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

1. Background	1
2. Satellite-based vessel monitoring systems	1
3. VMS presently in operation.....	2
4. VMS implementation by IATTC.....	5

1. BACKGROUND

The 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 Director 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, most recently at the 3rd meeting of the Working Group on Compliance and the 69th meeting of the IATTC in June 2002. VMS was also discussed in February 2003 at the 25th session of the FAO Committee on Fisheries on the topic of making monitoring, control and surveillance of fishing vessels more effective.

The document presented at the 69th meeting of the Commission has been modified to take into account the discussions at recent meetings. 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 with interests in the Pacific Ocean and regional fisheries organizations akin to the Commission, and considers implementation of such a system by the IATTC.

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 (new satellites with greater bandwidth and increased transmission speed) that makes it possible to transmit automatically-generated evidence that a vessel is engaged in fishing is fast becoming cost-effective. Onboard sensors can, 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 video-quality images, 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) creates 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 it provides immediate access to vessel location, details of its activities, and near real-time transmission of important catch data (electronic logbooks) to verify status of quotas and information necessary for fisheries management.

The advantages of VMS in terms of crew safety and improved general communications should not be underestimated. VMS has led to improved safety for vessels, and permits the real-time transfer (both from and to the vessel) of market and oceanographic 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 offers examples of VMS in use by relevant regional fisheries management organizations and by IATTC Parties or participating governments as well as other states with interests in tuna fishing in the Eastern Pacific Ocean.

3.1.VMS in regional management fisheries organizations

International Commission for the Conservation of Atlantic Tunas (ICCAT). In 1997 ICCAT adopted a recommendation (Appendix A) to promote the use of VMS and to initiate a three-year pilot VMS program. Parties with vessels greater than 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. 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.

Indian Ocean Tuna Commission (IOTC). In 2002 the IOTC adopted a resolution regarding the establishment of a vessel monitoring system (Appendix B). A flag-state based two-year pilot program is to be implemented by July 2003. The technical specifications of the program are similar to the one implemented by the ICCAT, including the assurance of transmission of the information in case the transmitter malfunctions, and the annual report to the IOTC, and will be evaluated by the Commission at its meeting in 2005, with a view to establish a comprehensive VMS program.

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.

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.

3.2.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, and is considering the use of SRS in conjunction with VMS.

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. A small-scale 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 was carried out during 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. Although implementation and legal problems have arisen, this is one of the largest operational VMS system in the world. The types of vessels covered are purse seiners of more than 32.6 m³ 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 cod, 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, Bermuda, Canada, Chile, China, French Polynesia, Iceland, Indonesia, Kiribati, Malaysia, New Zealand, Norway, Portugal, and South Africa have VMS in various operational stages. Others, such as El Salvador, Guatemala and Nicaragua, have expressed interest in developing VMS.

4. VMS IMPLEMENTATION BY IATTC

4.1.Objective

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 the reporting rate has been low. Reporting of catch data by distant-water longline vessels using current systems is slow, with a time lag of one to several years.

The IATTC could adopt the use of a VMS to improve both monitoring and research data. VMS would provide vessel position data, 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.

Several 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.

4.2.Operational requirements

The operational requirements of most VMS currently in operation are very similar. They include performance requirements that make the VMS equipment tamper-proof, fully automatic for location data, operational at all times regardless of environmental conditions and capable of manual transmission of reports, messages and other data. Position data usually transmitted include coded vessel information, location (with an error of less than 500m at a confidence level of 99%), and date and time. Latitude and longitude are typically collected every 6 hours. The resolutions of both ICCAT and IOTC include these requirements, as do the FFA programs.

Since many countries with tuna fishing interests in the eastern Pacific Ocean already have operational VMS or have expressed interest in developing such a system, most VMS technical details are not described here, as they are readily available elsewhere. At a minimum, technical decisions should be made regarding the satellite system to be used, the ALC type and requirements (both physical and functional), the nature of the FMC and the scope of the program (i.e. type of vessels included and data to be transmitted).

4.3.Implementation

A practical VMS solution for the IATTC may be a flag-state based program, with Commission participation. Under such a program each country develops and controls its own VMS, and arrangements are made for information to be transmitted to the Commission staff for research use, and, if so decided, for

coordinated monitoring. An initial IATTC VMS program would involve transmission of vessel position information, as well as the data required for the weekly at-sea report. Each country would present an annual report on its system to the Commission.

ICCAT and IOTC are carrying out similar pilot programs in which 10% of vessels are required to use VMS. However, phased implementation schemes, in which all vessels, possibly grouped by size and type, would be required to use VMS, have been discussed. There are advantages to both approaches, but 10% coverage seems at this point to be the more appropriate and consistent starting approach for the IATTC.

A two-year schedule for evaluation and 100% implementation would give IATTC Parties that do not currently have VMS enough time to develop their system, including the determination of appropriate technical specifications for the different VMS components, and the establishment of fully functional FMCs. This schedule would also permit the consideration of a consistent legal framework among Parties for compliance purposes.

Appendix A.

RECOMMENDATION 97-12
VESSEL MONITORING SYSTEM PILOT PROGRAM

TITLE: *Recommendation by ICCAT Concerning a Vessel Monitoring System Pilot Program*

(Entered into force: June 13, 1998)

RECOGNIZING the developments in satellite-based vessel monitoring systems (VMS), and the possible utility within ICCAT;

THE INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS
(ICCAT) RECOMMENDS THAT:

1. Each Contracting Party with vessels greater than 24 meters in overall length (or greater than 20 meters between perpendiculars) and fishing for ICCAT species on the high seas outside the fisheries 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. The pilot program will be a flag-state based program.
2. Each Contracting Party shall implement a three-year pilot program effective 1 January, 1999; except the three-year pilot program for vessels fishing in the Mediterranean, which shall be effective 1 January, 2000. Contracting Parties are encouraged to implement the pilot program earlier, if possible.
3. The pilot program shall not apply to vessels that never spend more than 24 hours at sea, counted from the time of departure from port to the time of return to port.
4. Information collected shall include the vessel identifier, location, date and time, which shall be collected with a required frequency to ensure that the Contracting Party can effectively monitor the vessel.
5. Performance standards shall at a minimum include a system that:
 - is tamper proof;
 - is fully automatic and operational at all times regardless of environmental conditions;
 - provides real time data; and
 - provides latitude and longitude, with a position accuracy of 500 m. or better, with the format to be determined by the flag state.
6. At its meeting in the year 2000, the Commission shall establish procedures on the submission of aggregate information and how the information is shared between Contracting Parties. These procedures shall ensure that appropriate measures are in place to ensure confidentiality.
7. By 1 June 1998, each Contracting Party shall submit to the Secretariat a report on anticipated implementation of its pilot program. Beginning in 1999, each Contracting Party shall report annually on the progress and implementation of its pilot VMS program. These reports shall be included in the annual national report.
8. The Commission shall evaluate the pilot program at its meeting in 2002.

Appendix B.

Resolution 02/02

RELATING TO THE ESTABLISHMENT OF A VESSEL MONITORING SYSTEM PILOT PROGRAMME

Adopted during the Seventh Session of the Commission, in 2002

The Indian Ocean Tuna Commission (IOTC),

Recognizing the developments in satellite-based vessel monitoring system (VMS), and the possible utility within IOTC

Taking note of the results of the Intersessional Meeting on an Integrated Control and inspection scheme, held in Yaizu, Japan, from 27 to 29 March, 2001

Taking note that it was agreed that Vessel Monitoring Systems are a valuable element to assure the monitoring of tuna fisheries activities; that nevertheless, it is necessary to incorporate these systems progressively to allow all Contracting Parties to implement this systems at national level;

Resolves in accordance with the provisions of Article IX.1 of the Agreement creating the IOTC, that:

1. Each Contracting Party and Cooperating Non Contracting Party with vessels greater than 24 metres in overall length (or greater than 20 metres between perpendiculars) and fishing for IOTC species on the high seas outside the fisheries jurisdiction of any coastal state shall adopt a pilot programme for a satellite-based vessel monitoring system (VMS) for ten percent of such vessels. Those Contracting Parties and Cooperating Non-Contracting Parties with less than ten vessels shall ensure the participation of at least one vessel. The pilot programme will be a flag-state based programme.
2. Each Contracting Party and Cooperating Non Contracting Party shall implement a two-year pilot programme effective 1 July, 2003. Contracting Parties and Cooperating Non Contracting Parties are encouraged to implement the pilot programme earlier, if possible. Exceptionally, Contracting Parties and Cooperating Non Contracting Parties may defer the introduction of the system to 1st January 2004.
3. