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A SATELLITE-BASED VESSEL MONITORING SYSTEM (VMS) FOR IATTC PARTIES

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1. BACKGROUND

The Inter-American Tropical Tuna Commission (IATTC), considering the recommendations of the Permanent Working Group on Compliance, approved a Resolution on Compliance during its 66th meeting in June 2000. In this resolution, the Parties asked the staff to study the potential of vessel-monitoring systems (VMS) for use by the Parties and to present its analysis to the Commission for consideration. The potential of these systems for research purposes was discussed at the 1st Meeting of the Scientific Working Group in April 2000, and they have also been discussed at Commission meetings, particularly in regard to compliance with management and conservation measures.

This document offers an overview of how satellite-based VMS works, describes systems currently in use (or soon to be implemented), with emphasis on those being implemented by states and regional fisheries organizations with interests in the Pacific Ocean, and discusses issues regarding implementation of such a system for IATTC Parties.

2. SATELLITE-BASED VESSEL MONITORING SYSTEMS

A satellite-based VMS involves the monitoring of vessels for the main purpose of determining their locations, usually for management reasons (*i.e.* to monitor compliance with time and area closures). An automatic location communicator (ALC) installed on the vessel and integrated with the global positioning system (GPS) automatically transmits, at certain intervals, a signal with position and other information to a satellite. Currently, the main satellite systems used for this purpose are Inmarsat and Argos. This information is relayed to a fishery-monitoring center (FMC), where a variety of software tools are used for mapping, statistical analyses, querying and archiving of data.

In addition to identification and location data, other information, such as catch reports, can be transmitted. Technology is or soon will be available to transmit automatically-generated evidence that a vessel is engaged in fishing. Onboard sensors could, for example, indicate the vessel's speed and direction, and information on the operation of the engines or the hydraulic boom used for fishing. Sensors can also be used to transmit information valuable to fisheries research, such as sea-surface temperature and salinity. Integrating all this information with data obtained by other means (satellite remote sensing (SRS), catch data, modeling and observer programs) can create a powerful tool for enhancing not only compliance, but also fisheries research and management.

A VMS is a particularly good monitoring and enforcement tool for international fisheries regimes. The FAO has stated that VMS allow the efficient and inexpensive monitoring of industrial fishing fleets, because they provide immediate access to vessel location, details of its activities, and near real-time transmission of important catch data to verify status of quotas and information necessary for fisheries management.

VMS can also lead to improved safety for vessels and crews, and permit the real-time transfer of market information, which can result in significant revenue gains since decisions regarding port delivery or the species to which effort should be directed can be made while the vessel is at sea.

3. VMS PRESENTLY IN OPERATION

This section reviews some of the VMS currently in use by IATTC Parties or participating governments and by relevant regional fisheries management organizations, as well as other states with interests in tuna fishing in the Eastern Pacific Ocean.

3.1 National and regional VMS

European Union (EU). In 1992 the European Commission decided that member states of the EU were to carry out pilot projects with VMS, to be funded by the EU. The positive results from the pilot projects, carried out in 1994 and 1995, led to a series of regulations that require all vessels of length over 20 m between perpendiculars or 24 m overall registered in or flying the flag of an EU member state to install ALCs, beginning January 1, 2000. The standard procedure is for information to be transmitted to both the flag state and the coastal state in whose waters the vessel is fishing. The EU has concluded bilateral agreements with several countries especially devoted to VMS implementation.

France. In May 2000, a FMC opened in Etel, France, that receives data from three systems (Inmarsat, Argos and Euteltrac) and is capable of tracking over 1000 French and EU vessels in French waters. The FMC is linked to other centers in Europe.

Honduras. Installation of an Argos ALC on board every vessel operating on the high seas under Honduran flag is mandatory, according to a Resolution dated March 2001. A FMC was inaugurated late in 1999.

Japan. The VMS operated by Japan has been developed largely within the framework of negotiation of access agreements. Tuna longliners fishing within the Exclusive Economic Zone (EEZ) of South Africa and high-seas trawlers in the EEZ of the Russian Federation are required to carry an Argos ALC. No satellite-based VMS is used in the maritime zones of Japan. There is a FMC in Tokyo that monitors about 200 vessels in several fisheries.

Republic of Korea. The Korean Ministry of Fisheries has a Argos FMC to monitor vessels in the Pacific and in the vicinity of the Russian Federation and Antarctica. About 250 vessels use Argos ALCs, and are monitored while they fish in the EEZs of countries with which Korea has fishing agreements, including, in the Pacific, the Federated States of Micronesia, French Polynesia, Kiribati, and Peru.

Mexico. An experimental VMS based on a combination of satellite and cellular telephone technology was implemented during 2000, showing that the system could work well in both nearshore and offshore areas. A voluntary VMS project involving the swordfish fishery began in 2000.

Panama. In 1999 Panama decided to monitor domestic and foreign vessels with a VMS, and a FMC became operational late that year. The system, which uses Argos ALCs, covers over 100 vessels.

Peru. In 1993 Peru decided to use an Argos VMS to monitor about 100 foreign vessels fishing under license in Peruvian waters. The system was later expanded to include domestic vessels. A FMC in Lima became fully operational in 1999. There are currently about 800 vessels with ALCs, and there are plans to include 200 smaller vessels. This is one of the largest operational VMS system in the world to date. The types of vessels covered are purse seiners of more than 32.6 m^3 carrying capacity, trawlers and longliners, but large purse-seine vessels have recently been excluded from the VMS requirement. While the focus of the VMS is on compliance by verifying positions, other types of data, such as catch reports, sea-surface temperatures and salinity, are collected.

Spain. An FMC became operational in August 1999. Three types of ALCs using Inmarsat were certified

for installation aboard more than 1800 vessels worldwide. The Spanish government reimburses vessel owners for the costs of purchase and installation of the ALC.

Taiwan. About 60 vessels are fitted with Argos ALCs.

United States. In 1995 the United States began an experimental VMS for Hawaii-based longliners for a management scheme linked to closed areas. The other major fisheries with operational VMS are the Atlantic sea scallop fishery and the mackerel and pollock fisheries in Alaska. The system uses the Inmarsat, Argos and Boatracs services to track about 550 vessels, and it has a future potential of 1500 vessels. In 1999 several VMS equipment providers were approved for use by pelagic longline vessels in the Atlantic fisheries for highly-migratory species, particularly northern bluefin tuna. In 2001 and 2002 the US National Marine Fisheries Service (NMFS) reconsidered the scope of this VMS in light of relevant conservation requirements.

Other countries. Several states, including Argentina, Australia, Canada, Chile, French Polynesia, Iceland, Kiribati, Malaysia, Maldives, New Zealand, Norway, Seychelles and South Africa have VMS in various operational stages. Others, such as El Salvador, Guatemala and Nicaragua, have expressed interest in developing VMS.

3.2 VMS in regional management fisheries organizations

Forum Fisheries Agency (FFA). The FFA Convention requires vessels to provide appropriate information on catch and effort relating to fishing in a member's waters or conducted under the jurisdiction of a member. In October 1999, the FFA agreed to implement a VMS program fully within two years.

FFA members may not license any vessel to fish unless it is included in the FFA VMS Regional Register of Foreign Fishing Vessels. To be included in the Register, fishing vessels are required to have an FFA-approved ALC aboard, and any vessel that fails to comply has its license to fish in FFA waters revoked or suspended. The VMS, which uses the Inmarsat service, is managed centrally from Honiara, Solomon Islands, and the data are distributed to member countries as necessary for monitoring, control and surveillance.

The FFA has detailed requirements for ALC equipment and use: it must be reliable and not prone to breakdowns at sea, and must be capable of sending position reports continuously and automatically. The format of data sent must be highly stable and incapable of being changed without prior consent of the FFA. Vessel owners are responsible for the purchase, installation, maintenance and operation of the ALCs. Vessel captains must notify the FFA immediately if the ALC is removed or does not work properly. If an ALC fails to transmit, the FFA may request that the vessel proceed immediately to a designated port for inspection.

The FFA contracts with a private company to provide the land-based infrastructure for receiving, processing and forwarding data obtained via the VMS. The FFA also works closely with the ALC manufacturers to ensure that the equipment meets specifications and is installed correctly. The FFA has detailed installation standards and requirements for ALCs to ensure that they operate correctly and cannot be tampered with. For example, authorized agents of the manufacturer must install the ALC, and the requirements of Inmarsat, various safety authorities, and the FFA must be observed.

