235-100M	Unknown
United Kingdom	280,000	Directflight (SFPA) Directflight (MAFF) RAF/RN	2 x F-406 3 x F-406 35 x Nimrod[3]	Unknown 1640 Unknown
New Zealand	1,720,000	Civilian charter RNZAF	4-6 Civilian types on ad hoc basis 6 x P-3K	51 192

Notes on table

* as opposed to square nautical miles

[1] This total includes some surveillance hours on tasks other than fisheries protection (e.g. customs).

[2] This is not the total size of the EEZ but the area within which the majority of patrols are tasked.

[3] These aircraft are primarily dedicated to the ASW role with minimal fisheries protection work.

SURVEILLANCE TASKS

In general terms, and prior to the identification of specific areas of concern, two broad categories of requirements can be determined; programmed and response patrols. Each category beaks down into sub-categories and will be discussed below in turn. The distinction between these categories relates to the degree of prior knowledge and will apply as other factors such as range, time, area and so on.

It is possible that a patrol may move from one category to another or include a number of sub-categories. For example, while a patrol is in the air it may be called upon to respond to a developing situation or when planning the patrol a number of functions may be achieved by the same flight.

Programmed Patrols

1. *General or routine* - these occur where there is no prior concern about a specific offence or offences and the patrol is designed to cover a specified area of portion of the fishing fleet. While the patrol may be general in nature it is still very much targeted, in that careful consideration will be given to the best place to send the patrol and it will still have a specific objective. For example, a general patrol may be dispatched to cover the Chatham Rise orange roughy fleet and any other vessels it encounters while there.

2. *Perimeter protection* - instead of patrolling a specific location or group of vessels the patrol targets the integrity of New Zealand's EEZ. Again there is no specific information or intelligence suggesting specific instances of offending. This type of patrol may be used where there are concerns that a stretch of our EEZ in particularly vulnerable to unlicensed foreign intruders. For example, sea surface temperature analysis may suggest that conditions within the northern edge of our EEZ are right for tuna fishing leading to a call to patrol the perimeter of our zone to detect the presence of possible illegal fishing vessels or carriers.

3. *Area protection* - these are very similar to the second category but instead of protecting the integrity of the EEZ they are more concerned with internal area restrictions, such as closed areas. This type of patrol requires a higher degree of knowledge to determine the extent of closed areas and whether particular vessels fall within the class or classes of prohibited vessels. The patrol may need to determine what fishing method the vessel is using, the size of the vessel or its status under the Ship Registration Act 1992. This form of patrol will often be used in conjunction with another, for example, a routine patrol of the east coast of the North Island may also be programmed to cover several closed or restricted areas.

4. *Deterrence* - these are specialised variations of the general patrol which take place in situations where, although there is no evidence of specific offending, there is a requirement for a patrol for primarily deterrence value. An example of this occurred in 1999 when concern developed in relation to the deteriorating levels of compliance among foreign charter vessels fishing along the boundary of the territorial sea. A RNZAF Orion made a covert sweep of the area to see if any offences were being committed. Once it had determined that there were no specific offences it then made a very overt run down the edge of the territorial sea. This had the desired

effect of sending a message to the vessel operators that they were being watched and their behaviour improved accordingly.

Response Patrols

1. *Offence detection* - in a situation where there is reliable intelligence that an offence is being committed, aerial surveillance may be the best, and sometimes only, means of collecting the evidence required to bring a prosecution. These patrols will be very focused and may spend all or part of their time in a covert mode. A number of important factors, such as chain of evidence considerations, must be addressed to ensure that any ensuing prosecution is successful. An example of this type of patrol was Operation DOLPHIN in which a P3 Orion was dispatched to obtain evidence of several large factory trawlers sneaking into a closed area at night.

2. *Intelligence gathering* - in some situations the operational requirements may be identical to the first category but instead of gathering evidence the aim is to gather intelligence. This may occur where a case is being developed for later termination or where, although there is no illegal activity, New Zealand has a wider interest. An example of this was in Operation STRAW in which a New Zealand Orion searched in the Tasman sea for the predicted rendezvous between 2 foreign vessels that had operated in a manner likely to undermine an international agreement, to which New Zealand was a party. Although the likelihood of a prosecution ensuing was minimal the intelligence to be gathered was considered important in terms of New Zealand's international standing and objectives.

3. *Target control/hot pursuit* - these relate to situations where aerial surveillance capabilities are required to control a target and maintain certain options under the United Nations Law of the Sea (UNCLOS). Hot pursuit occurs where a vessel flees a jurisdiction after committing an offence. As long as continuous pursuit is maintained the vessel may be pursued and apprehended on the high seas. Aerial surveillance constitutes maintaining pursuit for the purposes of UNCLOS. An example of this occurred in Operation MERCURY where an Orion, on a routine patrol, detected a Korean vessel committing an offence. Another Orion, sent up specifically for the purpose of controlling the target watched the vessel as it fled New Zealand's jurisdiction. Although the decision was taken not to continue hot pursuit the use of aerial surveillance assets ensured that further pursuit remained an option.

4. *Operational support* - in some situations, particularly where there is the chance that a vessel may flee, it is useful to have aerial surveillance capability to support a surface operation. The form of support varies although it is generally used to maintain a higher degree of control and deterrence. An example of this type of patrol came during Operation HAWKE when a P3 Orion was used as aerial cover during an operation to board a foreign charter vessel outside the territorial sea. There was concern the vessel might try to flee, possibly once fishery officers had boarded the vessel. The vessel made initial movements as if it intended to run but then changed its mind, and one of the factors for its change of heart is believed to have been the sight of a P3 making passes 200 feet overhead.

5. *Specialist* - this covers a wide range of extra functions that aerial surveillance assets may be asked to conduct. This category reflects the fact that there are few limits to the inventive uses that may be made of aircraft. An aircraft may be used to track a beacon planted on a vehicle or vessel. Or as was initially considered in the case of Operation HAWKE, a helicopter may be the best means of boarding a vessel. Helicopters may also be used to transport compliance personnel in an operation taking place in rugged or otherwise inaccessible terrain. A number of practical considerations, such as cost or health and safety issues, may come into play when looking at these types of specialist patrols.

Evidential Levels

As indicated, evidence gathering is a primary role of aerial surveillance assets, whether it is the unexpected result of an offence detected during a routine patrol or as the planned outcome of a specific offence detection patrol.

> **It is an aircraft's ability to gather direct evidence, particularly photographic evidence, which sets it apart from other forms of surveillance, such as the VMS. Many of the other forms of surveillance can locate a vessel and give an indication of its likely activity, but aerial surveillance is one of the few that can provide categorical evidence of vessel activity.**

A very high standard of evidence is required to meet the threshold demanded by the courts. Gathering aerial surveillance evidence to support successful prosecutions requires specialised equipment and advanced crew training. The court will need to be certain that the surveillance equipment on board the aircraft is accurate and has been used by qualified crew. The crew will need to give credible witness statements in support of any photographic or video evidence, as well as evidence of their own observations. A direct chain of evidence will need to be maintained so the court can be assured that there has been no tampering or contamination of evidence subsequent to the patrol but prior to the court proceedings.

MFish has previously identified three levels of reporting standards:

1. *Intelligence* – Information that may be classified which is used to assist with enforcement analysis and decision making, including asset deployment, and which may be obtained from a wide variety of sources and agencies. Generally, this information cannot be used as evidence in a court of law because it may compromise the provision of further intelligence.
2. *Evidential (low)* – Routine information derived from surveillance patrols (aerial or surface), which may be used as intelligence and also as evidence if the need arises in the future. An example would be a vessel sighting that is recorded, position fixed, photographed and reported to MFish. Some time later, the sighting is deemed to be relevant to an investigation and can be used as evidence.
3. *Evidential (high)* – Information collected when an offence is suspected, and is part of standard infringement procedures. For an aerial patrol this may include 4 point photography, position fixing by several means, special reporting and handling of exhibits and the provision of testimony in court.

SURVEILLANCE AREAS

A number of areas of interest have been identified as potential targets for aerial surveillance patrols. These target areas have emerged from an incorporation of background information on the major fisheries and analysis of MFish compliance concerns.

Specific Areas of Interest – Inshore	**Priority**
Paua poaching on southern coast of Wellington	
Chathams rock lobster and paua	
Marlborough rock lobster and paua poaching	
Rock lobster (Central East) closed season/poaching	
Wairarapa paua poaching	
Freshwater eel fishery (nationally)	

Otago closed season for rock lobster
Kaikoura rock lobster poaching
Nelson scallop restrictions
Hauraki Gulf method restriction boundaries
Banks Peninsula rock lobster poaching
Banks Peninsula set net restrictions for protection of Hectors Dolphins
Wairoa Hard restrictions
Bay of Plenty area/method restrictions
Southland trawling inside dredge oyster fishing area
Three Kings closed area
Poor Knights Marine Reserve
Northland trawl and Danish Seine restrictions
Checking locations of marine farms (nationally)
90 mile beach toheroa poaching
Toheroa on Oreti beach (closed and open season monitoring)
Otago trawl restrictions
Banks Peninsula trawl restrictions
West Coast of North Island trawl restrictions
South Island voluntary closures for purse seining around river mouths
Inner-Hauraki Gulf seasonal closure

Specific Areas of Interest – Deepwater

West Coast South Island hoki fishery dumping by-catch
Cook Strait hoki fishery dumping hoki
Cook Strait hoki fishery dumping by-catch
South East Coast South Island oreo hygrading
Scampi fishery area mis-reporting (in particular Chatham Rise)
Illegal transhipments within the NZEEZ
Scampi competitive catch restrictions
Squid trawl fishery gear restrictions (carriage and operation of SLEDs)
Southern bluefin tuna unlicensed fishing
Other tuna species unlicensed fishing
West Coast South Island hoki fishery - dumping hoki
Central East and South East Chatham Rise blue nose area mis-reporting
South East Chatham Rise oreo area mis-reporting
West Coast South Island orange roughy area mis-reporting (ORH7B)
Central East Area orange roughy mis-reporting (ORH 2B)
Scampi fishery - dumping by-catch
Dumping/hygrading of scampi
Territorial Sea closed areas
Kermadec fisheries area fishing prohibitions
Auckland East and Central East (North Island) closed areas (>46m)
Auckland West trawling restrictions (>46m)
Central West (North Island) area trawling restrictions (>46m)
South East Coast (South Island) area restrictions (>46m)
West Coast (South Island) area restrictions (>46m)
Solander trench closed area (trawlers >46m & bottom-longlining >30m)

Specific Areas of Interest - International

Westpac Bank orange roughy straddling stock
Ross Sea toothfish IUU fishing
Southern Ocean toothfish unlicensed fishing

Specific Areas of Interest – EEZ Breaches

As noted in the section on surveillance tasks some of the roles relate less to the activities of the legitimate fishers and more to the detection of illegal or unregulated fishing. One of the more important functions, in terms of New Zealand's sovereignty rather than fisheries protection, that aerial surveillance is tasked with is the preservation of the integrity of the New Zealand EEZ.

Figure 6 shows recent incidents involving breaches of New Zealand's EEZ or straddling stock areas. The nature of these incidents are variable, ranging from illegal transhipments involving multi-millions of dollars worth of fish to unidentified fishing craft engaged in unlicensed fishing.

Breaches of EEZ Integrity (Including Westpac Bank)

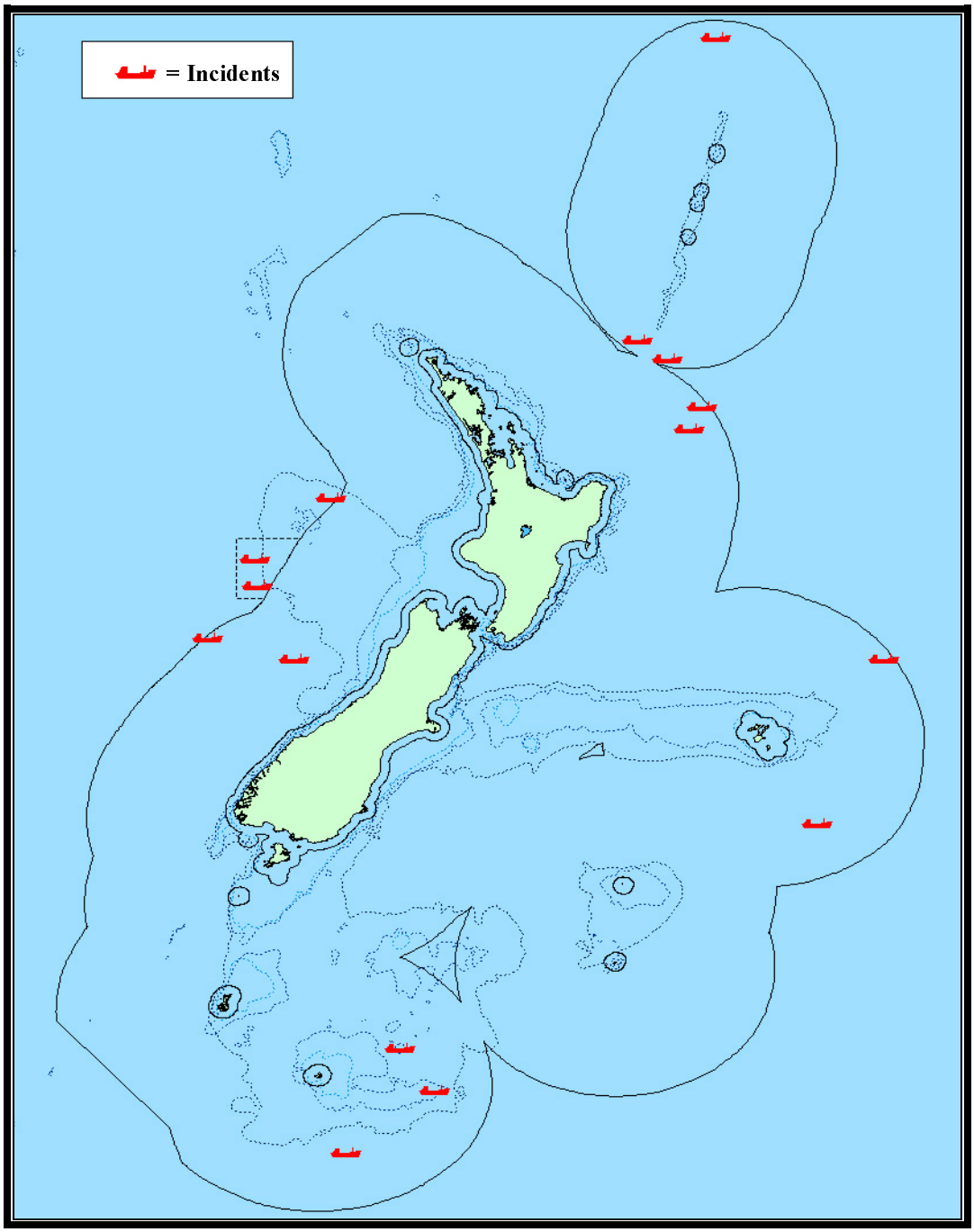


Figure 6

SURVEILLANCE RANGES

As a key step in the process of establishing MFish's aerial surveillance requirements, this report has determined a series of bands, consisting of fisheries grouped by percentage. This enables the establishment of a series of ranges, and the percentage of fisheries falling within each range. Once these ranges are determined, and the level of activity in each is established, it is a relatively simple procedure to calculate the operational capabilities necessary in order to provide the appropriate level of coverage over each range.

