

CHAPTER 8

FISHERY MONITORING, CONTROL AND SURVEILLANCE

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1. INTRODUCTION

1.1 What is monitoring, control and surveillance?

In brief it could be said that monitoring, control and surveillance (MCS) is all about compliance to fishery management measures. This is of course a rather simplistic approach, but when the elements are analysed we see that they all lead towards this goal: monitoring gathers information on the fishery that is used to assist in developing and assessing appropriate management measures, while surveillance uses this information to ensure that these controls are complied with.

If a more precise meaning for MCS is required reference should be made to a definition developed by an FAO Expert Consultation in 1981 (FAO, 1981):

- (i) **monitoring** – the continuous requirement for the measurement of fishing effort characteristics and resource yields;
- (ii) **control** – the regulatory conditions under which the exploitation of the resource may be conducted; and
- (iii) **surveillance** – the degree and types of observations required to maintain compliance with the regulatory controls imposed on fishing activities.

This definition may be helpful in clarifying the individual elements of MCS - but it is not a point to dwell. A definition alone will do little to assist a fishery manager grappling with the need to understand the role of MCS within fishery management or to assist them in finding a way forward towards an MCS solution. More important than a definition is the need to understand the core objective of MCS and to have some grasp of the options available to achieve this.

This objective of MCS is clear: to contribute towards good fishery management through ensuring that appropriate controls are set, monitored and complied with, (controls have been discussed in detail in earlier chapters of this Guidebook: technical measures (Chapters 2 and 3) and input and output controls (Chapter 4) are all considered as the 'control' element of MCS). This at the end of the day is what MCS is aiming for and whatever methods, tools, components or systems are used, the individual or joint outcome should contribute towards this objective.

On the other hand the options available for an MCS system and the various combinations of these options are almost limitless. They include a range of separate or interlinked components of hardware in varying degrees of sophistication, various levels and types of human resources (both linked and separate to the hardware), a whole host of approaches to implementation ranging from military type enforcement to community driven compliance programmes and then finally, once the system is developed, to even more choices of how to manage the MCS system and organisation. This chapter therefore aims to give an overview of the most common options available and an insight into some advantages and disadvantages associated with these different choices.

The use of the term MCS is sometimes criticised as being too wide and confusing in terms of concepts and functionalities in relation to the core function of the operations, compliance or law enforcement section of the fisheries management authority. This is essentially because the 'enforcement' section of the authority does not usually focus on the monitoring or control elements of MCS but rather on the surveillance and enforcement elements. However, for all the criticism the term MCS may receive it has become a common term used internationally and it offers a wider perspective that fits well with some of the more modern trends and approaches towards the issue of compliance and law enforcement. Therefore the use of the term MCS has been adopted for this chapter and all functions of MCS are considered, leaving the reader able to select the functional elements that relate to their needs or operational circumstances (i.e. who performs the tasks e.g. enforcement personnel, scientists or administrators is not specified, but the tasks are).

1.2 A historical perspective

Before we look further into the systems available today it is interesting to consider briefly the history of MCS and why for many fishery management authorities the MCS section of their organisation may be relatively new. In the early days of fishing some type of informal community or tribal management system often existed and this would usually include ensuring that fishers complied with certain accepted codes of behaviour. These informal codes of behaviour were based on community wisdom, philosophy and superstition, as to the best way to

manage a fishery or water area that fell under the 'control' of one social group (community or tribe). If other social groups came into the given area, again informal codes of behaviour would dictate the way forward, or if these were not adequate, minor or major conflicts would break out. However, we see that the need for more formal and complex MCS systems is a relatively new concept that links very strongly to the United Nations Convention on the Law of the Sea and the establishment of the Exclusive Economic Zones (EEZs). Prior to this the majority of fishing activities within territorial seas could be viewed from the shore and this simplified MCS activities.

The MCS systems developed for the new EEZs were essentially developed as the implementing arm of fishery management, primarily to ensure that control measures, once agreed and adopted, were adequately implemented. Today this is still the core function of most MCS systems but due to the integrated approach to fishery management, encouraged through many international instruments and specifically the FAO Code of Conduct for Responsible Fisheries, a far greater and more linked role for MCS is emerging. In this new role MCS strategies now include the need to contribute towards the development of management plans (and therefore control measures) through the provision of information that is key to the evaluation of different management measures. MCS systems are also becoming active in the promotion of compliance by fishers through user participation, rather than following the old focus on the enforcement of controls. These two new trends are changing the approach of MCS in many parts of the world and are bringing it closer to other sections of fishery management and also to the fishing communities.

1.3 The role of MCS in fishery management

Often the concerns of MCS have been overlooked in the development of management strategies and plans in light of the belief that good fishery management is considered synonymous with good science. That is to say that as long as suitable scientific analysis and modelling was backing the choice of management priorities and measures then the need to successfully implement these measures (to obtain a high level of compliance by the fishers) was ignored. However, as a result of many unsuccessful management regimes that were based primarily on scientific assessment, the need for a more balanced approach is becoming increasingly evident and popular: an approach that considers compliance with conservation-based measures as essential for proper management of fishery resources. The emerging picture in modern fisheries management is therefore one of interlinked and compatible systems that provide feedbacks and checks to the management strategy – MCS is one of these systems.

Modern fisheries management is therefore placing MCS strategy, planning and activities at a far more central and integrated place around the table of fisheries management (see Figure 1, Chapter 1). For example, in Canada enforcement officials now regularly attend consultative meetings with industry and actively participate in the development of management plans. It is still clear that when the objectives of the fishery are chosen (biological, ecological, economic or social) concerns over MCS will rarely apply, as the objectives are related to the direction given by the national and fisheries policy. However, when we move down a level to the discussion on the alternative management strategies (including the selection of the management measures) that will be adopted to implement these objectives, there are various aspects related to MCS that should be considered. Below, some points are listed that indicate the type of questions that the MCS representatives should be asking to ensure that the MCS concerns are considered when accessing any proposed plans:

- (i) what are the practical requirements needed to implement the management measures (this should be considered from the monitoring, surveillance, compliance and enforcement points of view) and are these available;
- (ii) an evaluation of any previous records of success or failure of management measures should be made (preferably quantitatively but even in a qualitative manner if no data are available) and the results considered in light of any proposals;
- (iii) what are the factors that will encourage compliance rather than demanding enforcement and what are the requirements to develop these – are they feasible;
- (iv) the consequences of non-compliance (i.e. violations of the set controls) must be considered in relation to the effect that these will have on the status and viability of the fishery, therefore the level of compliance that is required in order to support the management plan should be considered;
- (v) what is the cost of these management measures and/or non-compliance from both a financial and resource perspective and, from a financial perspective, who should cover these costs, government, industry, or both?

Potentially, illegal fishing or illegal fishing activities could compromise the implementation of management plans and can, in extreme cases, undermine the rational exploitation of the resource. For this reason the FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing¹ was developed and adopted by COFI in March 2001 (Chapter 1). Also a management plan (however simple) that cannot be properly implemented may damage the credibility of the fishery management authority and be detrimental to the management of other fishery resources. It is therefore important to try to ensure that management plans can be properly implemented and that non-compliance is kept to an acceptable level.

For example, the use of total allowable catches (TACs) as a means to control catch levels implies that all landings must be monitored and catch by species recorded in close to real time (e.g. through logbooks and sampling or a complete landings monitoring programme). Also adequate steps are required to prevent discarding at sea of the target species and the unregistered transshipment of catches. It must therefore be asked; can the MCS organisation implement these required checks; or can the organisation be realistically developed to do so? Another example could be in relation to an effort control of the number and fishing capacity of vessels. Effort controls are generally considered less expensive to implement than output controls but require accurate fleet registration, close monitoring of fleet performance and of technical or operational developments that may affect efficiency (see Chapter 4, Section 6). Again, the question must be asked can the MCS organisation do this? Even if we consider one of the simplest control measures such as closed seasons or closed areas, these require the ability to monitor the closed times and areas (e.g. through vessel or plane patrols) or to develop voluntary compliance in such a way as to ensure that the management measures are adequately implemented, again it must be asked can this be done?

¹ The details of this IPOA can be found at <http://www.fao.org/fi/ipa/ipae.asp>

As well as considering the requirements that fishery management plans have of MCS, what MCS requires from management plans should also be considered. MCS activities must relate to specific management objectives, therefore clear management statements are required to develop MCS systems to the appropriate levels and at an appropriate cost. In addition to management objectives, information about management priorities, management measures and the available resources will also be needed. Even if full management plans are not in place an indication on these issues is required as the MCS strategy will aim to marry the priorities for the fishery with a practical approach to ensure an acceptable level of compliance, and also to balance the reality of limited enforcement resources with the expectations of industry and, to some extent, the other branches of the management authority.

Figure 1 gives a simplified diagrammatic representation of the main information links between management, science and the MCS functions of a fishery management authority. It does not aim to give the complete picture of fishery management but to highlight the main interactions and feedbacks. It is important to note that the three functions depicted (management, science and MCS) are not necessarily synonymous with sections of the same name within the fisheries management authorities, (e.g. monitoring can be performed by either the scientists or the enforcement officers).

An example of the links and feedbacks in the diagram could be that the link joining the monitoring to scientific research could relate to the fact that the scientific section analyses the influence of the management measures on the fish stock and the fishery, while both the MCS and scientific sections provide information for the analysis, and the MCS section provides details on how compliant the fishers are to this management measure. For example if a mesh restriction of 150mm is in force on a fishery, the scientific section will evaluate the influence this has on the catch composition (possibly using information collected by the MCS section). This information is then extrapolated through modelling into predictions of fish size (and age) for the entire catch of that species, but of course these predictions are assuming that there is 100% compliance to the 150mm mesh restriction. It is therefore the task of the MCS organisation to ensure that the management measures are complied with or (and more realistically) to inform the scientists of the estimated level of non-compliance. With this information the scientists are able to adjust their models to reflect a more accurate estimate of the size structure of the fish caught. This information will then be passed to management in two forms; firstly in the link between scientific research and fisheries management as scientific predictions on the status of the stock and as advice for future restrictions or management measures; and secondly through the link between MCS (strategy) and fishery management as information on non-compliance. If non-compliance is high (that is the controls are regularly being violated) it is an indication to management that the controls are unsuccessful.

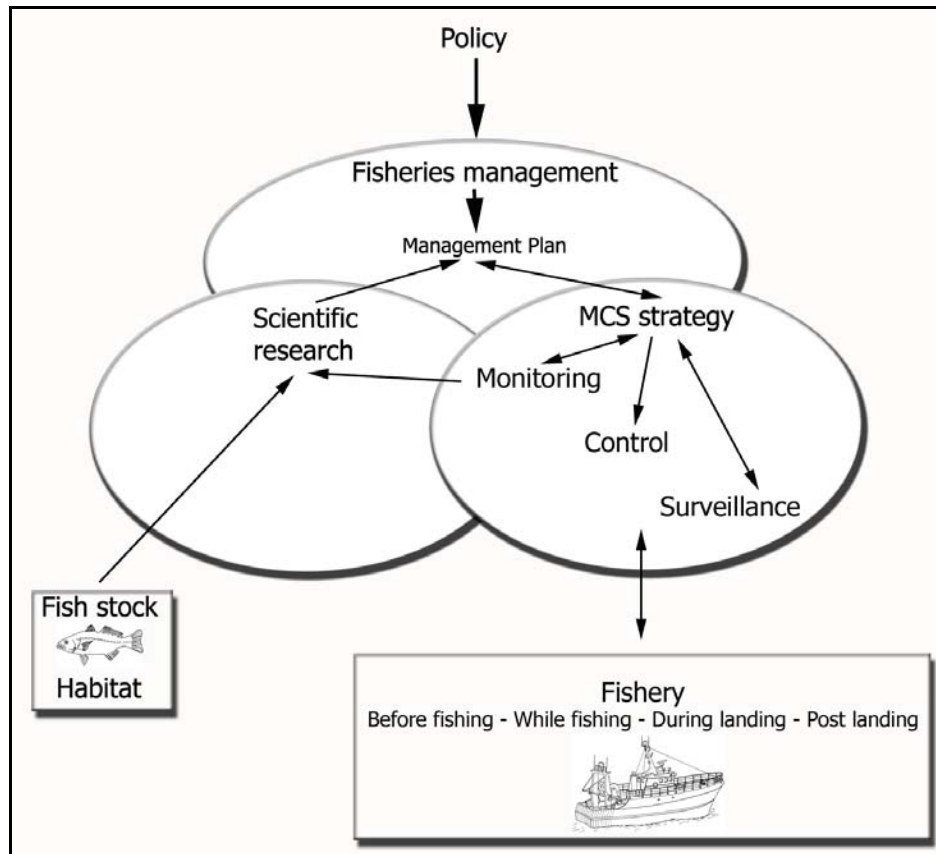


Figure 1 The main links between MCS and fishery management

2. THE MCS SOLUTION

We have seen that MCS is an integral part of fisheries management, both requiring information to set the strategy and plan and also feeding information into the management system to assist in producing management decisions: or to put it another way the type of controls set will influence the monitoring and surveillance, while the monitoring and surveillance should influence the types of controls set. It is now necessary to consider which factors play a role in the design of an MCS solution for a given fishery.

First and foremost there is no unique MCS solution for all fishery situations, nor are there inherently right or wrong approaches to the implementation of MCS systems. MCS systems should be developed for either specific fisheries or a group of interacting fisheries (in terms of ecological, fleet or management interactions). The MCS system chosen will be shaped by a variety of factors and the main ones are discussed in this section. The factors include aspects important to all three elements of monitoring, control and surveillance. Different factors will hold varying levels of importance depending on the situation, for example a multi-species artisanal fishery will have different priorities to a large-scale single-species industrial fishery. However, it is worth considering all of the points made in this section in order to evaluate their importance.

2.1 Strategy and plan

In designing a MCS strategy key strategic considerations are required and these are discussed in section 2.2. The following points although not key considerations may assist a manager in developing the strategy.

- (i) An MCS strategy is vital if any overall cost benefit is to take place within the fishery. It is often difficult to stop an activity or to start one within an established organisation and for this reason analysis of the economic inputs and outputs from a fishery are required to determine what activities to plan for, what to stop, what to upsize and what to downsize.
- (ii) One of the struggles that MCS managers face is how to balance the need for a flexible strategy and plan that is able to react to the dynamic nature of fish, fishers and fisheries and how to manage this flexibility within a system of annual planning for financial, human and hardware resources. One solution in more traditional MCS systems (e.g. vessels, aircraft and observers) is to identify which activities may need to be most flexible and always to plan these with room for adjustments and changes and if possible to include a mid-year review of the plan. Another solution is to adopt a MCS system utilising more modern components such as a Vessel Monitoring System (VMS) or remote sensing as these are by nature more flexible.
- (iii) A breakdown of the activities into two core areas; firstly a component covering enforcement including policing and deterrence; and secondly the monitoring and compliance component including stakeholder consultations and sector awareness actions, can be a useful approach to dividing activities.
- (iv) Usually economic return from a fishery is one of the objectives, therefore it is interesting to consider, for example, that achieving 100% compliance may cost more than the economic returns from a fishery, whereas 70% compliance could be both affordable and the remaining 30% non-compliance could be planned for in the management plan and therefore not become a threat to the sustainable use of the resources. The point of interest is that when developing a strategy for monitoring or surveillance a balanced and realistic approach must be considered. It should also be noted that the level of compliance aimed for is a strategic decision required separately for each fishery.
- (v) Both short-term and long-term strategies are important for good fisheries management and it is vital that policy, strategies and plans have the same objectives to work towards.
- (vi) A well-designed strategy will include the consideration of assessing the performance of the MCS system against the targets (refer to section 5).
- (vii) Most of the larger fishing nations rely on some level of consultation with resource users; however the level of participation that is allowed and encouraged is a key question when developing the MCS strategy. It is worthwhile to consider some of the arguments for greater participation or sharing of power and the long-term value of compliance over enforcement as discussed in 2.2.7 of this Chapter and in Chapter 7, and also the current international recommendations that are encouraging this type of participation such as Paragraphs 6.13, 7.1.2 and 10.4.1 of the Code of Conduct. The process should also include groups other than fishing interested parties, such as environmental groups. Long-term strategies should aim to resolve conflicts between different interest groups (e.g. artisanal and industrial fishers, trade or environmental organisations).

(viii) Finally when revising or developing a strategy the following simple questions should always be asked.

- What is required in terms of the fishery you are managing?
- What is feasible in terms of the legal framework?
- What is realistic in terms of available resources?
- What is practically possible to implement taking into consideration the political situation and the interested parties involved in the fishery?

An example of a simple strategy and plan for the MCS system could be if we imagined the management plan for an extensive artisanal fishery with very limited information on catch or effort, but the knowledge that decreasing catches and heavy exploitation in certain areas had lead to the introduction of a new minimum mesh regulation for a certain gear, a ban on beach seines and two designated no-fish areas. The country has a national employment policy and limited financial resources available to manage the fishery. The fishery is not of high economic value but important for local employment and food security. This information is the type of information that can come from a management plan to the MCS organisation, perhaps in more detail or perhaps not.

A possible strategy for implementing these measures would go along the lines that in the short term emphasis would be placed on two aspects, that of data collection and that of encouraging voluntary compliance through community self-monitoring and fisher obligation (developed through an awareness campaign). The data collection should employ local staff on a part time basis supported by a team of supervisors. These supervisors would also spearhead the awareness campaign and the community self-monitoring programme. The long-term strategy would look into possibilities to create alternative employment through the tourist industry for fishers. The strategic goal would be that by year three, quality catch and effort data would be available to allow for simple stock assessment, by year three compliance by the fishers for gear and area restrictions was over 80% and by year 5 alternative livelihoods have been identified for 5% of the fishers.

The plan would then give operational details to the strategy. For example in month 1, 20 data collectors are to be employed from various points in the fishery. A training course of one week is to be given to the data collectors with instruction given by a team of 3 inspectors from the MCS organisation that will form the support to the data collectors and also plan and implement the awareness campaign. A frame survey will be carried out in month 2 using the data collectors and supervisors and initial introductions and information dissemination to the community will occur. In month 3 a sampling programme for data collectors will be designed in light of the frame survey data and further training given on sampling techniques and form completion etc. By month 5 the data collectors will be sampling one day per week at their allocated beaches. The supervisory team will visit data collectors on a regular basis to collect forms and to discuss the work. The awareness programme will start in month 4 with community meetings and radio transmission on the need for conservation in fisheries and so on until an overall MCS plan is developed for the year.

The example above, although very simplistic and limited, shows how the three levels (management plans, MCS strategy and MCS plans) are linked. It is important to have both a strategy and a plan within the MCS solution as they assist in many ways in ensuring a sense of objective and purpose to often very isolated and separated activities (for example due to the strategy it will be relatively easy to explain to data collectors where their role fits into the overall plan for fisheries management, without it this link is less tangible). A MCS strategy is therefore necessary to give the organisation clear indications in relation to priorities, resource allocation and human resource development, while the plan turns this into practical reality. It can take

years to build and train an organisation to a level of satisfactory performance, a point that underlines the need for long-term strategies and detailed planning.

2.2 Key strategic considerations

Following on from the last section, eight key strategic considerations are now discussed. These considerations are important in the shaping of the MCS strategy and some aspects may be relevant for the MCS plan.

2.2.1 Type of fishery

Industrial or artisanal

Industrial fisheries require integrated cost-effective MCS solutions – these will usually include various components such as vessel registers, observer programmes, VMS and patrol vessels and aircraft. Often the emphasis is on enforcement rather than compliance although this is changing and is discussed further in section 2.2.8. The monitoring aspects of industrial fisheries are generally easier than in artisanal fisheries as vessel logbooks can often be implemented, VMS and observers can be placed on larger vessels and the landing of fish is usually through certain ports that facilitate landings monitoring.

If foreign fleets are involved in the fishery it is generally important to maintain a good MCS system with an emphasis on deterrence and enforcement but also ensuring adequate monitoring of catches. Voluntary compliance by foreign vessels is more difficult to achieve even when long-term commitments to the fishery exist. National fleets will generally be more amenable to voluntary compliance and this can be developed through participation in the fishery management process (see Chapter 7).

In artisanal and small-scale fisheries the combination of large numbers of fishers, mixed gears, migrant fishers and the proliferation of landing points makes MCS a very complex task. Often the most appropriate approach to MCS in these fisheries is through the community-based approach. However, alternatives such as government data collectors sampling at landing sites, combined with frame surveys and possibly some enforcement presence can also offer low cost solutions.

Multi-user fishery

When more than one type of fisher is targeting a fishery (e.g. artisanal, industrial or recreational) often the MCS effort will target the user that offers the biggest threat to the fishery in terms of financial loss or biological damage. It is more often than not the case that the larger the vessels the greater the potential crime, but if a large amount of small vessels or gears are violating controls the cumulative effect can also be significant. It is important to consider all the users, especially to ensure that the monitoring programme covers the whole fishery, perhaps through a sampling programme.

An example of a multi-user fishery is the Namibian coastal line fishery. It is a multi-species fishery and is exploited by commercial linefish vessels, day-trip skiboats (commercial and recreational), recreational anglers and subsistence anglers. The majority of MCS effort is targeted at the commercial linefish vessels as they are catching the largest volume of fish and they potentially offer the largest biological threat to the fishery. They are controlled through a system of licences and closed areas and monitored through logbooks and monitoring of landings by inspectors. However, effort is also given to monitoring the other resource users where the control measure is a bag limit that is applied for the recreational and subsistence sectors. These

are monitored at varying intensities during the year mostly corresponding to the tourist season, by a combination of awareness campaigning, beach inspections and road blocks.

Offshore fisheries may also require a strategy for interaction between fishers (e.g. in a demersal longline and trawl fishery) or between fishers and other users (e.g. oil prospecting or drilling operations), again participation by all users is a useful approach to this type of MCS issue.

Gears

As discussed in Chapter 2 of this Guidebook, the managers' toolbox includes both passive and active gears and the type of gears used in the fishery will influence the type of MCS required. In general passive gears are easier to monitor and control than active gears that require more mobility, equipment and more complex detection systems. When an effective MCS system is in place potential poachers are far more likely to use active gears than to risk the potential of being trapped when returning to collect passive gears. In Norway, the police or coastguard often lie in wait for returning salmon fishers that have left illegal nets (i.e. unlabeled and missing the licence number details) in the water. When offenders are identified they receive heavy fines and the nets are confiscated.

Multi- and single-species fisheries

Multi- or single-species fisheries will also have different demands on the MCS system. Single-species fisheries will often have more complex control measures to implement but on a more uniform fishery that will make monitoring more simple. Multi-species fisheries may have less complex controls but a large variety of fishing methods and vessels that require considerable effort to monitor adequately, in order to gain accurate information on catch and effort.

2.2.2 Type of management measures

Use rights

There are many different management strategies that combine different management measures, and linking these management measures to a feasible MCS strategy is important. As a starting point it is very difficult to ensure compliance to a specific management measure in an open access fishery and this is a reason to encourage the implementation of rights-based fishery management strategies. The type of access rights that can be used (e.g. territorial rights (TURFs) or limited entry access rights) are discussed in detail in Chapter 6 of this Guidebook and these will be important in the type of MCS system developed. Ensuring that only the allocated fishers are exploiting the resource and that no poaching is taking place is a core MCS activity that is best addressed in the strategy. Depending on the value of the fishery and the threat by poachers it may be necessary to put major effort into surveillance activities. In the south west Atlantic, the squid fishery is a seasonal fishery and the fishing fleets follow the squid through its migration across highseas, and through two EEZs. Within the EEZs poaching can be high especially when the squid is located around the boundary area. The Falkland Islands Government responds to this by putting patrol vessels and aerial surveillance in the EEZ boundary area throughout the period of squid migrations and aims to intercept and arrest poachers.

Input, output and technical controls

Input controls relate to effort control and this can be broken down into two types of controls related to the number and size of vessels (capacity control) and the time spent fishing (usage control). Output controls relate to limiting what is caught through limits of TAC, bag size or limiting bycatch (refer to Chapter 4 for a fuller description). Broadly speaking effort control is

easier to enforce. Vessels and fishers need to be monitored for compliance to the effort control (such as numbers of lines, areas fished or vessel horse power) but usually fishers are more willing to provide catch and effort data as there is no benefit from giving falsified information.

Closed areas and seasons (Chapter 3) are a means for controlling effort and also for limiting the possibility of certain bycatch, size or spawning condition by means of limiting the area available for fishing. This type of zoning lends well to self-policing or community involvement in self-surveillance. If a fishery is seriously in danger or recovering from overexploitation, such as some of the reef fisheries around the islands of the southern Indian Ocean (recovering from disruptive exploitation methods such as poison and dynamiting) then it may be appropriate to close an area completely. Closed areas are generally easier to enforce than gear or catch restrictions or 'no take' areas.

Output controls on the other hand are the hardest to control as they require accurate figures on catches (usually by species) that require either complete monitoring or a detailed inspection programme to support logbook, landing or processing data. If a high level of potential violations is expected, a strong deterrent to fishers will be needed combined with an evaluation of the level of non-compliance.

2.2.3 The legal framework

The domestic legal arrangements within a given country set the framework and basis for the operational activities of the MCS system (see Section 9, Chapter 1). It is therefore important that both those developing and those operating an MCS system understand these legal arrangements and the mechanisms to change them. From an operational view point the conduct of fisheries investigations and the preparation for and conduct of prosecutions are two additional areas relevant to those operating an MCS system.

At the top of the legislation is the constitution of each country, followed by Acts (or similar instruments). There will most likely be an Act relating to Fisheries and one that determines the Maritime Zones. These are both of importance to the MCS strategy. The Act relating to fisheries will be the most important and it should provide details on definitions, management regimes (including the designation of power to the appropriate government authorities to determine national MCS policy), powers of MCS officers (inspectors, observers etc) and details on the offences that can be made under the Act. Following the appropriate Acts there will most commonly be some form of regulations or system for providing lower level supporting legislation to the fishery, this may include licences and other legally binding documents where the rules and regulations of the individual fisheries are set out.

In order to design an MCS strategy that will be possible to implement, it is important to consider this legal basis and to aim to utilise the legal strengths of the system by selecting a strategy and MCS components that will be able to work effectively within the given legal framework. The actors that may need to be considered in legal considerations include the state actors, international organisations and non-state groups (e.g. industry associations, NGO's, vessel masters, owners and fishers). The key facts that the legal framework will establish are who can fish, where, what, how much, with what, and where it can be landed. Understanding how these work and how the law is set up to deal with actions that do not legally agree with what is set out on these issues is something that every fishery manager must know.

2.2.4 Human resources

People are the centre of any MCS organisation or operation. No technology, strategy or plan will be able to replace the demand for quality personnel. Therefore consideration of the human

resource requirements of an MCS solution is required. At the strategy level a realistic evaluation of the personnel available to the organisation is required in relation to the MCS needs, the financial resources, the time available and the feasibility for long and short-term training. The following points could be considered.

- (i) Knowledge levels: what are the minimum knowledge levels required for the different personnel tasks or professions?
- (ii) Recruitment procedures: what are the criteria used for recruitment and will these be suitable for the MCS needs?
- (iii) Probability of corruption: what is the potential for corruption among MCS personnel and are there any anti-corruption initiatives that could be implemented?
- (iv) Training capability and capacity: what level of training can the organisation provide for personnel and what external training will be required, how long will it take?
- (v) Political, social and policy requirements: is your organisation aiming for a labour intensive industry or is high technology and efficiency more important?

Knowledge about the dynamics of the fisheries, possible infringements and effective use of MCS resources are the main keys to success in a MCS operation and if this is lacking the strategy must address how to get it. Basic knowledge will be needed immediately if the organisation wants to gain respect from interested parties and donor technical support may be one option to initiate a professional and functioning operation if such knowledge is not available. In order to assure the long-term sustainability of the organisation training must form part of the strategy and plan. This training should ideally be a well-designed training plan for all levels of staff, which runs throughout their career structure.

When considering the organisation's approach to a human resource strategy the following may be useful.

- (i) It is worthwhile considering if a well-trained, better-paid and smaller work force would result in higher productivity and a more effective organisation than a less competent larger workforce.
- (ii) Training should ideally be officially acknowledged, for example through permanent employment, higher rank, bonuses or higher salary. This is important for motivation, sustainability and recruitment in the organisation and should be reflected in a human resource development plan.
- (iii) Practise has shown that the most effective way to train for lower level jobs is through vocational modular training preferably based on adult learning principles. These training programmes (for example for observers, inspectors, clerks and radio operators) can often be taught by more senior personnel in the organisation and developed for specific local situations.
- (iv) In relation to in-house training courses it is also important that quality criteria are demanded from instructors to ensure that a certain level of quality is maintained in the teaching.

2.2.5 Financial requirements

Cost effectiveness

Cost effectiveness is a primary consideration for all MCS systems and a comparison between the costs and benefits from different MCS options is required. The MCS strategy will need to provide clear guidelines on the financial resources available and on the approach to allocating these. Generally, if the costs of the MCS solution exceed the expected financial and other benefits of the MCS interventions, then alternative, less costly options should be explored. However, there are always exceptions to the rule such as when a country values a resource beyond its immediate financial return for social or historical reasons. To aim for a cost effective solution may appear to be an obvious conclusion, but it's surprising how often this is overlooked. In the 1990's the United States spent approximately \$80 million on the surveillance of foreign fishing operations while collecting only \$41.5 million annually from the same fishing fleet. In contrast in the small coastal state of Costa Rica, the cost of a modest enforcement programme for the tuna fishery was calculated to be about 50% of the expected revenue from this fishery. Another example is Namibia which collected N\$120 million (US\$15 million) from the fishing industry in 1999 while the cost of the MCS organisation was estimated to be N\$66 million (US\$8 million). This indicates a sound and sustainable organisation well proportioned to the financial income of the sector.

Who should pay?

The questions that must be considered at the strategy development stage (if this has not happened previously) is how can enough income be generated to meet the needs, who should pay and how should they pay? There is an increasing trend to recover costs from those active in the fishery, such as the fishers, the boat owners, the port owners and the fish processors: by determining which interest groups benefit from the fishery, costs can then be appropriately attributed and recovered. As fishers are usually the primary beneficiaries of MCS programmes it is worthwhile considering how much of the cost they should bear. It is recommended that this share may best be increased incrementally with time – this has the dual effect of encouraging more compliance because increased compliance implies reduced costs and also encourages the industry to internalise the costs of their sector. As an alternative, it may be feasible to tailor the MCS programme around fishers' ability or willingness to cover costs by linking specific management measures to MCS programmes. For example, the "cost" of an individual quota system (as it may require additional monitoring resources) would be higher than that of a competitive fishery and as the fishers allocated quotas would benefit from a well implemented system, they should also cover some or all of the additional costs associated with the quota system.

Donor support

Special provision is given to developing countries in the Code of Conduct (Paragraph 5.2) where countries, relevant international organisations, whether governmental or non-governmental, and financial institutions are called on to assist developing countries in areas including financial and technical assistance, technology transfer, training and scientific cooperation. Funding for fisheries management in many developing countries relies heavily on donor assistance and this assistance is in many aspects the only solution for any organisation lacking resources and expertise. There are some pitfalls related to this type of support: common examples include the many developing countries that have fallen victims to eager donors that haven't considered the receiving countries capacity to operate and maintain their generous gifts of expensive hardware. Often equipment such as patrol vessels or planes cannot be utilised due to lack of resources and

end up tied up at jetties or in hangers. In such cases, greater benefit would have resulted from a more moderate MCS-system with consideration of long-term costs. It is therefore important to ascertain the long-term commitment of the receiving government before accepting any technical assistance in the form of hardware.

Low cost options

When considering costs it is worthwhile asking the question do lower cost options exist? Normally the answer is yes they do. Larger commercial fishing operations including domestic and/or foreign vessels do not necessarily require patrol vessels and planes as part of the MCS system. A VMS combined with a certain degree of observer coverage can also do the job. The main cost of the VMS system (vessel unit) can be borne by the industry, while a simple observer compliance and data-collection programme can be established to compensate for the weaknesses of VMS. Vessels participating in the fishery can be channelled to certain harbours or checkpoints before leaving the fishing zones for control purposes by inspectors. This type of system is able to address a wide combination of management measures on an already licensed fleet. In order to improve the level of compliance, the above system can be combined with a low cost awareness and participation programme to encourage fishers to be engaged in the decision-making for the fishery. Additionally or alternatively, if unlicensed vessels are a serious problem, small private aeroplanes carrying one fisheries inspector could be leased (for example twice a week) and this in combination with low-cost patrol vessels would have a deterrent impact on illegal activities. Alternatively assistance from the Navy or Coastguard may be a possibility.

Regional and bilateral strategies

Another option for cost saving is to incorporate an MCS strategy and operations plan into bilateral or regional fisheries agreements. This approach is encouraged in Paragraph 7.7.3 of the Code of Conduct. A successful example of this is a low cost solution called 'no force' that was developed by the South Pacific Forum Fisheries Agency and implemented in 1986. The concept is built on the principle of voluntary catch reporting from the fishing vessels, regional sharing of enforcement costs, regional sharing of catch and compliance information and use of "good standing" for granting of fishing rights. This system has joined together 23 countries and territories covering 30 million km² of ocean and one of the world's most productive tuna fisheries, through a regional MCS strategy and plan. Bilateral or regional co-operation apart from the potential cost saving angle can also be of great value when fishers are migratory either due to trans-boundary or migratory fish stocks or simply due to their searching strategies to locate fish stocks to exploit. There are many further examples of regional co-operation (e.g. the Indian Ocean Tuna Commission, the West African Sub-Regional Fisheries Commission, the Organization of Eastern Caribbean States Fisheries Unit). Some are inevitably more successful than others, but in recent years more success stories are emerging from this type of shared management.

2.2.6 MCS dimensions

In considering the area and dimensions that MCS covers, it should first be noted that MCS is related to the fishery (this includes the fishers and fishing related activities) and not to the fish stock *per se*: fisheries are managed by managing the fishers not the fish. So MCS relates to routine fishery operations, this includes four key dimensions; before fishing, during fishing, landing the fish and post landings (Figure 1).

These four dimensions should be considered when designing an MCS strategy and plan in order to obtain the optimal level of monitoring and surveillance at the least cost. For example if all

the MCS effort is placed on the 'during fishing' dimension this would not facilitate any crosschecking or validation across dimensions. Ideally the aim should be to spread the monitoring and surveillance across the four dimensions. For example in the European Community cross-checking is made through logbooks, catch and effort reports, VMS, patrol vessels and planes during fishing, landing declarations at point of landing and sales notes at post landings.

There will inevitably be trade-offs between different combinations of solutions such as the choices between covert or overt surveillance, education of interest groups or traditional enforcement, total monitoring or sampling. For example, a regular presence by MCS platforms such as patrol vessels will act as a deterrent to discourage potential violators from carrying out illegal operations, but equally it is important that an initial inspection performed in an area arrives as a surprise to the crew of the fishing vessels. These two strategies are obviously at conflict and it is therefore important to find a balance that suits the objectives of the operation.

2.2.7 Targeted MCS

The use of targeted MCS is an important strategic consideration that can have a large impact on the cost effectiveness and the efficiency of an organisation. When an individual fishery covers a large physical area or the total number of fisheries managed by one-authority covers a large area, the MCS resources of that organisation will often be over stretched. Random checks as part of a sampling strategy may be sufficient to get the required data for monitoring, but often the surveillance effort that is targeting enforcement must be aimed at known or suspected offenders, that is, it must be intelligence driven. This targeting of routine offenders rather than the occasional or opportunistic offender is important to catch offenders and also as visible deterrent to potential offenders.

This intelligence driven enforcement is also known as adaptive operations. The information usually comes from the fishing community itself and is therefore part of a co-operative or participatory management approach. Encouraging reporting can be a difficult task: fishers will often feel loyal to their colleagues (one day their safety may depend on them). Therefore to encourage fishers to report, the following ideas may help; a code of ethics for fishers, education to the fishers about their role in the management system, easy reporting methods (e.g. Western Australia's 24 hour telephone line or the internet reporting system for the Southern Ocean toothfish), a reward for the information, clear administrative systems and legislation and, perhaps most importantly, the nurturing of good relationships between the inspection officers and the fishers.

2.2.8 Compliance or enforcement

Many fishers operate in an environment rigorously controlled by the authority. The area they work in is however often isolated without witnesses or law enforcement units present. Fishers are therefore easily and frequently tempted to violate the regulations designed, as they often see it, specifically to restrict their effectiveness. In addition, even in the most advanced and complete enforcement systems, fishery inspectors can rarely be everywhere due essentially to cost limitations. So what can the fishery manager do? The answer given more and more often these days is to balance the enforcement and compliance aspects of the MCS system, to encourage an environment where maximum compliance from fishers occurs and to use enforcement in areas where voluntary compliance is not successful or requires support.

The balance between compliance and enforcement is a question that must be considered at the strategy stage. It is not something that is only applicable for artisanal or small-scale fisheries: voluntary compliance has a role to play in all MCS strategies and it is generally considered to be

the positive output of adopting a participatory approach, which is the essence behind Paragraph 7.1.2 of the Code of Conduct.

Legitimacy

The assumption with legitimacy is that people are more inclined to obey rules that they feel are legitimate (rightful, justifiable and reasonable). Therefore, there needs to be a perception of fairness in legislation if it is to become effective. Creating a sense of legitimacy towards the management strategy or any particular controls will depend on many factors, such as:

- the content of the regulation itself – how does it compare with the view of the fishers;
- the distribution of the regulations – are they equitable;
- are other partners (fishmongers, processors, recreational sector etc) carrying a fair burden of the enforcement;
- were the fishers involved in the formulation of the controls and regulations;
- is the implementation transparent;
- do the fishers feel an ownership towards the management;
- is there a good dialogue between the authorities and fishers?

One way to ensure these is through a balanced strategy that is open for all to see.

Legitimacy does not just apply to the legislation but also to the perception of the fishery management authority. If the public perception of the authority is low in terms of technical skills, corruption, laziness and public arrogance, this will have an effect on the overall compliance by fishers – as well as being internally very destructive!

Deterrence

Deterrence is another way to increase voluntary compliance and it mainly relates to the severity and certainty of sanctions. Illegal activities must be unprofitable, and more importantly it is vital that fishers can not get caught for a violation and still gain from the crime. This may appear obvious but there are many fishery management regimes that have not addressed this issue adequately.

If voluntary compliance is an objective then crime mustn't pay (Code of Conduct, Paragraph 7.7.2): if the deterrence is high enough then compliance is encouraged. In Western Australia the rock lobster fishery is a high value fishery where industrial fishers are given 'black marks' for serious offences. If three black marks are given in a 10-year period then their license is cancelled. This high penalty system has ensured high compliance.

Participatory management

Where does the obligation lie to ensure that the management measures will be complied with? In answer to this question and due to the failure of many traditional enforcement driven MCS systems, participatory or co-operative management methods are becoming more popular as a means of fishery management in partnership with other interested parties (including of course the fishers). There are many advantages in involving willing fishers; their understanding and knowledge of the fishery will increase, the chance of violations due to lack of knowledge will decrease and hopefully their desire to comply and assist in ensuring that others comply with controls will increase.

Community management is a term that generally refers to the involvement of small-scale or artisanal fishers in the fishery through the community structure, while participatory management refers to all types of fisheries and includes community management. Community management

does have a special place to play in MCS and for many countries it is the most feasible option to encourage compliance. For example even high penalties and deterrence will not be effective if fishers are either financially desperate or hungry – in these cases the number of violations will increase. This may be a serious and difficult situation for a fishery manager and often only community intervention will be able to influence fishers. Chapter 7 of this Guidebook gives a fuller discussion of the subject.

Apart from the obvious advantages of voluntary compliance from a biological point of view, it also has significant financial implications for the MCS organisation: if the compliance is greater then costs of enforcement are less. However, it is important to note that there are cases where enforcement is essential and certainly voluntary compliance is not the best route to follow in all cases. On the negative side, voluntary compliance tends to take longer to implement and for the results to become apparent – this may spell disaster if violations are critical to the sustainability of the stock where the best option may be immediate enforcement action.

3. CORE COMPONENTS

This section considers the possible core components of an MCS system with a focus on physical components and hardware. Information is included on the objectives of each component and the ability it has to implement different control measures (Table 1). Selection of components will relate to the MCS strategy including cost considerations and the points made in Section 2 of this Chapter and Table 2.

New technology may offer the possibility of improved MCS systems and enhanced cost efficiency, but it should be noted that technically advanced MCS components may take years to develop into efficient instruments. The level of compliance required, knowledge, MCS experience and running costs should be given serious considerations in the planning phase before implementation. If new, more technological solutions are chosen it is important that old procedures and working practises are revised to take advantage of the new components. Another challenge is to manage organisational changes: changing old routines and analysing ways to improve effectiveness and efficiency are the only way to fully utilise the potential of new developments.

Table 1 Comparison of the effectiveness of different MCS components to implement control measures

Dimension	Component	Effectiveness of element for management controls			Detection of unlicensed vessels/fishers	Power of arrest	Cost
		Input	Output	Technical			
Before Fishing	Clearance / issue of documentation	Medium	None	None	No	Yes	Low
	Vessel clearance	Medium	None	Low	No	Yes	Low
While Fishing	Logbooks	Medium	Medium	Low	No	No	Low
	Patrol vessels	Medium	Medium	Medium	Medium	Yes	High
	Patrol planes	None	None	High	High	No	Medium
	Helicopters	None	None	High	High	Yes	High
	Observers	High	High	Medium	Low	No	Low/ Medium
	VMS	Medium	None	High	No	No	Low/ Medium
	Satellite Imagery	None	None	Medium	Medium	No	Low/ Medium
	Beach patrols ²	High	High	High	High	Yes	Low
	Navy or coastguard	Low	Low	Low	High	Yes	High
During landing	Catch monitoring	None	High	None	No	Yes	Low
	Transshipment monitoring	None	High	None	No	Yes	Low
Post landing	Market and sales monitoring	None	Medium	None	No	Yes	Low
	Export monitoring	None	Medium	None	No	Yes	Low
	Roadblocks and transport monitoring	None	Low	None	No	Yes	Low

² Only beach related fishing activities

Table 2. Advantages and disadvantages of different components of MCS

Component	Advantages	Disadvantages
Clearance / Issue of documentation	Ensures valid documentation among the fishers and provides opportunity for briefing of captains.	Can only be performed on vessels calling at national ports with an MCS presence.
Vessel clearance	Good source for information about the fishery. Controls in relation to e.g. engine size, fishing gear can be conducted.	Fishing gear and other equipment may be hidden.
Logbooks	Can be used onboard any fishing vessel in any language. Keeps historical track on catches and positions. Cheap	Poor literacy rate by fishers may be an obstacle in certain fisheries. Quality of data will depend on fishers' motivation.
Patrol vessels	Provides at-sea verification of fishing gear, discards, dumping, logbooks and catches. Most important to control offshore operations and foreign fleets. The only platform that can effectively conduct an arrest offshore. High deterrence factor.	High cost and limited area surveillance capability. Low rate of detection of infringements.
Patrol planes	Can provide high coverage for identification of illegal incursion of unlicensed vessels and effectively patrol borders and closed areas.	No ability to arrest or to inspect catch or gear.
Helicopters	Can cover relatively large area, can deploy inspectors on vessels and arrest.	High cost and limited distance covered compared to patrol plane
Observers	Can monitor all operations onboard a specific vessel and verify catches, discard, dumping, gear and validation of required documents	Medium cost. Only viable on larger vessels. The integrity of observers may be a relevant question in terms of the quality of data provided.
VMS	Provides up to real time monitoring for licensed or fitted vessels and can reduce interception times for enforcement craft. Low to medium capital and running costs (ship unit bought by fishers)	No coverage of vessels not fitted with the required equipment. Requires integration with other platforms or sensors to be utilized effectively. Technical maintenance and IT support can be limited in some countries.
Satellite Imagery	Full coverage of area scanned	Expensive for regular scans. No positive identification of targets unless verified by other sensors.
Beach Patrols	Efficient tool within recreational and near shore fisheries. Contact with fishers.	Visibility of inspectors, access to remote areas can be difficult.
Navy and coastguard	If available can be free to fisheries organisation, if they are in the field they can monitor border violations.	Limited capability – only border violations as limited fishery knowledge.

Component	Advantages	Disadvantages
Catch and transshipment monitoring	Can monitor landed catch and quotas. Has power to arrest in port. Low capital and running costs	No possibility of monitoring vessels that do not call at port. No possibility of monitoring dumping, gear violations or off-shore transshipments. Information is only of fish landed not those discarded and no geo-referenced data.
Market and sales monitoring	Good information source in terms of landed species and market demands	Difficult to trace the origin of the fish.
Export monitoring	Good information source on volume of landed fish in high value fisheries.	Only part of the landed catch may be exported.
Roadblocks and transport monitoring	Good tool against sale and transport of illegally caught fish.	Roadblocks are easily detected and can be avoided.

3.1 Before fishing

Control of fishing vessels or small craft and fishers before fishing trips, at the time of the issue of a licence, through annual frame surveys or through spot checks is a useful and low-cost MCS operation that can facilitate the following:

- the checking of gear and effort control mechanisms (e.g. horsepower and vessel capacity) to ensure that regulations or licence conditions are complied with;
- if illegal gear is detected or shown then it can often be secured so that it is not possible to use it while fishing;
- to gather information for fishery statistics;
- if vessels have already been fishing it may be necessary to determine if any catch is still onboard;
- this pre-fishing interaction with fishers can be very positive and show the seriousness of the organisation; also MCS personnel get hands on experience with the fishing sector;
- it will generate feed-back from the fishers that may give valuable information for planning or fisher intelligence.

Safety at sea can also be controlled if a vessel is inspected at port. This is an issue that the Code of Conduct focuses on in Paragraph 8.4.1. Fishing at sea is the most dangerous occupation in the world. The drive for economical gain in fisheries has resulted in poor safety for many fishers and this is particularly true for vessels not covered by international instruments such as the Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (1995) (STCW-F) which refers to vessels over 24 meters or powered by more than 750 kW. It is important for fisheries management authorities to play a large role within this field in cooperation with the maritime authority. The international instruments also set a minimum recommended standard that can be made valid for smaller vessels within national legislations. Two sets of guidelines to improve the design, construction and equipment of fishing vessels were formulated in the 1960s and 1970s, not as a substitute for national laws but to serve as a guide to those concerned with framing national laws and regulations. These publications are under revision by the International Maritime Organisation (IMO) and are the Code of Safety for Fishermen and the Voluntary Guidelines for the Design, Construction and Equipment of Fishing

Vessels. The safety of fishers is in the interest of the fisheries management authority: this responsibility must not be avoided!

3.2 While fishing

Fisheries MCS operations carried out at sea can have an impact as a deterrent or for enforcement of all control measures but generally they are most significant for output and technical controls. It is the only method that allows infringements in relation to logbooks, gear types and catch to be detected on the site of the crime (while fishing). Important information is also collected at sea that can be time, date and position referenced in relation to both activities and catch.

3.2.1 Logbooks

Logbook data (catch, effort, location, environmental parameters, and gear) is completed by fishers during fishing activities. Logbooks usually need to be designed for each fishery and when good co-operation with fishers can be gained they provide valuable information for scientific assessment, catch monitoring, and feedback to the fishers in terms of historical records. The quality of the data in the logbooks may vary and will relate to the management measures applicable (e.g. in an effort controlled fishery, catch and bycatch data are likely to be more accurate than in a catch controlled fishery), control routines (e.g. regular verification by inspectors or observers or the need for daily radio reports) and the fishers perception of the importance of the logbooks.

3.2.2 Patrol vessels

Fisheries patrol vessel is a very broad term for vessels in a variety of sizes with many different configurations and these vessels along with patrol planes and observers are seen as the traditional tool for MCS. The main principle is that a vessel is able to monitor and enforce fisheries legislation on the fishing grounds. The type of fleet to be controlled may vary from artisanal boats to large foreign trawlers. The fleet to be monitored, sea and weather conditions, possible hostile situations etc. will determine the capacity and configuration required for a patrol vessel. Patrol vessels carrying fisheries enforcement officers are often the only way to obtain some vital and legally acceptable evidence of infringements. It is also the principle platform that can conduct an arrest of a vessel at sea (helicopters also have this feature to a limited extent).

Patrol vessels can be costly to buy and to operate, but they are in many ways irreplaceable, therefore efforts must be made to optimise their operations. Patrol vessels are slow platforms covering relatively small areas, so their main purpose would be deterrence due to their low capacity to detect infringements.

3.2.3 Patrol aircraft

There is a wide range of aircraft available with different performance abilities within the range of light aircraft, which are suitable for maritime and fisheries surveillance. Air operations are very useful for surveillance of large areas and can be utilised in trans-boundary, regional and high seas operations. This MCS component is the only one that can provide an overall picture of a large fishing zone within a short timeframe. Correct utilisation and appropriate information sharing of aircraft sightings will improve deployment of patrol vessels and observers. Aircraft can also have uses for monitoring such as sightings of fish schools, whales, and reef destruction.

Helicopters are more limited than fixed wing aircraft in terms of monitoring large areas effectively but they have the advantage of being able to hoist personnel to and from a vessel. Helicopters normally are 5-10 times more expensive to operate than a small fixed wing aircraft,

and therefore the need for one must be clearly identified. The main objectives of a helicopter in the fisheries surveillance role would be the same as for a fixed wing aircraft with the addition of the ability to carry out fisheries inspections including possible arrest of vessels, if applicable, by fisheries officers. This is particularly relevant when the helicopter is carried by the patrol vessel.

3.2.4 Observer programmes

Observer programmes are the only way to implement and to ensure compliance with certain controls such as bycatch or discard regulations that require continuous monitoring. Observers are also able to collect time, date and position information for activities and catches (including biological data) and through this monitor for area and season restrictions and provide valuable information for the scientific organisation. Observer programmes also contribute to deterrence and can create transparency among fishers.

Observers require training, manuals and suitable equipment and supervision to perform their task adequately. Vessels need to be large enough to accommodate observers and possibilities need to exist to place (in port or via the patrol vessel) observers and remove them from vessels. Observers are generally a low cost option for at-sea monitoring and surveillance that have many advantages such as providing continuous contact with fishers, a high deterrence impact and valuable data collecting. Observers do not have the power of arrest so they are only able to record and report any infringements, not to act.

3.2.5 VMS

A Vessel Monitoring System (VMS) provides real-time position, course and speed (PCS) data through a communication link directly into a base station. This allows operators to follow all licensed activity as it happens. These data are sent from a unit on the vessel to a shore receiving station that then displays the vessels on electronic maps with an accuracy of around 100 meters. Satellite communication such as Inmarsat-C is most commonly used, although VMS can be implemented through a range of communication solutions depending on their respective coverage. Fishing in illegal areas, trans-shipments of fish and transfer of fuel can all be indicated through this system. VMS is a tool to assist in more timely and cost effective monitoring and surveillance of authorised and participating fishers. It also significantly supports the more efficient direction and deployment of patrol vessels and patrol aircraft.

Additional opportunities provided by a VMS include the manual entering of catch and effort data (from logbooks) that can be forwarded through the same system for assisting in management of quotas and stock assessment when timely information is required. VMS also creates a solid safety feature for vessels as their position is known at all times and an emergency function is built into the system. Added benefit for the industry is also possible including the option for improved fleet management and catch information that may be available in a timely manner, facilitating improved marketing possibilities (these can be closely linked to the growing electronic marketing of fish and seafood now available).

The validity of VMS information in court needs to be tested for each country. Legal experiences internationally suggest that additional information such as photographic evidence from a patrol vessel, plane, or observer is needed to secure sufficient evidence in case of violations. It is also important to remember that VMS only monitors those vessels carrying active equipment onboard. It will never detect poachers or unlicensed vessels. VMS is highly valuable to assist with area controls, border controls and fleet separation of a regulated fishing fleet.

VMS can be limiting due to its cost for smaller artisanal or in-shore vessels that can seldom be burdened with the cost of the required vessel units. This has generally limited the use of VMS to larger commercial vessels although a trend towards less expensive units is emerging.

3.2.6 Satellite Imagery

The future may open up for additional remote sensing tools that will primarily be useful to supplement the VMS in terms of detecting unregulated fisheries as well as being able to secure acceptable evidence for prosecution of illegal activities. Satellite images are taken from satellites and include radar or photographic images. Radar images have proven particularly useful as they provide good pictures regardless of cloud coverage or light conditions (day or night), while photographic images are more limited by these conditions.

These pictures can become available to fisheries officers in nearly real time (within 2 hours). As fishing vessels move slowly when they fish, the comparison of VMS and satellite images will highlight the presence of illegal fishers and prompt on the spot response from the fishing authority. Present weaknesses with satellite images are that poor sea conditions reduce the detection capability of the system. It is, however, stated that results from different studies confirm that fishing vessels longer than 35 meters in length can be detected at a 95% probability with radar satellites. A second weakness at the present time is that a picture cannot be ordered as a reaction to an incident as the beam programming requires at least 28 hours advance notice.

The present limitations will certainly be reduced as countries and organisations continue to explore the use of satellite imagery. The European Community, Peru, Norway, Canada, The Maldives and many more are participating in research and pilot programmes in relation to integrating satellite imagery with VMS. Potential savings are directly related to aircraft and patrol vessel costs as their efficiency can be increased significantly as the planning and operational deployment of these units will improve.

3.2.7 Beach patrols

In artisanal or recreational fisheries beach patrols may be required to check for fishing licences, bag limits, size restrictions (of fish), gear restrictions or for gathering information. These patrols can be performed randomly or in some type of planned sampling strategy. They can be performed on foot or in vehicles. They will also provide an important interaction with the artisanal or recreational fisher working from the shore (e.g. beach seines, and pole and line fishing) to allow the transfer of information directly to the fishers.

3.2.8 Navy and coastguard

The navy is normally neither designed, educated or particularly trained for fisheries MCS operations. The organisation can be a valuable asset in the sense of monitoring border violations of unlicensed vessels and assistance during hot pursuit, but it is seldom efficient for monitoring catch or gear controls.

A coastguard is more capable of fisheries protection tasks while usually being less advanced than a navy in terms of training and equipment. A coastguard is normally designed around the UN Convention on the Law of the Sea with basic police tasks to perform with emphasis on border violations, fisheries enforcement, search and rescue operations, custom and immigration tasks. It is thus important to remember that any deviation from a pure fisheries protection is a compromise that will reduce the effectiveness of each individual function.

3.3 During landing

The place of landing whether it is a small landing site or a large port provides a bottleneck in fishing operations where vessels can be checked, documents such as logbooks collected and the fish being landed can be identified and weighed. Monitoring of landings is one of the most important elements of MCS operations when output controls are in place. Landing controls are normally less expensive than use of classical MCS platforms as inspectors will be able to travel by road to most ports or landing places, and sampling systems can be developed to suit the local conditions. It is important to remember that monitoring of landings does not detect discarded or trans-shipped fish or fish sold prior to landing. Only physically landed fish can be monitored without knowing where or how the fish has been caught.

3.4 Post landing

Control measures of trade units dealing with fish may be another valuable site where catch data can be verified. Inspections of fish markets, transport providers and sales organisations can provide valuable information about the catches. This type of operation generates valuable information for biological and economical crosschecks as well as validation of other MCS information. It is also a viable operation for control of illegal fish, especially undersized and protected species in general. This is especially valid in small-scale and semi-commercial domestic fisheries where high value catches such as lobster, tuna, sharks and swordfish are caught. Road blocks are another method that can be useful for recreational fishers when bag limits or requirements for licences can be checked.

4. FACILITATING FOR MCS

To facilitate for MCS means that apart from the core MCS system further arrangements or actions are taken to make MCS operations easier, more efficient and more cost effective. Often relatively simple arrangements can result in substantial improvements in the MCS solution.

4.1 Administrative options

Vessel marking system

A proper vessel identification system must be in place in order that patrol vessel crew, airborne personnel or inspectors are able to identify fishing vessels and verify legal vessels effectively. Small registration marks or hand painted registration numbers will make the job of the enforcement units almost impossible. FAO sets standards for marking of fishing vessels that have both proven adequate and provide an easy system to follow (FAO Standard Specifications for the Marking and Identification of Fishing Vessels). These standards are recommended and they support the guidelines given in Article III Paragraph 6 of the FAO Compliance Agreement and Paragraph 8.2.3 of the Code of Conduct. When Malaysia decided to implement a vessel marking system they adopted FAO's standards and in line with these designed a tamperproof registration mark and zonation system. As an incentive to encourage fishers to register they gave a certain timeframe during which registration would be free, and after which time it would be expensive to register. Following this system Malaysia was able to successfully implement a registration and marking system in a few years.

Banning of certain transshipments

Banning of transshipments at sea or outside the port limits is an option to centralise the transshipment operations and therefore make inspections more practicably possible. This option can be applied to certain valuable fisheries or possibly to foreign fleets or across the board to all fishers. It also facilitates the deployment of at-sea observers onto vessels.

Briefing and vessel clearing

In a commercial fishery it can be very valuable to have the captain report to the fisheries authority at the start of each fishing season in order to be briefed about the conditions of a license and to offer the opportunity to collect documentation including logbooks, licences etc. At the same time the vessel will be available for clearing by inspectors.

Checkpoints for vessels leaving a zone

If a foreign fleet is operating then the establishment of checkpoints at certain positions may be a useful system to allow inspections of the vessels before they leave the zone to offload in a foreign port. Alternatively if catch control is very important, offloading of catch can be restricted to specific domestic harbours to ensure complete control of a specific fishery. In Norway vessels have to report at a checkpoint before they leave the Norwegian EEZ for foreign ports. The inspectors are then able to decide if they will inspect the vessel or not: the compliance advantage of this is that the fishing vessels are always prepared for inspection whether it is conducted or not.

Limitation of landing sites

For artisanal or small-scale fisheries many countries have thousands of landing sites making it impossible to control or even realistically to sample landings. One option is to limit the landing sites for a particularly valuable, protected or overexploited fishery or fish species. This channelling of landings to only a restricted number of landing sites makes it easier to deploy inspectors or data collectors to sample the fishery. It may be necessary to support this with spot-checks at other landing sites and markets to ensure a deterrence against violating this regulation.

Special courts

Many courts are not familiar with fisheries violations; this often results in low fines or lost court cases. It may well be worthwhile considering an educational programme or seminars that focus on fisheries legislation and related infringements for court staff and judges, stressing the importance of fisheries management to the country, the possible economical gains that illegal fishing has for offenders and the requirement and effect of high deterrence. Alternatively it is possible to train and allocate special judges or courts to handle fisheries violations.

Coastal zone separation

Conflict between fishers using different gears, between small-scale and large commercial fishing vessels or different resource users is a common problem for an MCS organisation. MCS solutions in a coastal fishery can be very complex due to the multiplicity of resource users and the often difficult access to the resource and landing places. Finding the appropriate solution will need involvement with other managers in the coastal zone and possibly involve the consideration of zones for different users or fishing types. Such options may contribute significantly to decrease tensions and conflicts between the different fisheries or participants and often facilitate self-regulation.

Joint committees

It is important to consult all interested parties when designing and implementing the MCS solution as discussed in Section 2.2.8 and Chapter 7 of the Guidebook. In order to facilitate this participation, joint committees can be formed that meet on a regular basis to allow dialogue and exchange of information. This type of co-operation is valuable within all fisheries ranging from artisanal to large commercial fisheries.

4.2 Information management and sharing

A MCS system will produce large amounts of information through the different monitoring and surveillance programmes. Some of this information is required almost immediately for surveillance activities and to co-ordinate the effective deployment of MCS components, while other information is needed in a less timely manner but over a longer time-series. These different requirements for information make good information management vital. The definition of 'good' is not an easy one: striving for accurate and timely information is important, but also the concerns of what information and in what format are a vital question. It is far too easy to collect too much information, which then is a burden on administration and database systems to compile, check, retrieve and store. The need for information should determine how much and what information is collected, how it is compiled, shared and processed.

It is important to consider both information sharing inside MCS and dissemination of the outputs. Even if exact data requirements differ between MCS, scientists or economists there is a large overlap and the sharing of information is important. The MCS organisation could for example improve deployment of inspectors, observers, patrol vessels and planes if seasonal statistics within the different fisheries were shared between the scientific and surveillance personnel. Stock assessment often suffers from a lack of basic data that can often be enhanced by observer, data collectors' or inspectors' information. Economical data such as catch value and market data will give an indication of the financial status the fishing fleet is operating under: the probability of infringements and illegal fisheries generally increases with reduced profit and difficult market situations. The market situation will also influence the fishers' perception of what is fair and not fair in terms of management measures and resource rent and consequently have an impact on voluntary compliance: a difficult situation for the MCS manager but one that a flexible strategy will be able to deal with if adaptive deployment is possible and the information on markets is readily available. There are many more examples, but the important message is that information sharing between the different areas within fisheries management is vital for the optimal development of the fisheries administration and MCS system.

It is not essential to have an electronic system for information management but it is often the ideal choice if the infrastructure and personnel can support it. If it is opted for, it is important not to become too ambitious and to plan the system within the capability of the organisation both financially and in terms of personnel skills; this is especially relevant when the previous systems have been manual. Implementation and the training of personnel to maintain a newly computerised system will take time and a sensible approach is to design and implement a phased system with one or two aspects of the system being implemented at a time, with integration and linkage occurring later. It is also recommended to adopt a standard software development life cycle even for the development of small systems; information on these is available in any basic reference material for systems development.

4.3 Management system

While the policy level aspects of MCS are normally (and should be) firmly rooted in government, the operational aspects need not be. Conventionally the fisheries management

authority, the navy, the police or the coastguard have been responsible for the operational aspects of MCS systems.

For cost and efficiency reasons, contractually engaged private MCS operators are gaining acceptance; examples include the observer programmes of Canada, US and Australia, air surveillance in Canada, patrol planes and certain coastguard vessels and fisheries protection vessels in Norway. The question to be asked is which functions of the MCS organisation are core functions and which are non-core functions. For example the core functions of designing strategies, fining and arresting violators, interpreting VMS output and observer violation reports are usually kept within the fishery management authority itself. However, why should the MCS organisation train pilots, engineers and have the expenses of operating an aeroplane when all that is needed is 8 hours of air patrol per week? The function of flying the plane is not a core function and it may be more viable to provide a fisheries officer to join a private aeroplane tasked for the required flying time.

This option to outsource or privatise non-core functions is an option that should be explored within the fields of MCS in line with the legislative framework for fisheries. It is often more efficient and more cost-effective to rent necessary services from a private operator and thus to remove the burden of maintenance and training of technical personnel and equipment maintenance from the core organisation.

5. ENSURING SYSTEM PERFORMANCE

Measuring performance of the MCS system against the strategic targets should be an annual activity of the MCS organisation and it should involve feed-back from involved interested parties. It is a fact that the perfect MCS system with 100% compliance does not exist. It is therefore imperative to explore what level of compliance is required when a MCS strategy is developed and to compare this to the actual level of compliance being achieved. These actions will also encourage the scientists to use these parameters as a part of their calculations for stock assessment. The definition of the level of compliance required will depend on two main points; an evaluation of the risk related to the sustainability of the stock on the lower limit, and an evaluation of the cost factor for the upper limit.

5.1 Assessing MCS performance

MCS performance is not measured by the number of arrests or prosecutions (legal actions) as this does not reflect the level of compliance, which is the true measure of a successful MCS system. The most practical way to estimate compliance is to compare the number of detected infringements in relation to the percentage of the population being sampled (vessels, fishers, gears etc). The number of infringements can then be raised to the estimated number in the entire population that is being sampled on a monthly, seasonal or annual basis. The resultant estimate may not be completely accurate for many reasons but it does give a reasonable estimate of the level of compliance for a given management measure and can be compared both to the target and across time as a trend for changes in compliance.

An important factor to remember is that a high level of compliance or an improvement in compliance over time is a better measure of success in the system than a higher number of detected infringements. However, assessing the number of apprehensions or convictions, the number of observer sea days and fish sampled or the number of inspections and patrols will also provide details and statistics on the effort exerted in the MCS system that are also important for annual planning and control.

The following questions should be frequently asked to assist in measuring the effectiveness of the MCS system.

- What are the goals and objectives of compliance in the different fisheries?
- What were the expectations of the system?
- Are all MCS strategies implemented in an effective and efficient way?
- Are there changes in the fishing fleet or within certain fisheries that are not covered under the present MCS operations?
- Is there new technology or other means that can improve the MCS system?
- Do the fishers accept and comply with the fisheries legislation (if not find out why)?
- Are the staff performing as expected (if not find out why – it could be lack of resources, management skills, training, support)?

If these questions are regularly considered and analysed they will give some indication of the optimal levels of performance aimed for and the answers may help in accessing the best way to achieve the required outputs. Performance is assessed against the original objectives, and these will be a reflection of the overall fishery management objectives and the contribution of the MCS system towards these must be considered.

5.2 Cost analysis

The chances of detecting violations of fisheries regulations are directly related to the amount of resources used for monitoring and surveillance, and how efficiently these resources are used. Therefore cost-benefit analysis is required and this is closely linked to the assessment of performance. An increased level of compliance should be related to either an increased income to the State or decreased biological risk (which ultimately will be a financial gain to the State). The desired level of compliance will to a large extent determine the cost or visa versa. This is again related to the type of fishery, state of the stock, the value of the fishery and geographical considerations (e.g. number of landing sites, sea conditions, number of ports etc.).

Cost analysis in relation to performance must be prepared both historically and for the future. Essential questions are whether the resources applied are giving the desired results and if other components would achieve better results within the financial framework. This must particularly be kept in mind when costly hardware is considered: a new and larger patrol vessel will normally have a life cycle of 20-30 years with annual cost implications. Cheaper solutions like leasing a vessel or using observers may be a more sensible solution if the future of the fishery is uncertain.

6. CONCLUSION

MCS has historically often been perceived as a somewhat isolated element of fisheries management dealing primarily with the enforcement of legislation. This chapter has revealed that MCS in fact relates to all of the activities performed by a fisheries management authority in relation to the actual fishing operations. Setting effective fishery management strategies requires an integrated approach with a full understanding of the needs and constraints of the management system including those that an MCS organisation has in implementing the management measures. On the other hand the MCS organisation must understand the principles of fisheries management to be able to carry out their operations and in order to contribute useful information to the management process. Old barriers between the different components of fisheries management have to be removed to create a successful integrated fisheries management regime.

MCS is not intended to be a policing function where fishers are treated as criminals. The prime function of MCS is to increase compliance to agreed management measures by increasing

deterrence and voluntary compliance and thus decreasing violations. A strategic balance between the two aspects of deterrence (or enforcement) and voluntary compliance should be achieved for each fishery. Participatory management involving fishers and other interested parties is seen as a key tool required by all fisheries (artisanal, small-scale and commercial) in order to ensure an increase in compliance.

Many MCS solutions exist for a given fishery: selecting and compiling the components in the most cost-effective manner is not an easy task. The value of cross verification and achieving a balance between the different dimensions (before fishing, while fishing, during landing and post landings) has been introduced as an important element to consider when designing the MCS solution. This will not only provide the organisation with several different sources of information but also increase the overview of the fishing sector both from an information and deterrence point of view. The desired and expected level of compliance, the value of the fishery and the state of the stock(s) are all important factors that help the fishery manager to establish priorities to assist in allocating the MCS resources between components.

Large complicated fisheries often demand complex MCS solutions: these can often be assisted through simple limitations in terms of vessel marking, transshipment and landing sites. These options and more have been introduced to the fishery manager in order to assist in the facilitation for MCS, while, low cost and low technological options have been introduced for artisanal and small-scale fisheries with limited human or financial resources.

Finally, every MCS system requires regular assessment in order to ascertain if it is achieving the strategic targets in the most cost effective and efficient manner. This chapter has described the key element of assessing system performance to be a comparison of the levels of compliance over time and against the targets set out in the MCS strategy for given management measures. It is suggested that an improvement in compliance over time is the indication of a successful MCS organisation and system.

7. RECOMMENDED READING

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