All FFA member states have enacted legislation to implement the FFA VMS or are in process of doing so. These regulations cover common issues, such as provisions for the coastal state's ownership of all VMS data generated in its maritime zones and the confidentiality of VMS data, including the circumstances in which such information can be released. The rate of implementation of the VMS differs among FFA member states; the FFA VMS Register currently includes about 100 vessels.

International Commission for the Conservation of Atlantic Tunas (ICCAT). In 1997 ICCAT adopted a resolution and a recommendation to encourage the use of VMS and to initiate a pilot VMS

program. Parties with vessels greater that 24 meters in length fishing for species of concern to ICCAT outside the jurisdiction of any coastal state "shall adopt a pilot program for a satellite-based vessel-monitoring system (VMS) for ten percent of such vessels, or ten vessels, whichever is greater", not including vessels whose fishing trips last less than 24 hours.

The data transmitted by the VMS must include the vessel's identification and location and the date and time. As with other VMS, the system must be tamper-proof, fully automatic and operational at all times, regardless of environmental conditions, provide real-time data and provide a position accuracy of 500 meters or better.

The flag state determines the format of the data and submits annual reports on the implementation of its pilot program for ICCAT´s annual report. ICCAT established procedures for submitting information, sharing data and ensuring confidentiality at its 2000 meeting, and will evaluate the program at its 2002 meeting.

Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (MHLC Convention). The MHLC (Multilateral High Level Conference) convention includes explicit VMS requirements in its text. According to Article 10(1)(i), the MHLC Commission "shall … establish appropriate cooperative mechanisms for effective monitoring, control, surveillance and enforcement, including a vessel monitoring system." This program will require the use of VMS: each member state must require its fishing vessels to use near real-time satellite position-fixing transmitters while in the Convention Area and in areas under the jurisdiction of another member. The Commission will receive the information directly from a vessel's ALC, and the flag state may receive this information simultaneously if it chooses.

The Commission will establish the standards, specifications and procedures for the use of ALCs, and operate the VMS program for all vessels that fish for highly-migratory fish stocks on the high seas in the Convention Area. Any member of the Commission may request that waters under its national jurisdiction be included within the area covered by such VMS. The members of the Commission are required to cooperate to ensure compatibility between national and high-seas VMS.

Other Agreements. VMS has been implemented or recommended by several other regional bodies and arrangements, including the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Central Bering Sea Convention, the International Whaling Commission (IWC), the Northwest Atlantic Fisheries Organization (NAFO), the North East Atlantic Fisheries Commission (NEAFC), and the U.N. Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks.

4. POSSIBLE APPLICATIONS OF VMS BY IATTC PARTIES

Currently the IATTC obtains information for research and monitoring purposes from observers on large purse seiners, from vessel logbooks for the surface fleet and locally-based longline vessels, and from government sources for the rest of the fleet. Observers currently provide weekly reports on catches and dolphin mortality, but to date the reporting rate has been low. Reporting of catch data by distant-water longline vessels using current systems is slow.

The IATTC could adopt the use of a VMS to improve both monitoring and research data. VMS would complement the observer reports, and provide a means of real-time reporting for the other sectors of the fleet. This would be particularly valuable for the large longline vessels, mostly from Asian countries, for which catch data are not available until long after the fish are caught.

5. ISSUES FOR VMS IMPLEMENTATION BY IATTC PARTIES

If the IATTC decides to adopt a VMS, there are several issues that would have to be considered to ensure successful implementation.

5.1. Objective

Deciding the purposes of a VMS in the IATTC Convention Area is essential for implementation. Whether a VMS would be used for ensuring compliance, for data gathering and research, or both, must be determined if the VMS is to be integrated appropriately within the framework of fisheries management. Monitoring of compliance could be achieved with an ALC capable of transmitting only vessel location, speed, heading and identification in near-real time. However, other kinds of data could be transmitted, either automatically or manually: for example, oceanographic data (sea-surface temperature, salinity, oxygen levels and other variables) and fisheries information (fishing mode, catch data, size and species composition, and even biomass, via acoustics). In addition, data resulting from various duties carried out by observers could be transmitted securely through a VMS.

5.2 Operational requirements

Once the objective of the VMS has been determined, several operational requirements must be specified. General specifications for a VMS for compliance purposes are that it be:

- tamper-proof;
- fully automatic and operational at all times and in all environmental conditions;
- capable of providing real-time data;
- capable of providing the geographical position of the vessel;
- capable of providing special messages when the vessel enters or leaves the Convention Area and when it moves from a certain area within the Convention Area to another;
- preferably capable of providing two-way communication.