It is worth noting that the set of data used in this analysis is highly indicative of the major deepwater fisheries, but does not reflect the inshore fisheries at all. The reporting regime currently implemented in New Zealand does not require exact catching locations to be recorded for a number of important inshore fisheries. The analysis has, therefore, taken account of this and has been conducted from all available data concerning the locations where fishers have taken catch, which has generated by MFish's catch effort reporting system. Despite its highly indicative nature, this is an extensive amount of information, especially considering that the data set includes the latitude and longitude of 462,593,875 kilograms of catch.

Even though inshore fisheries comprise approximately 20 per cent of the total catch (a definitive figure is not available at this time), it does not compromise the accuracy of the overall model. Since this catch, by definition, occurs within the Territorial Sea it is localised at one end of the data spectrum. The inshore fisheries will therefore be dealt with as a discrete entity after the other data has been modelled.

Extra-territorial catch comprises 13.26 per cent of the total catch. In order to avoid the distortion of data, which is created by some of the fisheries occurring at extreme distances, all catch taken outside of the EEZ has been excluded. Since extra-territorial catch is localised at the other end of the range spectrum it will, like the inshore fisheries, be dealt with as a separate entity once the initial data modelling has been done.

The set of data used in the analysis therefore represents all of the deep-water catch taken within the EEZ, and is – as has previously been stated – highly commercially sensitive.

Given that this report aims to identify and detail MFish's aerial surveillance requirements, the data was analysed to determine the distance between the location where the catch occurred and the nearest major airfield. This was done with the intention of producing more meaningful conclusions as there is often a significant difference between the distance of catch taken from a coastline, and that which is measured from a major airfield. Catch taken near the Sub-Antarctic Islands, for example, would register as being close to land, but for the intents and purposes of aerial surveillance would require a journey of over 400 nm.

"Aeronautical Plotting Chart New Zealand – Chathams Series 200 Sheet 1 – Aero, Edition 9" was utilised in order to determine which airfields were used as base reference points.

The analysis is illustrated by figure 7.

Distance of Catch from Major Airfields

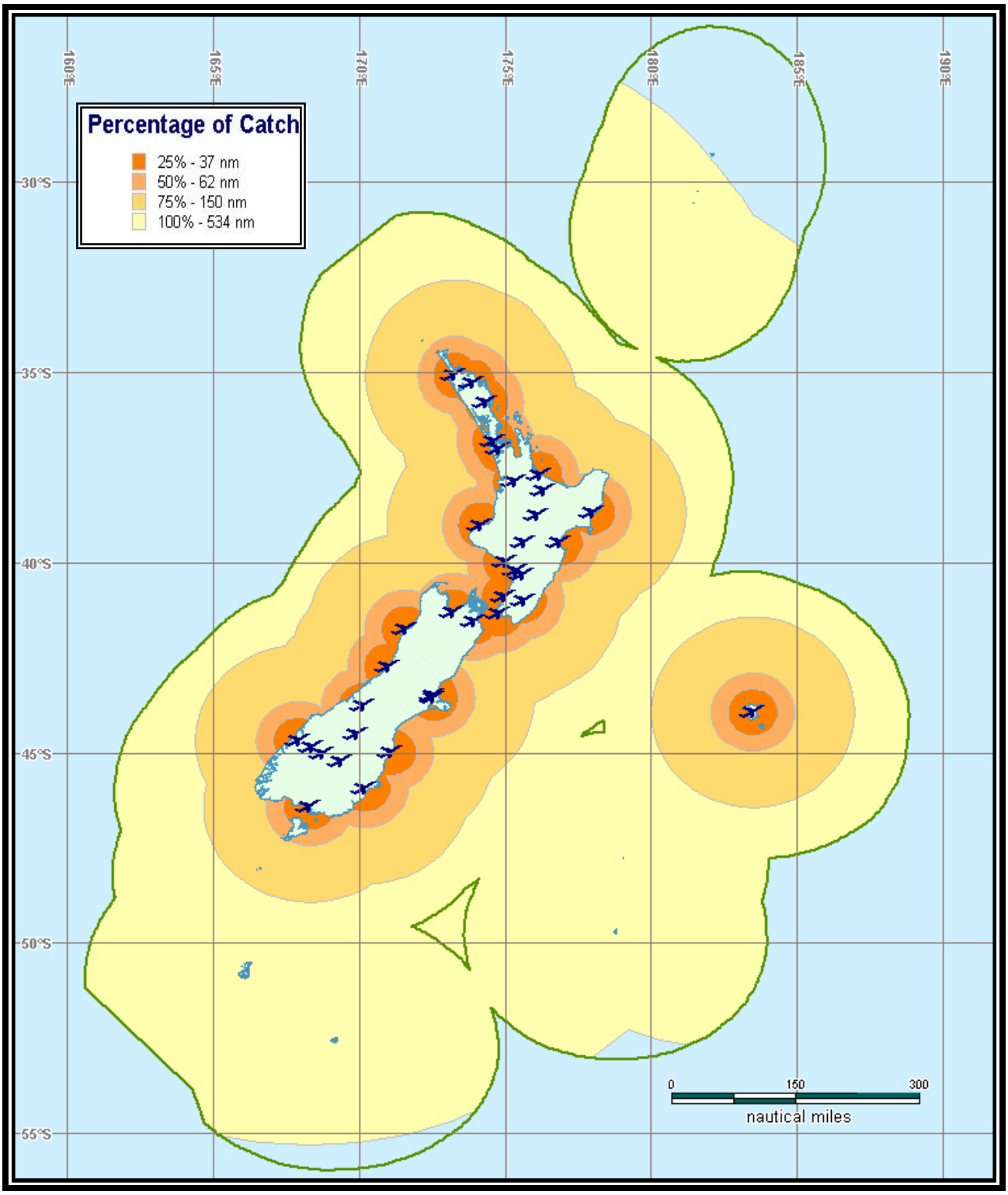


Figure 7

The analysis reveals that 25% of all deepwater catch is currently taken within 37 nm of a major airfield (band 1 figure 6), 50% within 62 nm (band 2), 75% within 150 nm (band 3) and 100% within 535 nm (band 4). Figure 8 shows the trend for the percentage of catch across distance.

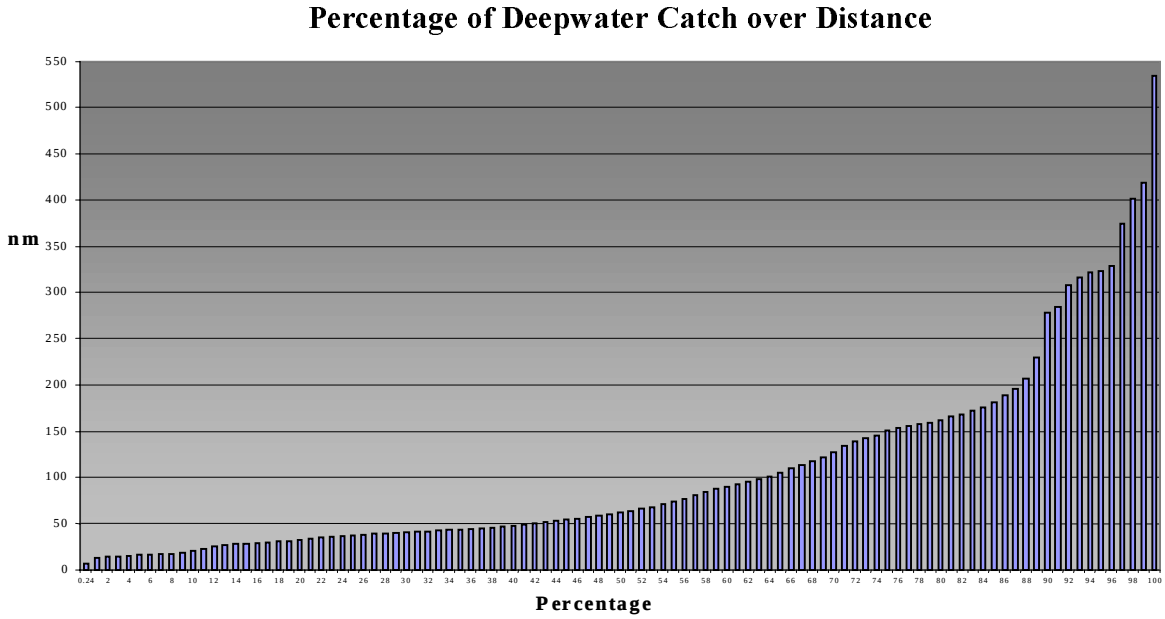


Figure 8

Trend analysis of this data demonstrates that most catch is taken relatively close (taking into account the large distances within the EEZ) to a major airfield. Aerial surveillance undertaken at short and medium ranges will be able to cover large percentages of the fishing fleet's catch capacity with small changes in range. Aerial surveillance targeted at longer ranges will suffer the law of diminishing returns, with large increases in distance required to bring about a small rise in the percentage of catch covered.

Conclusion

The most salient conclusion derived from this data is that long-range surveillance aircraft are not required to cover a major share of the fisheries within New Zealand's EEZ. This conclusion is further supported when considering the valuable inshore fisheries, which predominantly fall within the 12 nm Territorial Sea. The extra-territorial fisheries add an element of counter balance, yet in no way negate the premise.

It is also clear that, in order to cover all New Zealand's fisheries, particularly the top 20 per cent of deepwater and all extra territorial fisheries, a surveillance aircraft will require prodigious endurance and range. Based on the analysis conducted the following ranges have been determined to be significant for determining MFish's aerial surveillance requirements:

Description:	**Range:**	**Coverage:**
Short	From the beach to the outer boundary of the Territorial Sea (TS).	All inshore fisheries and 1 per cent of the deepwater fisheries. Also includes land-based surveillance (e.g. transportation).
Medium	From the boundary of the TS to 90 nm from major airfields.	This covers all inshore fisheries and 60 per cent of deepwater fisheries.
Long	From 90 nm to 300 nm	This covers 92 per cent of deepwater fisheries and some extra territorial fisheries.
Extreme	300 nm +	This includes 100 per cent of deepwater fisheries and all extra territorial fisheries.

These ranges are illustrated in figure 9.

Proposed Ranges for Fisheries Surveillance

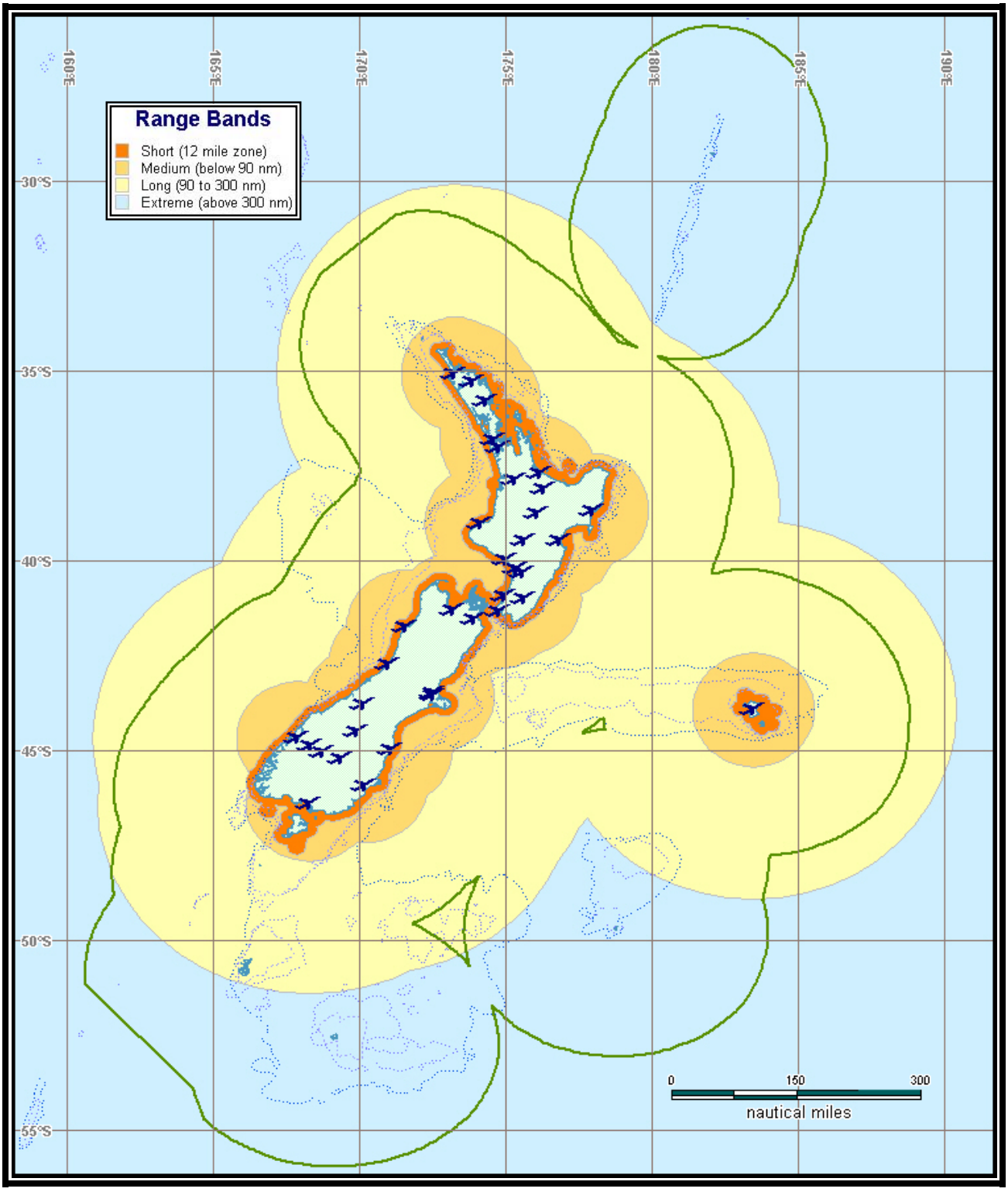


Figure 9.

SURVEILLANCE TIMES

There are distinct seasonal variations in most fisheries and, accordingly, aerial surveillance requirements will vary during the course of a year. Appendix 5 contains a month by month analysis of the spread of fishing activity and highlights major fisheries as they occur. The following chart demonstrates the changing requirements for aerial surveillance during the course of a year. See figure 10.

Monthly Surveillance Requirements

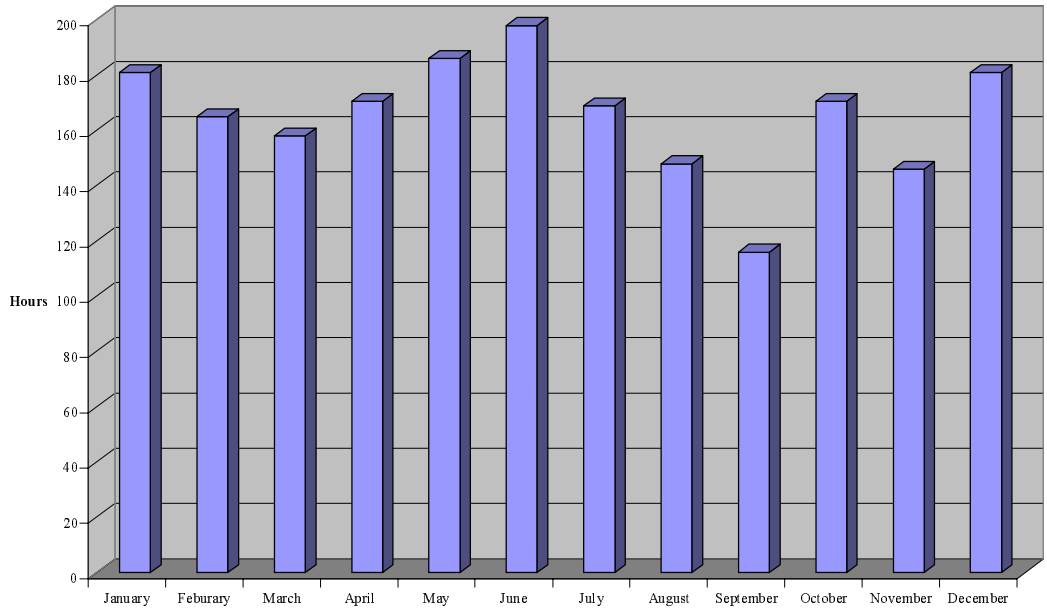


Figure 10

The following chart forecasts seasonal variations, which will cause aerial surveillance requirements to vary across the identified surveillance ranges. This forecast is indicative at best, as any number of factors (such as, major enforcement operations, environmental changes, or even international crises) may at any stage cause significant variation in surveillance requirements. See figure 11.

The total surveillance hours (1988 hrs) used to develop this chart have been derived from adding the assessments for the deepwater (1087 hrs) and the inshore (901 hrs). For the purposes of this calculation the deepwater figure includes international fisheries.

The deepwater figure is taken from the 1994 Report on Airborne Fisheries Surveillance (see page 14). This figure was tested against current and predicted usage and found to be still accurate. The breakdown of how this figure was arrived at is contained in Annex D of the 1994 report, a summary of which is contained in this review at Appendix 9.

Surveillance Requirements by Time and Range

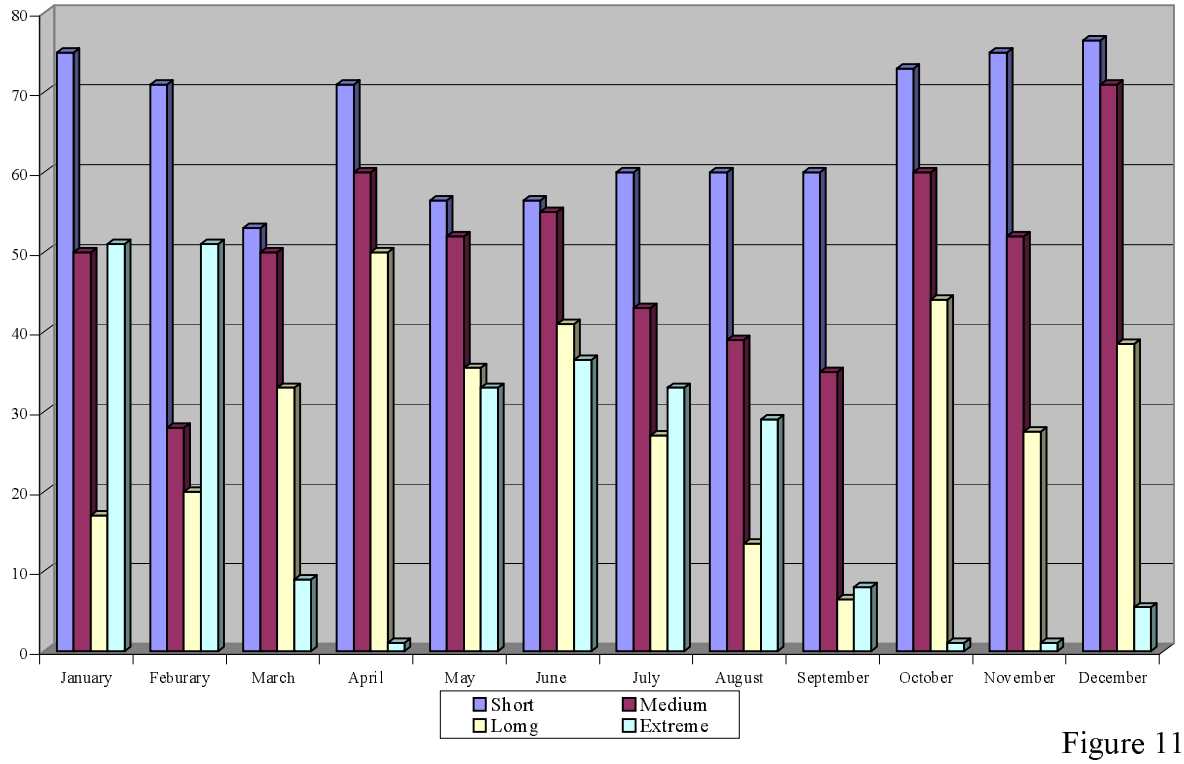


Figure 11

The inshore figure was derived from an analysis of the priority inshore fisheries as described under the heading of surveillance areas (pages 25-26). Each of these areas was assessed for its surveillance requirements and the results are set out in Appendix 10. The analysis also established the surveillance requirements for each MFish Compliance District, see figure 12.

Proposed Usage by MFish Districts

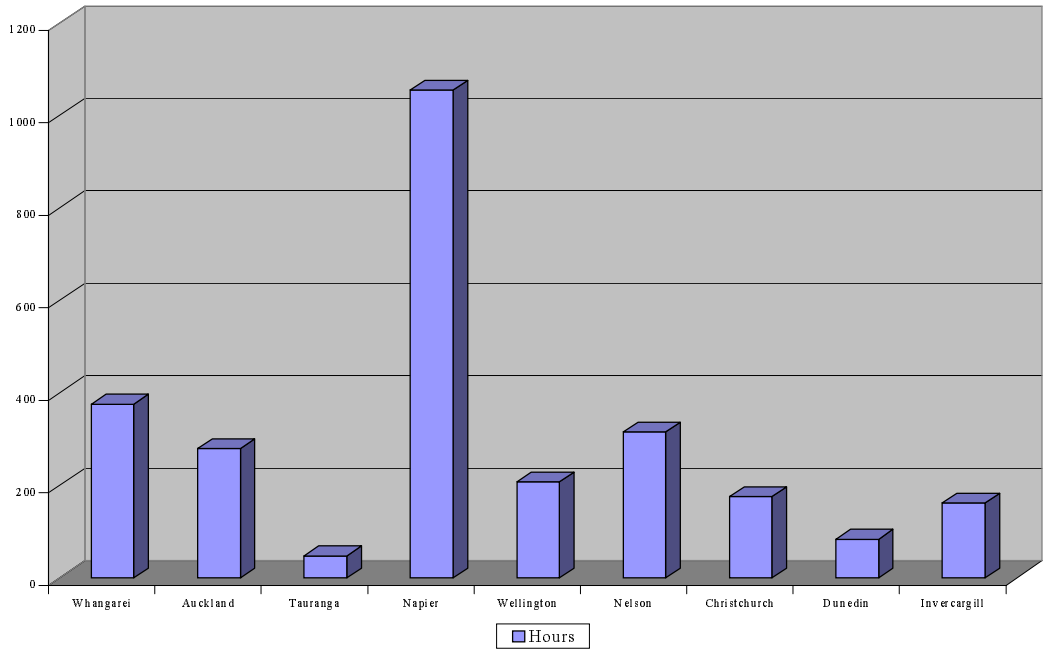


Figure 12.

The final figure of 1988 hrs is similar to the findings of both the 1990 and 1992 reports, which proposed figures of 2040 and 1798 hrs respectively.

SURVEILLANCE SYSTEMS

In the field of maritime surveillance a great deal of emphasis is placed on the capabilities of the respective airframes offered up for the role. It is important to select an aircraft with suitable attributes with respect to range, endurance and speed; however, with the advances in modern avionics the difference between competing airframes becomes less of an issue. In the maritime surveillance role the aircraft is simply a means of conveyance for the electronics carried onboard, the avionics are in effect the eyes and ears of the platform. **It is the systems that distinguish an adequate maritime patrol aircraft from an effective one, and these can be separated into four categories: collection, integration, storage, and transmission.**

Collection

Of paramount importance to any surveillance platform is its ability to first collect the information from the environment it operates in. A number of systems can be viewed as crucial to any proposed fisheries surveillance aircraft.

The radar is an essential item in any maritime surveillance kit. The aircraft will need to have high-powered surface surveillance radar capable of detecting small vessels at long range in various sea states. The radar must be able to track multiple targets with suitable range to allow for long range tracking of vessels. With respect to the stand-off capability, many of the commercially available systems allow for some degree of target identification using Synthetic Aperture Radar (SAR)/Inverse Synthetic Aperture Radar (ISAR) technology. The benefits of this technology should be considered in light of any proposed radar system.

The surveillance platform will also require optical detection systems. An Infra-Red Detection System (IRDS) with a minimum forward search scan of 180^{o} and an elevation range of 0^{o} to -90^{o} is a necessity. The IRDS should provide for exceptional image clarity, superior reliability and sufficient range in various conditions. Ideally the IRDS should be turret-mounted with the turret providing a stable platform not only for the IRDS but also for a visible light Video Camera and an ultra high magnification spotter scope which would be required for the aircraft.

In addition to these systems the crew must have access to manual optical detection equipment. This equipment should include gyro-stabilised binoculars, hand-held video camera and a SLR camera with suitable lenses for still photography. Consideration could also be given to the provision of Night-Vision Goggles (NVG) to assist in identification/navigation.

Consideration should be given to the acquisition of additional high tech detection systems, for example, radio surveillance system. This system monitors radio traffic and allows for an aircraft to home in on a radio source (i.e. a vessel or buoy) from long range. It is also effective for gathering valuable intelligence. Radio surveillance is an effective means of detecting and locating vessels in all sorts of conditions and helps to overcome some of the limitations of radar, especially in the Search and Rescue role.

Integration

To allow a maritime surveillance aircraft to operate effectively with its sophisticated electronics, these systems need to be integrated with each other and with the aircraft itself. There is little point operating powerful radar or IRDS system if the other systems such as the navigation suite cannot pass on vital information that may be required for evidential purposes. It must be stressed that the integration of the onboard systems is a key factor in helping to satisfy the high expectations of evidence, as explained in the section entitled Evidential Levels.

A number of companies have developed systems that integrate all the various equipment carried onboard the aircraft, and can tailor a package to suit the customer. Such a system is a necessity for any proposed surveillance platform.

Storage

The next priority is for the surveillance platform to securely store the information in a way that not only allows for its practical use at some later stage, but to also satisfy the courts if it is to be used in evidence (chain of evidence). Therefore, the aircraft must have the appropriate means of recording the information gathered from all the sensors, using a suitable medium (e.g. videotape, film negative, and audiotape). In addition to the actual storage of the information this information must be available for 'play-back' by the crew while the aircraft is in flight.

Transmission

If a surveillance patrol is to be efficient and effective the surveillance platform must have a comprehensive communications suite. As standard, the suite will need to cover HF, VHF, UHF, both AM and FM bands, and provide for a measure of security in using these communication bands (i.e. voice and data encryption). The aircraft will need to have direct communication with a shore-base while on patrol, and this communication should be in both voice and data (via a datalink). Such a link will allow for an easing of the command, control and co-ordination workload placed on the aircrew during a patrol and allow for the input of shore-based experts in a timely manner.

The aircraft will also need a versatile intercom system (ICS) allowing the crew to communicate with each other and to monitor all other radio traffic. Satellite communication should also be considered as an option in any potential aerial surveillance platform, to further enhance the options available to both the aircrew and the shore-based support.

Ideally, it is envisaged that there be a seamless communication link between the aircraft and the Ministry, which allows for a free flow of information both ways. This would greatly enhance the effectiveness of patrols by essentially acting as a 'force multiplier' (i.e. not only would the aircraft and crew be 'on patrol' but so too the MFish staff and their shore-based information systems).

CONCLUSIONS

Range Analysis

In view of the analysis in this report, particularly the surveillance ranges section, MFish has reached the clear conclusion:

> ***While a long-range capability is still required, an additional shorter-range surveillance capability could patrol the majority of our fisheries.***

The requirement to patrol extreme range fisheries, for example toothfish in the Ross Sea, means that the Orions (or an aircraft with similar attributes) will remain an essential surveillance asset. No civilian contractor is likely to have the means, or desire, to patrol at such extreme ranges and in such inhospitable conditions. Yet international fisheries such as those in the Ross Sea remain a high priority for political as well as fisheries protection reasons. As the development of international high seas fisheries are an increasing trend this requirement is likely to increase rather than diminish.

However, given that the Orions are meeting only a small percentage of MFish's requirements (17.6 per cent of the deepwater hours) and that the majority of fisheries, both inshore and deepwater, occur within 90 nm of a major airfield, there is no reason why the Orions could not be supplemented with much a less sophisticated aircraft.

Gap Analysis

In order to determine whether MFish's maritime surveillance requirements are being satisfied, a comparison (gap analysis) between the requirements derived from the above GIS analysis and the current level of surveillance effort as described in the background section of the review has been conducted. This analysis produces two further major conclusions:

1. ***There is a substantial gap between the aerial surveillance hours required by MFish and those it is currently receiving from both the RNZAF and ad hoc civilian service providers.***

This gap appears to be the result of a lack of suitable aerial surveillance assets. The RNZAF is constrained by its own resource limitations and can only provide a certain number of hours. The use of civilian service providers is not budgeted for in a co-ordinated manner, and there is no overall planning to ensure that priority requirements are satisfied.

The RNZAF, in accordance with the Interdepartmental Agreement, has provided a constant number of hours since 1992 (although it appears that there was no reassessment or reallocation of effort after the withdrawal of the Friendships). During the period in which the Friendships were operational the RNZAF met 14.4 per cent[5] of MFish's total requirements for surveillance hours (which equates to 26.3 per cent of the deepwater hours). Since 1992 they have on average met 9.6 per cent of MFish's total required hours (17.6 per cent of the deepwater hours). This figure is,

[5] This figure is derived from an average of 23.5 F27 patrols at an average of 4 hours each (estimate obtained from RNZAF)

however, slightly inaccurate, as it does not include extra hours obtained during the transit of Norpats and training flights. These extra flights are likely to increase the figure up to the 12 and 20 per cent marks for the total and deepwater hours respectively.