To ensure compatibility, it would be advisable to have a certification process for the different system components. Several countries and regional organizations have such a process, and their experiences could offer guidelines on this matter. The objective of such a process would be to have a small number of commercial brands approved for each component, from which the industry could choose.

Satellite system. There are two commonly-used systems, Inmarsat and Argos. There are also regional services, Euteltrac and Boatracs, for Europe and the United States, respectively. There are also several communication networks, such as NACLS, Station 12 and COMSAT, that could be used.

ALC type and requirements. Recent programs, such as the one implemented by the United States for the Atlantic longline fishery, have detailed specifications for approved ALCs. The FFA has also detailed technical guidelines on ALC features and installation procedures.

Technical guidelines for ALCs must include both functional (data handling) and physical (ruggedness, power supply and others) characteristics and detailed specifications for hardware, communications, installation and service activation, operation, interruption and repair and replacement. The most common type of ALC among countries with fishing interests in the eastern Pacific seems to be Argonet, which connects directly to the GPS unit aboard most vessels.

Fishery Monitoring Center. There is a variety of technical solutions for an FMC, ranging from dedicated hardware and software to geographic information systems (GIS) or simpler "off the shelf" mapping software, depending on the expected number of monitored vessels. Keeping track of over 100 vessels can become quite involved, and in most cases would necessitate specially-designed or adapted hardware and software. Argos has installed several centers, and mapping software such as *Absolute*, *Trackwell* and *Racal* has been developed for VMS.

Scope of the VMS program. There are two important issues in this regard: one is the type of tuna vessel to be covered by the VMS, and the other is how the data would be transmitted and handled. Several

combinations are possible: the data could be transmitted first from the vessel to the coastal country's FMC, from there to the IATTC, and finally to the flag country. Alternatively, they could be transmitted to both the flag and the coastal countries, and from there to the IATTC, or first to the IATTC directly, and from there to both countries. There are several advantages to each of these combinations of communication modes. However, if the IATTC decides to establish a FMC, the cost and complexity of the program would increase considerably. A more practical solution seems to be for each country to develop it own VMS, and for information to be transmitted to the IATTC staff for research use, and, if so decided, for coordinated monitoring.

5.3 Implementation

Phased implementation. ICCAT recommended a pilot program in which 10% of vessels would be required to use VMS. However, a phased implementation scheme, in which all vessels, possibly grouped by size and type, would be required to use VMS has been discussed. Again, there are advantages to both approaches, but 100% coverage seems to be the more appropriate and consistent approach for IATTC Parties.

A two-year implementation schedule would give the Parties enough time to develop their VMS, including the determination of appropriate technical specifications for the different VMS components, an installation schedule and the establishment of FMCs.

Confidentiality. If the IATTC wished to use a VMS for monitoring and compliance purposes it would also be necessary to decide to what extent the information generated would be shared. Security of information is essential for the success of a satellite-based VMS. The possibility of non-participating competitors obtaining near real-time location and/or catch data will affect the acceptance of VMS and, once it is in operation, may affect compliance and cooperation. Confidentiality and security risks would, in general, increase with the number of Parties sharing VMS information, and appropriate measures would have to be taken to address these risks. The risks exist in every phase of transmission, and all those involved, fisheries management agencies and companies alike, will have to exercise the utmost care in this respect.

Legal Framework. The legal framework should be consistent among Parties, and should consider the issues of who owns the data, and who could obtain what kind of information. In many countries the legal involvement of the navy and other government agencies would also need to be considered. For example, the US NMFS recently won a conviction using VMS data as evidence admissible in a court of law.

Cost. The cost of purchasing and installing an ALC depends on the transmitter and its characteristics, but is usually about US$3,500. The satellite communication system costs approximately US$225 per ALC per year, although a long-term contract with the satellite companies could be sought, as the United States did with ArgoNet/NACLS for its Atlantic longline VMS. Both of these costs could be borne by the industry, or a scheme of cost sharing could be implemented. The operation of the FMC involves the purchase of several computers and mapping software and the training of dedicated personnel, so the cost associated with the FMC is higher. The exact cost would depend largely on the number of vessels monitored simultaneously and on the detail of the information to be analyzed.