The discretionary use of civilian service providers by Compliance District Offices covers a further 2.5 per cent of MFish's total surveillance hours (which equates to 5.6 per cent of the required inshore hours). This figure is based on only one year's worth of data however extensive variation is unlikely and a figure of between 2-3 per cent is believed to be sufficiently representative.

This straightforward analysis leads to the conclusion that approximately 85 per cent of the total aerial surveillance hours that MFish has deemed to be necessary in order to adequately protect New Zealand's fisheries resources are not being provided.

2. *The gap identified in MFish's surveillance requirements is not spread uniformly but has the greatest impact in the short (12 nm) and medium (90 nm) range fisheries.*

The majority (around 80 per cent) of the current surveillance effort comes from the RNZAF Orion, an aircraft that is ideally suited to long (300 nm) and extreme (300+ nm) range patrols but unsuited to inshore and short range patrols. It is worth noting however, that there is an overlap between many of the deepwater fisheries and the Orions cover some fisheries that straddle the medium and long range bands (for example, West Coast South Island hoki and the Chatham Rise mixed fishery).

The short and medium range bands, which contain the majority of fisheries (61 per cent of total catch) are the poorest served by our current surveillance capability. The inshore fisheries receive only 2.5 per cent of required surveillance effort and that is by civil aircraft that possess, at best, only rudimentary surveillance systems.

IDENTIFICATION OF OPTIONS

1. *Do nothing.*
   Allow the current surveillance levels to remain as they are and accept that the issues raised in this review will be unresolved.

2. *Increased use of the Orions.*
   The issues would not be resolved by increasing the Orion hours dedicated to fishery patrols. This would provide some initial benefits in overlap fisheries but there are many short range tasks to which the Orion is neither suited and nor a cost-effective solution. Even with unlimited Orion hours major gaps would still exist in MFish's surveillance capability in the inshore fisheries.

3. *Increased use of the civil aviation sector.*
   Increasing the use of the civil aircraft is also not going to provide a resolution to the issues as surveillance is their secondary function and they do not have the sophisticated systems needed to meet MFish requirements. Even assuming that such a capacity exists, the use of a non-dedicated civilian surveillance capability is going to remain a stop gap solution.

4. *Contract a dedicated service provider.*
   This was the conclusion of the 1994 Report of Airborne Fisheries Surveillance and is a compelling option. A dedicated service provider would be able to meet the rigorous requirements both in terms of surveillance systems and the provision of evidence to a

sufficiently high standard. This option can meet all requirements and would do so in the most cost-efficient manner.

If Option 4 was selected there are a number of sub-options; the service provider may be:

a. *A commercial contractor*. This would provide the least risk for the New Zealand government but any purely commercial contractor would want to be tied in to a long-term contract in order to ensure operational profitability.

b. *The RNZAF*. The RNZAF could purchase suitable airframes and kit them out with appropriate civilian avionics. This option would provide economies of scale in terms of operational support and maintenance.

c. *A civilian/RNZAF joint venture*. This option has the potential to provide the best of both worlds. However, it may require difficult compromises from both parties.

d. *A Government Department/s*. This option would see governmental bodies moving beyond their areas of expertise and could be fraught with difficulty. The advantage would be a close relationship between the customer and service provider.

APPENDIX 1 – INSHORE FISHERIES

Definition

Traditionally a distinction has been made between inshore and deepwater fisheries. There is considerable overlap, so unfortunately there are no easy ways to define which fisheries fall into which area. For the purposes of this review, inshore fisheries are those that occur close to the beach or within the territorial sea. These fisheries are normally harvested in depths of 1 – 200 metres.

Inshore species

QMS:	Alfonsino	Barracouta	Blue cod	Blue moki
	Blue nose	Blue warehou	Elephant fish	Flatfish
	Gemfish	Ghost shark	Grey mullet	Gurnard
	Hapuku	John dory	Ling	Oyster
	Paua	Red cod	Rig	Rock lobster
	Scallops	School shark	Sea perch	Snapper
	Stargazer	Tarakihi	Trevally	Trumpeter
Non QMS:	Butterfish	Cockles	Eels	Kahawai
	Kina	Kingfish	Mussels	Paddle crabs
	Pilchards	Pipis	Salmon	Sharks (assorted)
	Skates & rays	Toheroa	Tuatua	

Fishing methods

The major inshore fishing methods are trawl, pair trawl, long line, hand line, jigging, trolling, dredging, pole-fishing, fyke nets, set-net, pot, purse seine, beach seine, Danish seine, diving and hand gathering (shellfish).

Profile of inshore fishers

The inshore fisheries contain a mix of fishers from the commercial, recreational, and customary sectors. It is difficult to determine the exact number of fishers involved in inshore fisheries and any attempt to put numbers to the recreational and customary groups would be speculation at best.

The majority of commercial fishers involved in the inshore fishery are small owner operators. They tend to operate smaller vessels and undertake fishing trips of limited duration (normally within a day). They are widely distributed among small coastal settlements as well as operating from the major fishing ports.

On an individual basis these smaller fishers have a reduced capacity to directly affect the sustainability of the fishery. However, they often operate on the margins of profitability, so the economic drivers for offending can be much higher than those for larger fishing companies.

Non-commercial fishers are another major inshore fisheries group. They may operate under customary regulations, as recreational fishers, or as an illegal poaching operations. Often poachers will use customary or recreational fishing as a cover for illegal operations. In many fisheries the non-commercial take has a huge impact on the sustainability of the fishery.

Major inshore fisheries

A fishery may be deemed to be a major fishery for a number of reasons such as size, sustainability concerns, commercial value, political profile, customary importance, illegal activity etc. The following fisheries are considered to be the major inshore fisheries:

- The rock lobster fishery (national)
- The paua fishery (lower North Island, South Island and Chatham Islands)
- Otago/Canterbury multi species trawl fishery
- Southland multi-species inshore trawl fishery
- Challenger area multi-species inshore trawl fishery
- Hauraki Gulf snapper
- East Coast North Island snapper
- Auckland/Northland multi-species inshore trawl and Danish seine
- Bay of Plenty multi-species trawl and Danish seine
- Bluff oyster fishery
- Nelson scallop and oyster fishery
- Freshwater eels (national)
- Southland blue cod

APPENDIX 2 – DEEPWATER FISHERIES

Definition

For the purposes of this review, deepwater fisheries are deemed to be those that occur predominantly outside the territorial sea but within the EEZ. These fisheries will generally occur at depths of between 200 – 1000 metres (or in some extreme cases out to 1500 metres).

Deepwater species

QMS:	Alfonsino	Barracouta	Bluenose	Cardinal fish
	Frost fish	Gemfish	Ghost shark	Hake
	Hapuku & Bass	Hoki	Jack mackerel	Ling
	Orange roughy	Oreo dories	Ribaldo	Ruby fish
	Scampi	Sea perch	Southern blue whiting	
	Squid	Warehou, blue	Warehou, silver	Warehou, white
Non QMS:	Albacore tuna	Bigeye tuna	Billfish	Skipjack tuna
	Southern bluefin tuna		Yellowfin tuna	

Fishing methods

The major deepwater fishing methods are bottom trawl, mid-water trawl, trolling, purse seine, long-line, and jigging.

Profile of deepwater fishers

The deepwater is mainly the domain of large factory vessels with large holds and the ability to stay at sea for three or four months. These vessels fall into three major categories: foreign flagged vessels fishing under a foreign licence (issued to a foreign Government); foreign flagged vessels operating under charter to New Zealand companies; and New Zealand flagged (domestic) vessels. Over the last 20 years the number of foreign licensed vessels has fallen dramatically but with a corresponding rise in the number of foreign charter vessels fishing for New Zealand companies. However in the last few years there has been a steady replacement of foreign charter vessels by large high-tech domestic vessels. The current deepwater fleet includes 11 foreign licensed vessels, 80 foreign charter vessels and 71 domestic vessels.

Major deepwater fisheries

A fishery may be deemed to be a major fishery for a number of reasons such as size, sustainability concerns, commercial value, political profile, customary importance, illegal activity etc. The following fisheries are considered to be the major deepwater fisheries:

- West Coast South Island hoki
- Cook Strait hoki

- South of South Island hoki
- Challenger Plateau orange roughy
- Chatham Rise orange roughy
- East Coast North Island orange roughy
- Chatham Rise oreo dories
- East Coast South Island oreo dories
- Sub-Antarctic southern blue whiting
- South Island squid
- Sub-Antarctic (Snares & Auckland Islands) squid
- Chatham Rise jack mackerel
- West Coast jack mackerel
- Sub-Antarctic jack mackerel
- West Coast South Island hake
- Chatham Rise ling
- Southland ling
- Sub-Antarctic ling
- Chatham Rise barracouta
- Pelagic southern bluefin tuna
- Other pelagic tunas
- East Coast North Island scampi
- Chatham Rise scampi
- Sub-Antarctic scampi
- Mernoo Bank silver warehou

The location of these fisheries can be seen in Appendix 5. These charts show where the major fishing activity is for each month of the year as well as an overall picture for the entire year.

APPENDIX 3 – INTERNATIONAL FISHERIES

Definition

International fisheries are those found beyond the New Zealand EEZ, either on the high seas or in foreign waters. A large proportion of New Zealand's domestic fleet routinely operates on the high seas surrounding the New Zealand EEZ, and some vessels operate as far as the Indian and Atlantic Oceans. The current growth of New Zealand fishing operations beyond the EEZ is a significant development phase of the fishing industry.

Some of these fisheries are unregulated, while others come under a variety of regional or international arrangements, which are subject to a rapidly developing area of international law.

International species

Albacore tuna	Antarctic toothfish	Bigeye tuna
Hoki	Krill	Orange roughy
Oreo dories	Patagonian toothfish	Skipjack tuna
Southern bluefin tuna	Yellowfin tuna	

Fishing methods

The main fishing methods used in international fisheries are bottom trawl, mid-water trawl, trolling, longline and purse seine.

Profile of international fishers

Historically the distant water fishing nations (DWFNs), such as Japan, Korea, Russia, Taiwan, China, and the USA have roamed the high seas and fished in foreign EEZs. However other nations, including New Zealand, are developing their own technologies and expertise in this last frontier. There are significant financial returns for successful operations in high seas orange roughy and toothfish fisheries.

Major international fisheries

The major international fisheries that New Zealand has an interest in are:

- Ross Sea toothfish
- Southern Ocean (CCAMLR area) toothfish
- New Zealand's Westpac Bank orange roughy
- Challenger Plateau/Lord Howe Rise orange roughy
- Australia's South Tasman Rise orange roughy
- Louisville Ridge orange roughy
- Indian Ocean orange roughy
- South Pacific tuna
- Tasman Sea tuna

APPENDIX 4 – ENFORCEMENT PARAMETERS

Size of the NZ EEZ	1 300 000 sq. nautical miles
Length of NZ coastline	11 510 kilometres
Number of recreational fishers	750 000 (est)
Number of fish dealers	4 500 (est)
Number of commercial fish landing points	950 (est)
Number of Iwi	52
Number of utilised fish species	317
Number of commercial fish species	130
QMS	44
Non-QMS	273

	1994	**2000**
Number of fish quota owners	1 759	1 522
Number of NZ commercial fishing vessels	2 489	1 981
Number of foreign chartered fishing vessels	127	80
Number of foreign licensed fishing vessels	25	11
Number of licensed fish receivers	490	254

Tonnage of commercial species

QMS	574 492 t	538 456 t
Non-QMS	82 774 t	73 281 t
Total	657 266 t	611 737 t

Value of commercial species

Export	$ 1 .27 b	$ 1 .34 b
Domestic	$ 121 m	$ 150 m
Total	$ 1 .33 b	$ 1 .49 b

Employment

Catch	4 838	4 793
Processing	4 219	5 310
Total	9 057	10 103

APPENDIX 5 – MONTHLY BREAKDOWN OF FISHERIES

Deleted

APPENDIX 6 – BACKGROUND ON THE P3 ORION

First entering service with the United States Navy in the early 1960's the Lockheed P-3 Orion was developed from the commercial airliner the L-188 Electra. The basic airframe remained similar to the airliner, though it was strengthened and somewhat further refined. The major change came when the electronic suite was installed. The aircraft was optimised to carry out Anti Submarine Warfare (ASW) and maritime surveillance for the US Navy and was suitably equipped.

The use of the Orion by Foreign Nations

The Orion is currently in service with a number of countries including Canada, Australia and the United States performing a variety of roles. The Orion airframe has remained largely unchanged over the nearly 40 years it has been in service. What has changed is the mission electronics carried onboard.

The range and capabilities of the avionics carried onboard Orions around the world varies greatly from country to country depending on the intended roles they are to fulfil and the financial constraints placed on them by government expenditure.

The cost of replacing the Orion is seen by many of these countries as prohibitively expensive so it is likely that the Orion will remain the main-stay of many of the worlds Maritime Patrol Forces (MPFs) for many years to come. An indication of the potential costs involved in replacing the Orion with an all new aircraft is illustrated by the US Navy's attempt at such an exercise in the mid 1980s.

After 20 years of service from the Orion fleet the US Navy initiated a study to look at a replacement aircraft. This resulted in a proposal from the aircraft manufacturers Lockheed called the LRAACA (Long-Range Air ASW-Capable Aircraft) or P-7A. Outwardly similar to the Orion the P-7A was to feature new engines, state-of-the-art cockpit and an all-new suite of sophisticated avionics.

However, the aircraft was never built and the programme was cancelled in 1990 due to cost over-runs. As an alternative the US Navy sought to have the existing Orion fleet upgraded with the avionics package intended for the now defunct P-7A. The aircraft was to be known as the P-3C Update IV. However, this too was cancelled for reasons of economy.

At this stage the United States will continue to use the Orion for the foreseeable future, albeit with limited systems upgrades. The latest US upgrade programme is the P-3C Anti-Surface Warfare Improvement Programme (AIP), which is the upgrade of 54 airframes with new radar, electro-optics and other sensors. The 'new' aircraft will be known as P-3C Update III+ with the programme expected to be completed by 2005.

P-3 Orions in New Zealand Service

New Zealand was one of the first export customers for the Orion, ordering 5 P-3B variants in 1965 for delivery to New Zealand the following year. The Orions replaced the Short Sunderland MR5 flying boats then in service with the RNZAF's No. 5 Squadron. At that time New Zealand's Maritime Patrol Force (MPF) was based in New Zealand and Fiji, but the introduction of the land-based Orion with its phenomenal range and endurance allowed the force to be consolidated at one base at Whenuapai in Auckland. The Orions remain there today and are currently tasked with carrying out surveillance, reconnaissance and counter sea functions over New Zealand's vast area of maritime interest.

In the early 1980s New Zealand's original P-3Bs underwent an avionics upgrade known as Project Rigel. This saw the aircraft upgraded with new radar, infra red detection system (IRDS) and navigation systems. This upgrade was applied to the five original aircraft and an additional P-3B was bought second hand from the Royal Australian Air Force (RAAF) around the same time. As a result of this upgrade the aircraft were re-designated P-3K.

One further upgrade project is currently underway on the fleet. Project Kestrel, which is a life extension programme being carried out on the airframe which will extend the Orions' service life for another 20 years.

New Zealand P-3Ks range over 3000 nm and can remain on station for up to eight hours at 700 nm from base. The aircraft's high transit speed and wide speed envelope make it a very flexible platform for conducting maritime surveillance.

Fisheries Patrols

When a possible date for a patrol is advised by Air Command in Whenuapai the Fisheries Communication Centre (FCC) then decides where they would like the patrol to go, and what they want to cover. After advising Air Command of the desired patrol area a flight plan is generated to cover the area. Due to the Orion's long range it is quite common to cover a number of areas of interest in one flight.

The profile of a typical patrol by an Orion begins with the aircraft climbing to an altitude of between 9000 to 14000 feet at the start of the patrol track. At this altitude the aircraft's radar has greater coverage and will pick up vessels at much greater range. Once radar contacts have been established, the aircraft will then descend to low altitude to identify and photograph the contacts. The Orion usually flies below 1000 feet in order to carry out this task. Depending on how many contacts are in the area the Orion may stay at low altitude or return to a higher altitude to use the radar. The aircraft will investigate any contacts within 60 nm of the patrol track therefore giving a 120 nm sweep of an area.

Prior to each patrol the FCC will update the crew on the latest vessel positions, what vessels are permitted to fish New Zealand waters and any other information that may be of use while on patrol. When the aircraft is on task FCC has the capability to contact the aircraft via Air Command who use a telephone patch to contact the aircraft either on VHF or HF communication channels. This communication link also operates in reverse if the aircraft needs to contact FCC, which often occurs. Each patrol also carries a fisheries 'TacPac' onboard, containing fisheries legislation and information relevant to the patrol.

At the end of each patrol a report of all the vessel contacts is forwarded to the FCC, together with photographs of each of the vessels.

APPENDIX 7 – PATROL DISTRIBUTION

The Exclusive Economic Zone of New Zealand has, for the purposes of managing fisheries under the Quota Management System, been divided up into ten areas known as Fisheries Management Areas (FMA). The boundaries of these areas are illustrated in Figure 13.

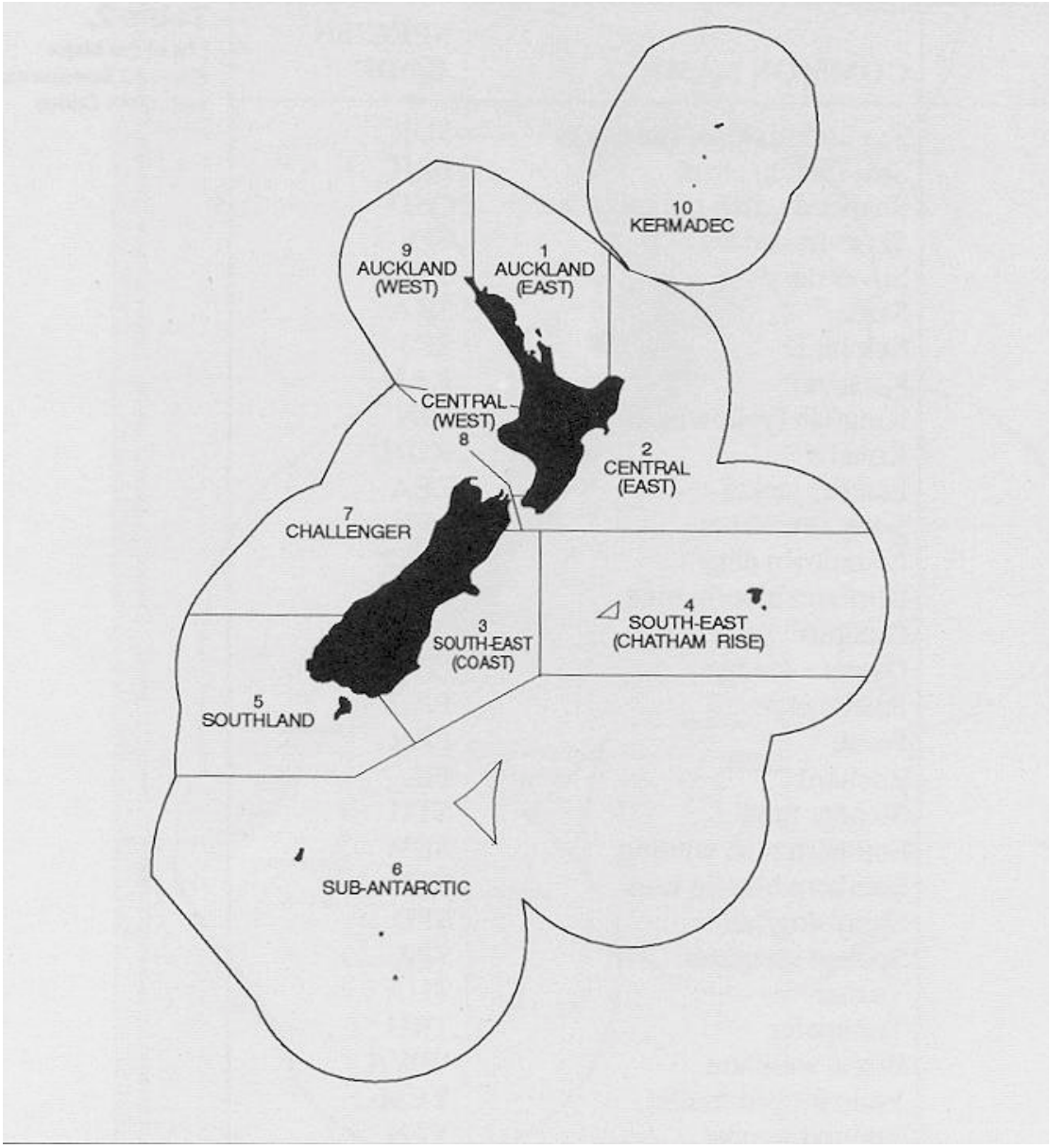


Figure 13

Recent analysis of the patrols conducted by the RNZAF over the past 10 years, and the areas these patrols covered, highlighted some changes that have occurred during this time.

Between 1990 and 1992 the F27 Friendship fleet contributed about one-third of the total number of fisheries patrols carried out by the RNZAF. Due to this aircraft's short-range, the patrols were often targeted in areas close to the fleets base at Wigram in Canterbury. This meant the Coastal regions around the South Island benefited from fairly regular surveillance coverage. This situation

is reflected in the distribution of patrols amongst the different FMAs with areas 3, 5 and 7 receiving a larger proportion of the effort (Figure 14).

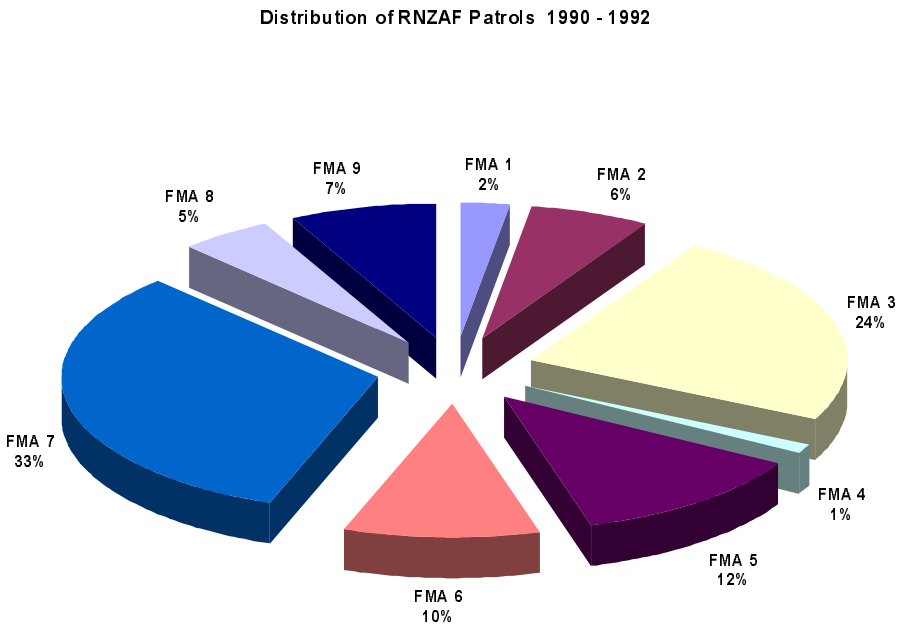


Figure 14

The retirement of the F27 fleet resulted in removing this effort from those areas. The allocation of P-3 Orion patrol effort between all the FMAs has remained relatively uniform for the past 10 years and this is illustrated in Figure 15.

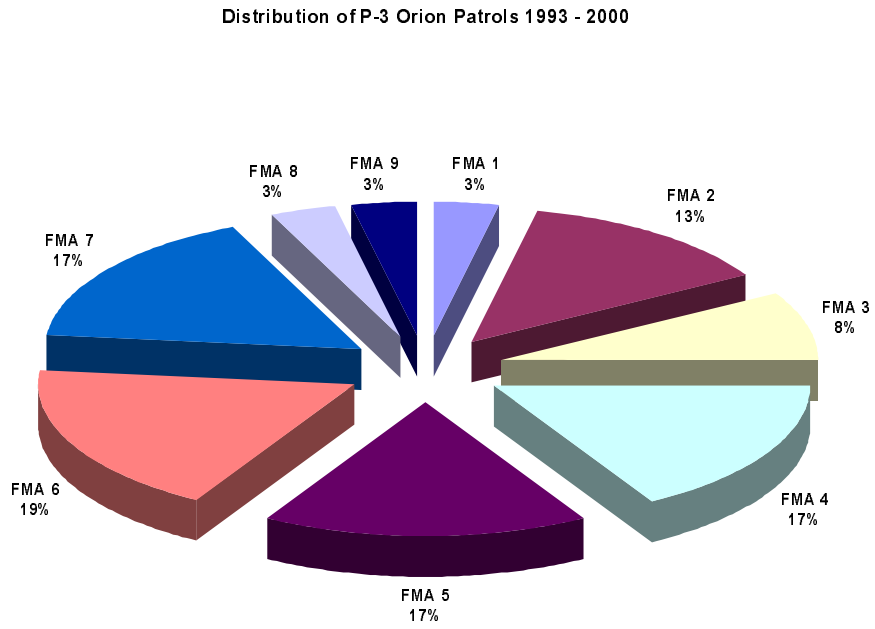
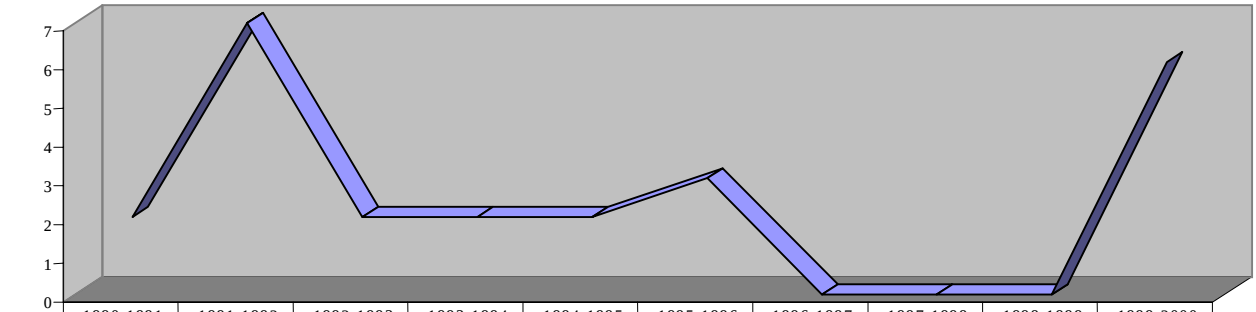


Figure 15

The South Island FMAs still receive a high proportion of the effort but the reduction in the total number of patrols carried out since 1992 has resulted in those FMAs receiving a smaller proportion of the effort than was the case leading up to the end of 1992. It should be remembered that the proportions illustrated above for the Orion patrols are from a much smaller total number (a mean of 26 patrols per year).

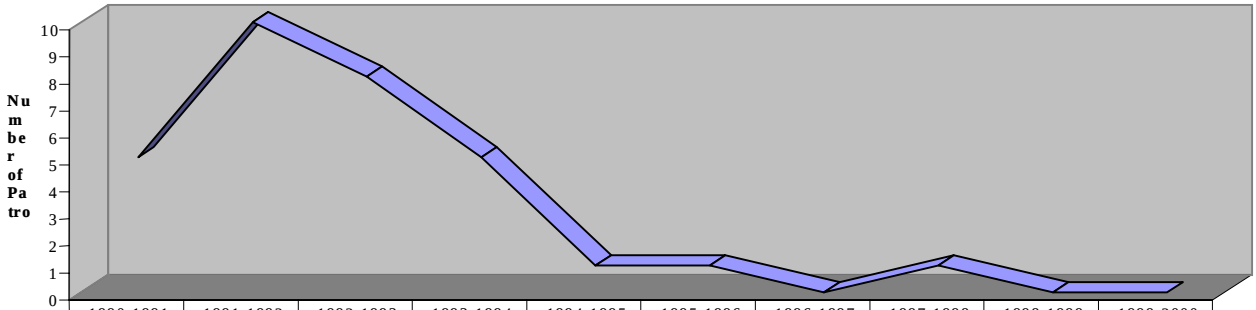
Of all the management areas FMA 3 has seen the largest reduction in surveillance coverage over the past decade.

Number of Patrols in FMA 1 (1990-2000)



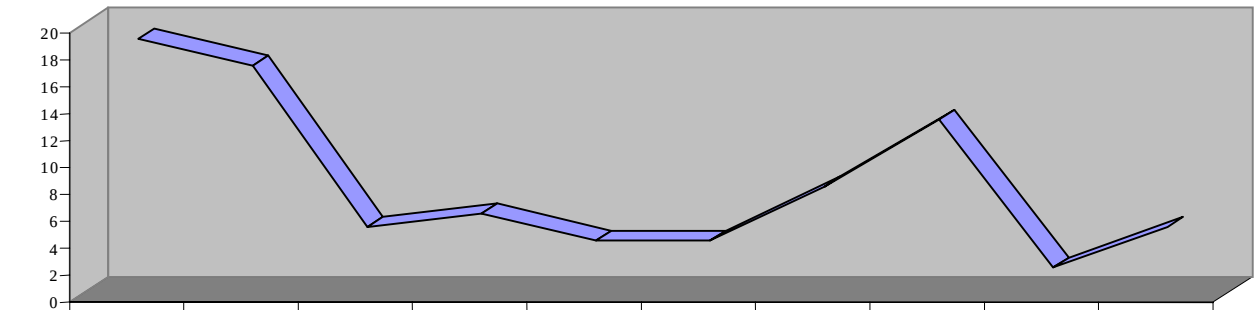
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 1	2	7	2	2	2	3	0	0	0	6

Number of Patrols in FMA 2



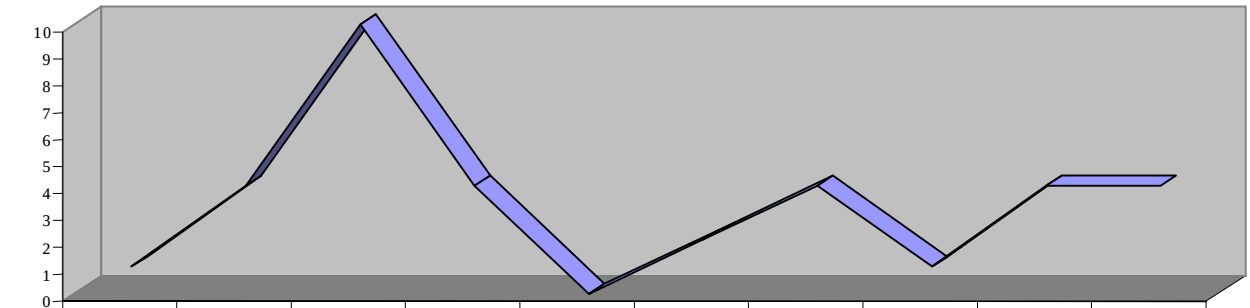
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 2	5	10	8	5	1	1	0	1	0	0

Number of Patrols in FMA 3



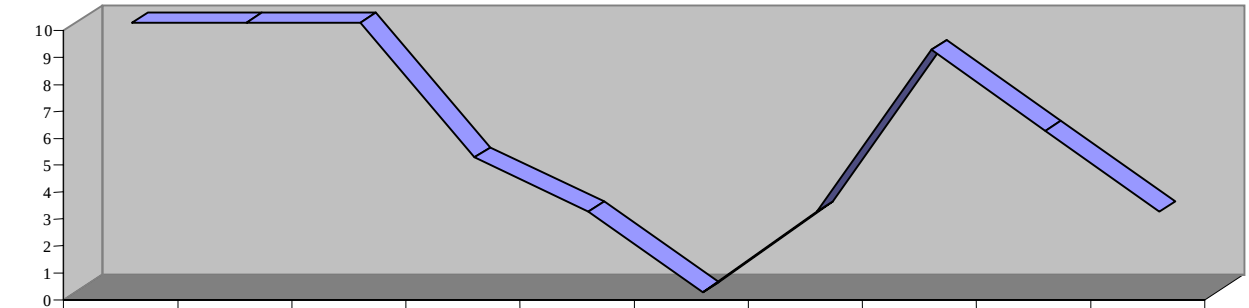
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 3	19	17	5	6	4	4	8	13	2	5

Number of Patrols in FMA 4



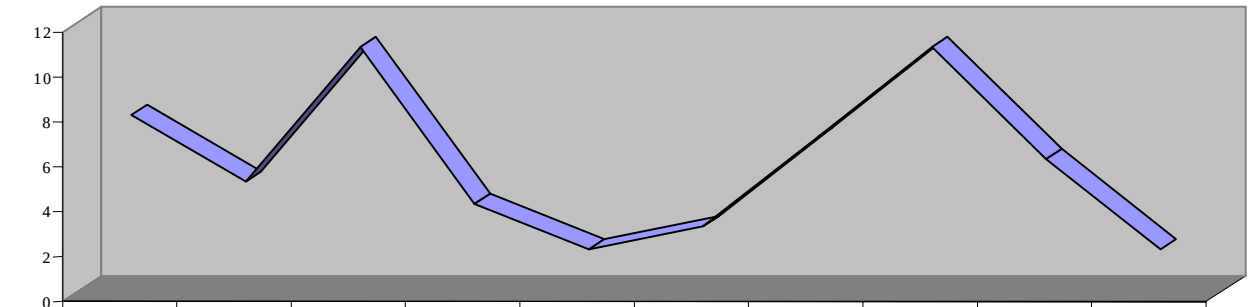
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 4	1	4	10	4	0	2	4	1	4	4

Number of Patrols in FMS 5



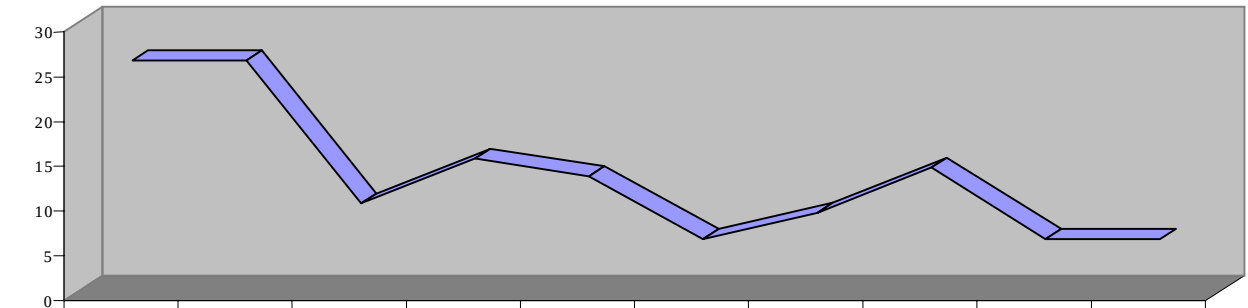
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 5	10	10	10	5	3	0	3	9	6	3

Number of Patrols in FMA 6



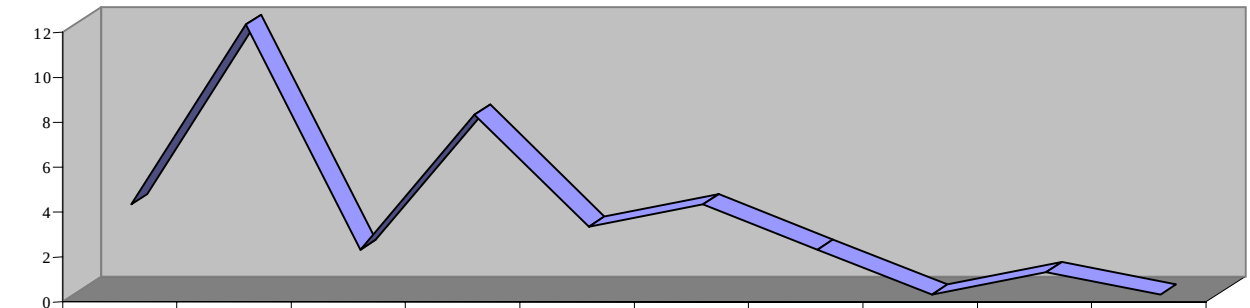
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 6	8	5	11	4	2	3	7	11	6	2

Number of Patrols in FMA 7



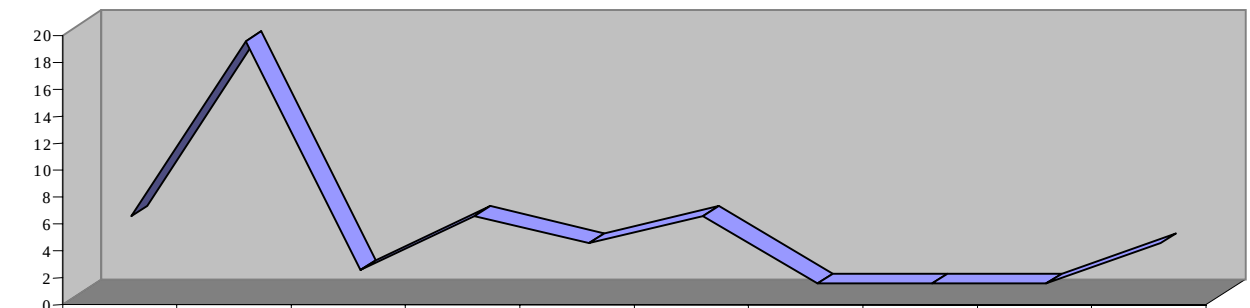
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 7	26	26	10	15	13	6	9	14	6	6

Number of Patrols in FMA 8



	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 8	4	12	2	8	3	4	2	0	1	0

Number of Patrols in FMA 9



	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
FMA 9	6	19	2	6	4	6	1	1	1	4

APPENDIX 8 – COUNTRY REPORTS

AUSTRALIA

The Australian Fisheries waters cover an area of over 3.45 million square miles considerably larger than New Zealand's maritime jurisdiction. With respect to fisheries protection and management, the Australian Fisheries Management Authority (AFMA) together with the various state fisheries agencies require a certain level of maritime surveillance to be carried out each year.

In terms of aerial surveillance AFMA relies on other agencies to resource this task. A large proportion of the aerial surveillance effort is carried out by private contractors, which are managed by Coastwatch, a branch of the Australian Customs Service.

Coastwatch

Coastwatch was established with the aim of 'centralising' the surveillance program and acts as a service provider to various Government agencies that have a need for either surface or aerial surveillance. Due to the requirements of the various agencies Coastwatch patrols are often 'multi-tasked' to improve cost-effectiveness and the efficiency of such patrols.

The main contractor to Coastwatch is National Jet Systems of Adelaide, which was awarded a nine-year contract in 1994. The contract is known as a 'turn key' operation with the contractor supplying aircraft, aircrew, administration and engineering support. Coastwatch controls the operational aspects of surveillance by managing and co-ordinating activities for the client agencies. One other company is contracted to Coastwatch to provide a helicopter service for Customs in the Torres Strait area.

Surveillance Aircraft

Coastwatch have divided Australia's aerial surveillance needs into three distinct areas for which National Jet systems provide suitable aircraft with the appropriate electronics fit.

1. For daytime visual surveillance of limited duration there are six BN2B Islanders and one Aero Commander AC500 Shrike. These aircraft fly short missions along coastal strips with one pilot and two observers and a basic surveillance fit of cameras and gyro-stabilised binoculars.

2. The offshore electronic surveillance out to 600 nm off the coast is carried out by three DHC Dash 8 series 200 aircraft. These aircraft are fitted with the Texas Instruments SV 1022 digital surveillance radar, IRDS and a high definition video camera mounted in a turret. This aircraft carries two pilots and two observers.

3. For the combined electronic and visual surveillance use is made of three Reims Cessna Caravan II F-406. The avionics suite for these aircraft is similar to the Dash 8 with the same radar plus night vision equipment. With one pilot and two observers these aircraft patrol the coastal areas and approaches from Perth north around to Sydney (i.e. the northern half of Australia).

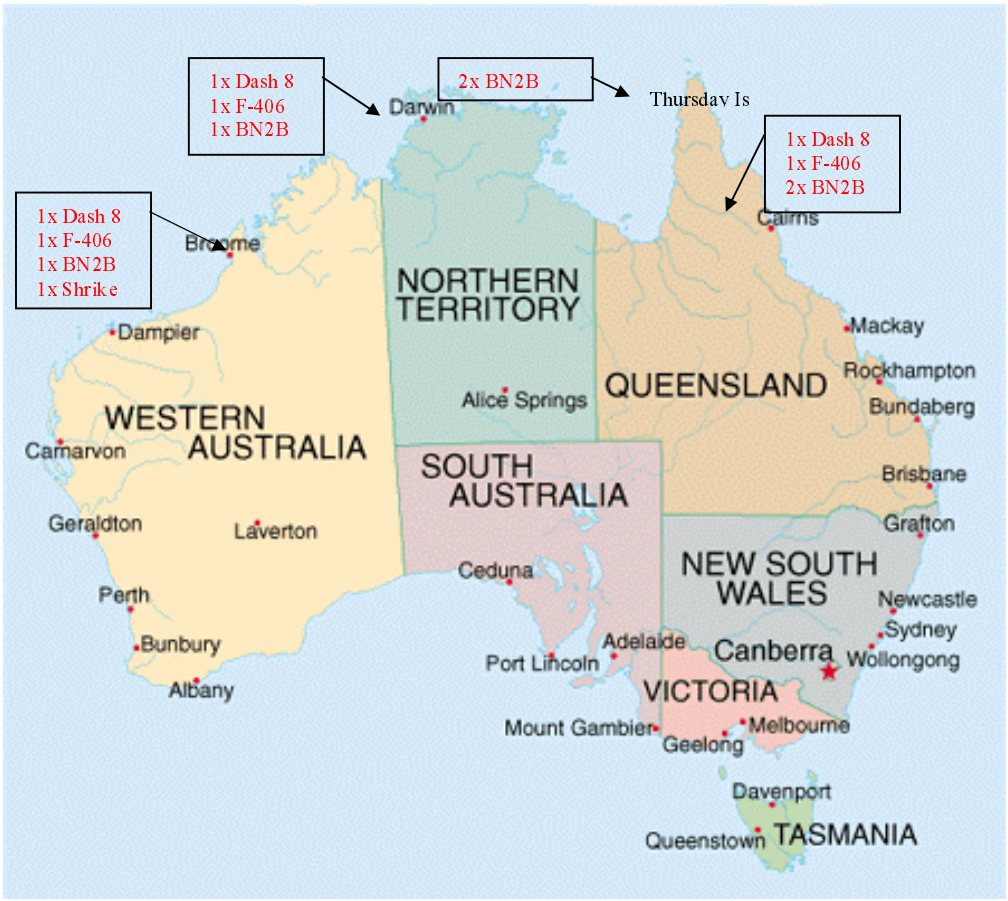
Dash 8 Series 200

Reims Cessna Caravan II F-406

Fisheries Protection patrols may be carried out by any one of these aircraft depending on availability and the type of mission required by the agency requesting the flight.

Coastwatch Bases

At present, the aircraft are based in four locations around the northern half of Australia as illustrated below. This reflects to some extent the concern Coastwatch has with illegal immigrants entering Australia. This, in fact, is where a lot of Australia's aerial surveillance resources are focused at present due to an increase in this activity.



The Coastwatch fixed wing aircraft conducted approximately 15,450 hours of visual and electronic surveillance in the 1999-2000 year on behalf of all their clients. This is expected to increase in the current year with the acquisition of two more Dash 8 aircraft to be based at Darwin and Cairns.

Royal Australian Air Force

To supplement this effort the Royal Australian Air Force (RAAF) provide 250 hours annually for fishery protection tasks, which in the main are flown by Orion aircraft covering the more remote areas of the Australian Fishing Zone, particularly the southern reaches.

Lockheed P-3 Orion - RAAF

CANADA

The majority of fishing operations that occur in Canadian waters are located on the Atlantic Coast of the country. This area includes the major fishing banks such as the Grand Bank off the coast of Newfoundland. For this reason, much of the aerial surveillance effort by Canadian authorities is focused on the 500,000 square mile of ocean on the Atlantic Coast that comes under Canadian jurisdiction. This area is equates to just over one-third of the size of the New Zealand EEZ.

The Department of Fisheries and Oceans (DFO) is the government agency responsible for the management of fisheries and hence the surveillance of the EEZ. The task of conducting aerial surveillance of the Canadian EEZ has been contracted out by the DFO to a private company Provincial Airlines Ltd.

Aerial Surveillance Contractor

Provincial Airlines Ltd are required to provide DFO with the exclusive use of three fully configured aircraft for a up to 5000 hours annually. Two of the aircraft are based at St Johns, Newfoundland, one operating in a back-up role whilst the remaining aircraft is based in Halifax, Nova Scotia. These aircraft are available 24 hours a day, seven days a week and the DFO is only required to provide the contractor with two hours call-up notice to use an aircraft. The exception to this is if the aircraft is undergoing scheduled maintenance.

Aerial Surveillance Aircraft

In order to fulfil such stringent requirements Provincial Airlines Ltd use three Beech King Air B200s specially equipped for EEZ surveillance missions.

Beech King Air B200

The centrepiece of the surveillance suite is the Litton APS-504(V)5 radar system manufactured in Canada by Litton Systems. This radar unit is used by a number of other nations in the same role. An example is the Republic of Ireland's Maritime Squadron, which has the radar fitted to its two CASA CN-235 100 M aircraft as described elsewhere in this paper. The radar is ventrally mounted beneath the fuselage just aft of the wing. The positioning of the radar in this location allows for it to scan through 360-degrees up to a range of 200 nm dependent on the altitude of the aircraft.

Other systems carried onboard each aircraft include an Infra-Red Detection System, a 70mm and a back-up 35mm camera system for black and white photography and a digital camera. The DFO requirement for the digital camera equipment is that the contractor must review this technology on a yearly basis in order to equip the aircraft with the most up to date system. This reflects the rapid technological advances occurring in this field. The main purpose of the digital imagery is to provide the crew and the shore base with real time images of the vessels to assist in identification.

Tying together all the information gathered from the sensors is a key function of any maritime surveillance suite. To undertake this function, Provincial Airlines developed the Airborne Data Acquisition & Management (A.D.A.M.) system. This is a real-time, maritime surveillance system used both onboard aircraft and in networked shore-base applications. Originally developed in 1985 the ADAM system provides data collection from onboard sensors, systems integration, tactical navigation, and in-flight reporting functions. This technology has been exported to other countries such as the United States.

Now in to its second five-year contract the arrangement between Provincial Airlines and the DFO is proving highly successful.

The Canadian Armed Forces

The Canadian Armed Forces is also used for fishery protection tasks on a smaller scale. In terms of aerial surveillance use is sometimes made of the Lockheed CP-140A Arcturus and the CP-140 Aurora of which there are three and eighteen in service respectively. The Arcturus and Aurora are essentially P-3 Orions but with different avionics suites. The Arcturus is a stripped down version utilised for crew training and fisheries patrols whilst the Aurora is fitted with the avionics of the S-3 Viking and is a dedicated ASW platform. These aircraft are tasked with carrying out the longer-range patrols on all three coasts especially the Pacific Coast and to the north. In total the Aurora/Arcturus fleet provide the DFO with an additional 1000 hours of aerial surveillance annually.

CP-140 Aurora on Patrol

REPUBLIC OF IRELAND

Since 1977 the Maritime Squadron of the Irish Air Corps has been responsible for providing fishery protection surveillance over the Irish EEZ. The Irish EEZ encompasses an area of 132,000 square miles of ocean, within which there are often up to 600 vessels operating at any one time.

While fishery protection is the main task of the Maritime Squadron they are also called upon to perform other functions within the EEZ which are often accomplished in tandem with the fishery patrols. These other tasks include preventing illegal drugs and arms importation, pollution and environmental monitoring and assistance in Search and Rescue operations.

Aerial Surveillance Aircraft

The Maritime Squadron currently operates two CASA CN-235 100 M dedicated maritime patrol aircraft, which were delivered from 1994. When it was ordered to replace the Air Corps fleet of Beech King Air 200s, the selection process for this aircraft took almost three years, and considered other aircraft such as the Dornier 228, Fokker F27 and F50, and Dassault Falcon.

CASA CN-235 100 M

Avionics Suite

In terms of the EEZ patrols carried out by the Squadron, the CASA CN-235 acts as an airborne platform for the search radar, which is the primary sensor onboard the aircraft. The importance of the radar is illustrated by the fact that the unit selected represents 25 per cent of the purchase cost of each aircraft.

The radar chosen by the Air Corps was the Canadian-built Litton APS-504 (V) 5 search radar that is mounted in a ventral position under the aircraft which provides for a 360 degree sweep. The following table provides an indication of the useful range of the radar when attempting to detect a small surface vessel.

Aircraft Altitude (ft)	Radar Range (nm)
15,000	150
1,500	47
200	25

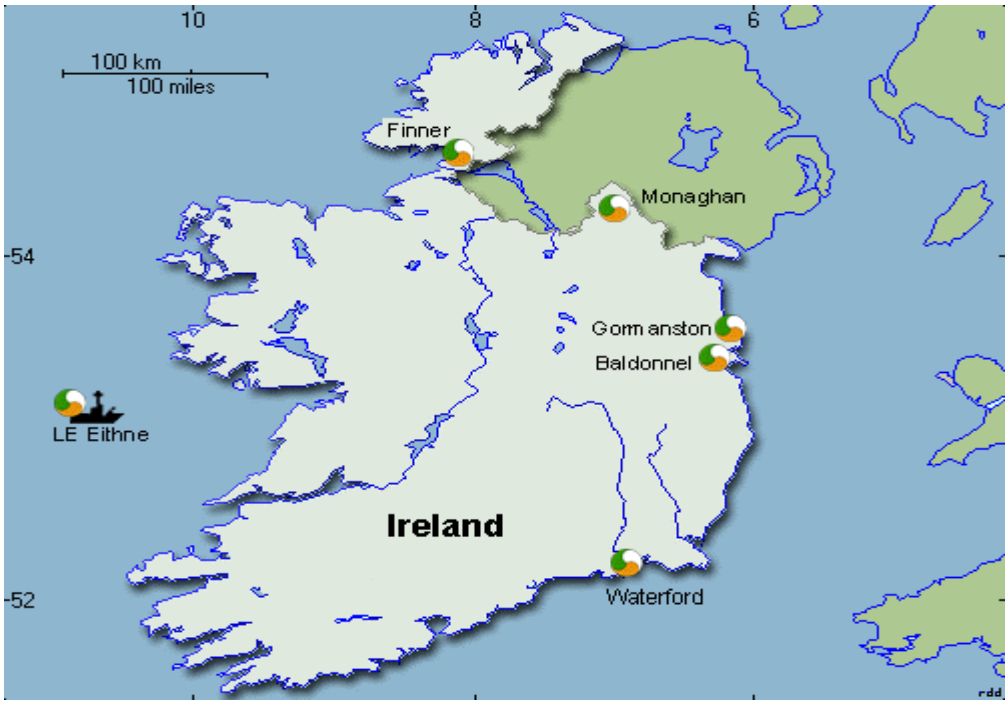
In terms of other avionics fitted to the CN-235, the secondary sensor is the Forward Looking Infra Red (FLIR) camera mounted beneath the nose, which proves useful when identifying vessels in conditions of reduced visibility or when undertaking SAR tasks. The aircraft also has HF and VHF communications, a HF datalink allowing the crew to transmit vessel sightings back to base at anytime during a patrol. At present a satellite communications facility is being investigated.

The Irish Air Corps, together with the Irish Naval Service operate a database known as the Fishery Protection Information System (FPIS) which lists and describes all EU fishing vessels. This system can be accessed from the PC onboard the aircraft during a patrol and any information from the flight is immediately entered into the database.

Future plans for the Irish Air Corps Maritime Squadron includes a possible upgrade of the aircraft's pollution monitoring capability. At present, the avionics fit is limited in this role. However, options such as the fitment of Side Looking Airborne Radar (SLAR) and a microwave radiometer and other pollution detecting devices are possibilities.

Fisheries Protection Mission Profiles

The majority of maritime patrols take place on Ireland's Southern and Western Seaboards which means the aircraft is in transit for about an hour at high level, after departing its base at Baldonnel, before it reaches its designated patrol area.



This transit time allows the radar to sweep an area of 200nm in radius thus producing a tactical picture of the disposition of surface vessels within the patrol area, which allows the crew to formulate a plan for the patrol in terms of identifying targets at low-level. The inspection passes are

normally carried out at 200 feet with the aircraft climbing to a higher altitude between targets to increase the range of the radar.

The duration of a typical patrol is up to eight hours, which includes the time spent transiting to and from the patrol area. To further enhance the effectiveness of the patrols, the Maritime Squadron will often attempt to co-ordinate the aircraft's activities with the activities of the vessels of the Irish Naval Service. This allows for a more integrated approach between aerial and surface surveillance of the EEZ thus providing a capability to both detect and apprehend illegal vessels.

Other mission profiles carried out by the squadron include high level patrols where the aircraft cruise at 16,000 feet over the entire Irish EEZ for five hours with no visual inspections carried out. This results in a tactical map of the EEZ showing the total number of vessel operating in the EEZ which is of strategic importance to Irish fisheries management in the absence of a VMS.

On behalf of the Inland Fisheries Board, the Squadron also flies inshore patrols. The aircraft flies along the coastline and into bays, inlets and estuaries relying mainly on visual means to detect illegal activities. Little use is made of the radar on these flights, with the fisheries officer being the main driving force for how the patrol is conducted.

INDIA

The Indian EEZ encompasses an area of ocean of approximately 850,000 square miles off the western and eastern coast, as well as the island territories of Lakshadweep in the Arabian Sea and the Andaman and Nicobar Islands in the Bay of Bengal. In order to manage this vast area the Indian Government established an independent Coast Guard organisation which was formally tasked with the surveillance of the EEZ and the maintenance of law and order in the area.

The task facing the Indian Coast Guard is huge with constant incursions by foreign trawlers operating illegally in Indian waters. Over the past ten years an average of about 30 trawlers were apprehended each year. Added to this is the difficulty of dealing with the large-scale narcotics and arms smuggling within the area.

The Coast Guard Fleet

At present, the Coast Guard has a force of 34 aircraft (fixed-wing and rotor), 35 ships and 25 interceptor boats. Of its 34 aircraft, 17 are Dornier 228-101 tasked specifically with aerial surveillance of the EEZ. The remaining aircraft are a mixed fleet of helicopters, which are embarked upon the Coast Guards Offshore Patrol Vessels (OPV). Over the next five years it is envisaged that another 19 Dornier 228s will be acquired to bolster the current fleet.

Aerial Surveillance

The 17 Dornier 228s are divided among three squadrons based on both coasts at Daman, Calcutta and Chennai. On a day to day basis the Coast Guard has about 12 aircraft available to carry out surveillance operations. As the aircraft has an operational speed of about 200 knots and a range of 940 nm such an availability of resources allows for a large proportion of the EEZ to be covered. However, in view of the Coast Guards operational needs the current situation is seen as inadequate, hence the proposed purchase of a further 19 airframes.

Dornier 228-101

The Dornier 228s are licensed-built in India by Hindustan Aeronautics Ltd with the primary sensor fitted being the Thorn EMI Marec/Super Marec search radar. This radar is fitted in a ventral radome beneath the aircraft in order to provide a 360-degree sweep. The aircraft are also fitted with various cameras and a search light for night identification. Other items include a IR/UV line scanner for pollution detection and a side-mounted loudhailer. In general, the avionics fit of the Coast Guard aircraft is not as comprehensive as the examples used in other countries.

The only major drawback of the Dornier aircraft, as perceived by the Indian Coast Guard due to the environment it operates in, is that they are unable to enforce the law when required to. In an effort to address this, deliveries of new Dorniers will include under wing hard points to allow for the carriage of multi-barrelled machine guns and Anti-Ship missiles.

Indian navy

In support of the Coast Guard the Indian Navy possess a number of aircraft for maritime surveillance. The Navy has 8 Tupolev Tu-142 M, 5 Ilyushin Il-38 and a small number of Dornier 228s and PBN Maritime Defenders. These aircraft are not optimised for EEZ surveillance but could carry out the task if required. However, this role is not a priority for the Navy and their availability is very limited.


Tupolev Tu-142 M of the Indian Navy

APPENDIX 9 – SUMMARY OF 1994 FIGURES

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APPENDIX 10 – CALCULATION OF INSHORE HOURS

Table Deleted

Calculation of Inshore Surveillance Hours

The data used in the preceding table indicates the number of patrol hours required for each priority inshore fishery.

It is important to note that the total hours given in the table does not fully reflect the seasonal variability of the fisheries involved, nor does it account for the ability of a single patrol to cover a number of fisheries.

The authors have estimated that the multi-tasking of patrols will have the effect of reducing this sum by a factor of three, creating a new total of **901** required hours.

APPENDIX 11 – OPERATIONAL CAPABILITIES

INTRODUCTION

The review proposes a contracted service provider as an attractive option and given that this option may need to be explored in further detail the following comments are offered as a guideline to what that contracted surveillance capability could look like. This approach is similar to that of the 1994 report in which they go as far as providing a full set of standards and performance requirements for a contracted service provider (in their Annex E). The current authors have borrowed liberally from the earlier report and updated sections to reflect developments in technology. They also have no pretensions about being aerial avionics experts and provide these comments as suggestions only and a starting point for further consideration.

As noted in the section on surveillance systems (pages 34-35) the physical requirements or restrictions placed on an aircraft may be extensively modified depending on the avionics carried. The traditional view that in order to obtain good identification of surface targets an aircraft needs to be able to fly "low and slow" has been rendered obsolete by high powered surveillance systems that allow targets to be identified while standing off at long range. As previously stated the airframe has simply become a means of conveyance for the electronic systems onboard.

AIRCRAFT

Airframe

The aircraft to be used in the conduct of aerial surveillance operations will need to be a multi-engine aircraft approved by Civil Aviation Authority (CAA) for full instrument flight rules. A multi-engine aircraft is required for safety reasons when operating for extended periods out at sea. Given the requirements established in the report the aircraft is likely to be a twin-engine turbo prop.

Aircraft used in aerial surveillance operations shall be capable of using without restriction all the Instrument Flight Rules (IFR) capable airfields in New Zealand.

General Operations

At all times aerial surveillance operations must be carried out in accordance with CAA requirements and directives.

The aircraft is to carry emergency equipment to meet the requirements of CAA for over-water operations. This is to include one life jacket for each seating position on board and sufficient life rafts to provide a place for each crewmember. The life rafts shall conform to CAA Regulations.

The aircraft is to have installed an air-conditioning system to maintain the cabin to a maximum temperature of 25'C and 60 percent humidity on a 32'C – 70 per cent humidity day with all equipment operating and six (6) people aboard with the aircraft either airborne or on the ground. The system should also be able to cool an aircraft that has been standing in direct sunlight, on the ground, within 10 minutes of initiating the air-conditioning system.

The aircraft will require an electrical supply capable of simultaneous operation of all normal and specialised equipment on one engine and be capable of extended ground operation for periods of up

to two hours. Each individual electrical system must perform its intended function when operated individually or in combination with any other electrical system on the aircraft.

The aircraft will need to be equipped with toilet facilities for use by the aircrew in-flight.

Crew/passenger capacity
The aircraft will require two appropriately qualified pilots and two qualified radar operators/observers. The aircraft will also need to be capable of carrying additional MFish personnel, in particular Fishery Officers, in situations where specialist knowledge or skills are required.

Carrying capacity
The aircraft should have the ability to carry at least six people, including the pilots. It shall also have an enclosed luggage locker with minimum dimensions of 1 metre x 1 metre x 1 metre and the capacity to carry up to 100 kilograms.

Range/ endurance
With a full complement of Aircrew and two passengers, the aircraft should be capable of being used to conduct a search of a 25,000 square nautical mile area 90 nm from a suitable airfield.

Air speed/Altitude – transit, infringement
Aerial surveillance operations should be flown at not less than 180 Knots indicated air speed (IAS) at 5,000 feet above mean sea level on an ISA + 15' (International Standard Atmosphere plus 15 degrees Celsius) day except when identifying sightings whereupon the speed should be varied as required. Normal operating altitudes will be between 500 and 10,000 feet above mean sea level though during transits, or when identifying sightings the speed and altitude may be varied in accordance with CAA instructions.

The transit speed of the aircraft should be not less than 210 knots indicated air speed at 10,000 feet ISA + 15' (International Standard Atmosphere plus fifteen degrees Celsius) day above mean sea level. It is expected that aircraft will descend to 200 feet above ground or sea level when identifying sightings during the day and 600 feet above sea level when identifying sightings at night.

Availability
Aircraft, pilots and observers will need to be available for programmed aerial surveillance operations within 12 hours of being notified, either orally or in writing, by an Authorised Officer except when the aircraft is undergoing scheduled or unscheduled maintenance. Scheduled maintenance should not amount to more than three days per one 100 flying hours per aircraft and unscheduled maintenance resulting in the inability of the Service provider to meet the required response time should not amount to more than three days per month.

Aircrew should be available for briefing for response aerial surveillance within two hours of being notified, and the said surveillance may be requested between the hours of 0400 and 2359 local time except when the aircraft is undergoing scheduled maintenance, flying or preparing to fly on programmed aerial surveillance.

The service provider should notify MFish before carrying out any replacement or major overhaul of the equipment specified in a schedule in order that consideration may be given to upgrading the type of equipment it is proposed to replace or overhaul.

Stand-off ability
The aircraft will require the ability to stand off targets and observe them without being observed. In the main this will be a factor of the surveillance systems placed on board the aircraft and as such is dealt with under the avionics section. However, the importance of the aircraft's ability to remain in covert contact with targets bears separate mention. As noted in the Requirements section of the Review (on page 24) the aircraft may be tasked with intelligence gathering as well as more overt patrolling. The collection of evidence will also be better facilitated by an ability to stand off and observe without alerting the offenders to the aircraft's presence. This ability should be seen as an overarching consideration in the selection of both an airframe and surveillance systems.

Livery
For recognition and deterrence purposes it would be advantageous to have the patrol aircraft fitted out in distinctive livery (as already occurs with Air Force patrols). If a separate service provider is used it would be preferable if the aircraft was distinctively marked so that its function was immediately obvious. Leaving aside the question of any possible multi-agency function, the greatest benefit to MFish would come from the aircraft carrying MFish livery. The Airborne Fisheries Surveillance Review in December 1994 made the following recommendations in relation to possible MFish livery:

Aircraft used in aerial surveillance operations shall be painted MFish teal (PMS 314). Except for those areas required to be painted red/black for safety purposes (e.g. the nose of the aircraft in front of the cockpit), areas where discolouration may be caused by exhaust fumes, oil and fuel stains or where aerodynamic damage may be suffered. The aircraft shall also be marked with:

a. Three white bands (five centimetres wide from nose to tail) on both sides of the fuselage;

b. The words "Fisheries Patrol" (25 centimetres high) in black block letters on either side of the fuselage adjacent to the fuselage stripe;

c. The words "Fisheries Patrol" (60 centimetres high) in black block letters on a white background or white block letters on the underside of the right wing; and

d. A MFish logo (40 centimetres high) on either side of the nose of the aircraft.

NB. This suggested livery has been updated to reflect the change from MAF Fisheries to MFish in the intervening years. It is also put forward as a useful starting point should the issue of MFish livery become relevant and it is envisaged that it will require variation depending on the type of aircraft selected to meet MFish, and potentially other, requirements.

AVIONICS

Radar

The aircraft should have surface surveillance radar, which will have the following capabilities:

1. be capable of detecting small targets such as fishing buoys in high sea states and be able to accurately home in on vessels operating in adverse weather and low visibility;

2. the radar should have a range of up to 200 nm at appropriate altitudes;

3. be integrated and able to interface directly with other equipment such as Forward Looking Infra-Red and the Tactical Navigation System in both azimuth and elevation;

4. be capable of transmitting information to the data management system which should include all the data necessary for mission management, infringement documentation and report preparation;

5. be capable of detecting and tracking multiple targets simultaneously (some Commercial Off The Shelf (COTS) systems have the ability to track up to 100 targets). The radar should be able to provide the operator with the speed, bearing and track of each target;

6. it should be possible for the radar display to be recorded in an appropriate medium to allow for historical data to be analysed at anytime during or after a patrol or for use as evidence in court;

7. have the ability to reduce clutter in order to display extremely small targets detected in bad weather conditions which would normally be hidden in background noise; and

8. an antenna system with at least 240 degrees forward looking sector for a nose-mounted unit, but ideally a ventrally mounted unit providing for 360 degree scanning;

9. a weather avoidance mode or separate weather avoidance radar;

10. a GPS navigational system for updating tactical and navigational information;

11. an appropriate display for the air crew that could allow for the following:
    - Multiple sector / full scan control
    - Expand and Freeze
    - Classification tools, including target feature measurement (such as overall length of masts, superstructure)
    - Weather radar video output to cockpit
    - Support for widely used video standards

Some consideration could also be given to acquiring Synthetic Aperture Radar (SAR) and Inverse Synthetic Aperture Radar (ISAR) capabilities. Such systems produce an image of a scene similar in some respects to an optical photograph. ISAR allows for both the target and the platform to be in motion which is ideal for fisheries protection work.

Navigation

Flights should be conducted in accordance with instrument flight rules procedures, provided that during daylight surveillance operations visual flight rules procedures may be used.

The aircraft should carry at least two independent and reliable GPS Navigational sensors and an Inertial Tactical Navigation System with a navigation database, and the Control Display Unit (CDU) accessible to both cockpit positions. These systems must provide a data interface for other equipment such as the Radar, Infra Red System, cameras, and any data management system.

The aircraft should also have an autopilot with coupling to the Tactical Navigation System. It could also be equipped with an instrument flight rules low level radar/radio altimeter approved by CAA.

The aircraft will also be equipped with a workbench suitable for navigation/plotting and a display showing aircraft navigational information fitted at an observation station.

A Differential GPS capability should also be considered for the aircraft.

In general, the accuracy of the navigation system should be able to satisfy the requirements of the court when given as evidence in any judicial proceedings.

Radio/Communications
The aircraft's communications system should have the following capacity:

1. the pilot shall have the capacity to transmit, receive, control frequency and to monitor simultaneously; two full instrument flight rules approved 360 channel Very High Frequency/Amplitude Modulation; and one CAA approved HF radio;

2. two fully instrument flight rules synthesised commercial aviation High Frequency (2 - 30 Megahertz) channel spacing 100 hertz one of which is fitted with SELCAL and an encryption device to allow secure transmissions between the aircraft and MFish. In addition a HF datalink would allow for 2-way voice and data transmission between the aircraft and base;

3. one Marine Band Very High Frequency/Frequency Modulation (at least 30 channels, including channels 12, 13, 14 and 16);

4. one Military Band Ultra High Frequency/Amplitude Modulation;

5. the facility for pilots and all observer positions to monitor independently all or selected communications and navigation aids simultaneously;

6. the capacity to operate all radio communications equipment simultaneously from all crew positions in the aircraft;

7. an aircraft ICS that allows undistorted communications between all seating positions on the aircraft and allows selective monitoring of all radios;

8. the aircraft should also have a satellite communications capability

For surveillance purposes consideration should also be given to acquiring a radio surveillance capability. This will allow the aircraft to home in on and locate any radio transmitter on any operating band or mode as specified by the requirements.

Optics/ video/ photography

A major requirement for any proposed surveillance aircraft is its ability to gather photographic evidence in all conditions including day and night. Therefore, as a starting point the aircraft will need some form of night illumination to allow for night time photography.

The aircraft should be equipped with two visual observation stations in the cabin with optically clear windows large enough to allow an observer an unrestricted view of the earth's surface immediately below the aircraft. Observation windows should be located on opposite sides of the fuselage and allow undistorted photography.

In addition to the carriage of standard binoculars, a gyro-stabilised set of binoculars with a magnification power of at least six times should also be fitted.

For the purpose of obtaining photographic evidence it should carry at least one camera with the following minimum capabilities:

1. 35 millimetre single lens reflex automatic with through the lens viewing, focusing and light metering;
2. zoom lens with capability to operate with focal lengths between 105 millimetre and 240 millimetre and fitted with an appropriate Ultra Violet or polarising filter;
3. providing a correctly exposed colour photograph under daylight conditions with fast film (minimum 400 ASA) and using a shutter speed of at least 111000 second;
4. imprint at least the time and date automatically on exposed film, and imprinting the flight number and position is desirable; and
5. fitted with a motor drive capable of at least three frames per second.

Night Vision Goggles (NVG) may be considered to give the crew a covert means of identifying a vessel at night.

The aircraft should have a digital camera available that is integrated into the data management system. This will allow images to be quickly analysed and transmitted within and beyond the aircraft. The digital camera needs to have sufficient resolution and magnification for the task.

For the purposes of long-range identification of vessels the aircraft could be fitted with an ultra-high magnification scope installed in a stabilised turret that provides for 360-degree rotation of the unit. The possibility of coupling this to a video recording system could also be explored.

In addition to the scope a TV/Video camera should be installed in the turret to provide for the recording of daylight imagery.

IRDS/FLIR

The aircraft should be equipped with a closed cycle forward looking infra red detection system with a search scan of at least 90 degrees either side of the aircraft heading (ie. 180 degree forward sector), and a minimum elevation range of 0 to 90 degrees. The system should:

1. have the appropriate capability in terms of operating parameters and reliability to satisfy the requirements of the task;

2. have a detector head capable of being slaved in azimuth and elevation to a designated surveillance radar contact position and, upon the occurrence of a sighting during an aerial surveillance operation, the Infra Red System must be capable of automatic tracking of the sighting to the on top position;

3. have a suitable video recording device with the capability of recording and playing back the infra red display whilst the aircraft is in-flight;

4. ideally be housed in a stabilised turret with the ultra-high magnification scope and daylight TV/Video camera;

5. have real time GPS information including date, time and the geographic location of the aircraft (in latitude and longitude) overlaid on the display.

Data Management System

In order to effectively analyse and use the information gained from the sensors the aircraft will need to incorporate a data management system. This system will integrate all of the onboard sensors and allow the operator to store or retrieve the required information in the formats specified for in-flight analysis, transmission or post-flight evaluation.

Avionics General

A requirement of any proposed avionics suite is that it not only fulfils the detailed requirements specified by the Ministry but also has growth potential. Surveillance technology and the operating environment as it is changes swiftly so the systems chosen must have that ability to keep abreast of those changes and still deliver a cost-effective solution to the Ministry.

AIRCREW

Qualifications/ experience

The service provider will ensure that no person should be used to perform the duties of a pilot in any aerial surveillance operation unless that person has complied with the following minimum requirements:

1. Holds a senior commercial pilot's licence with twin engine command instrument rating with three renewals, 1500 hours total pilot and 500 hours in command: and,
2. Have successfully completed a training course on the tactical navigation system installed in the aircraft in a school approved by the manufacturer of the equipment; and
3. Have completed any requisite training courses in surveillance operations as conducted or required by MFish; and,
4. The pilot shall comply with all CAA competency requirements for the class of aircraft that they are flying.

At all times during an aerial surveillance operation the pilot in command of the aircraft will have ultimate authority in all matters of aircraft safety.

The service provider will likewise ensure that no person shall be used to perform the duties of an observer unless they have complied with the following requirements:

1. Be medically fit to aircrew standards; and,
2. Have demonstrated ability in the operation of cameras, video recorders, digital cameras, binoculars, GPS equipment and computers; and,
3. Hold appropriate qualifications or experience in relation to map reading, aircraft communications systems, aircraft safety equipment, meteorology, and air traffic control procedures; and,
4. Have completed any required training courses or hold any manufacturer required certification in the operation of all surveillance equipment on the aircraft; and,
5. Have completed any requisite training courses in surveillance operations as conducted or required by MFish.

Reporting procedures

The range of matters of additional interest to the Government and to be reported by the service provider is diverse. Those matters relate to customs, fisheries, health, immigration, quarantine, the environment, shipping and navigation, and matters of interest to the New Zealand Police and include the following matters:

a. all vessels capable of making ocean passage particularly if information or intelligence suggests that such vessels may be involved in unlawful activities;
b. any sightings of light aircraft in remote areas flying to or from seaward;
c. any fishing vessels, particularly foreign fishing vessels that may not be authorised to operate in the New Zealand Fishing Zone, or New Zealand vessels in the company of foreign vessels;
d. any vessels or small craft in unusual locations or undertaking unusual or suspicious activities;
e. any discoloured water or apparent oil pollution;
f. any dumping of wastes or other materials at sea;
g. any damaged navigational aids or automatic weather stations;
h. any environmental damage;
i. any possible interference with historic shipwrecks;
j. persons or any signs of habitation on remote islands or reefs; and
k. any dead or dying marine life or bird life.

Powers.

Consideration will need to be given to the possible exercise of powers under the Fisheries Acts by aircrew. Section 76 (2) of the Fisheries Act 1983 deems "every officer in command of any vessel or aircraft of the New Zealand Armed Forces" to be a fisheries officer for the purposes of the Act. The current practice is that, although the officer in command of an Orion patrol is for the purposes of the Act a fishery officer, the commander passes on directives from or advises a vessel of a use of a power by a land-based, warranted fishery officer. If there are improved direct communications this even further obviates the need for aircrew to have the ability to use fishery officer powers. The exception to this would be situations where the aircraft is out of communication for some reason and an immediate call must be made.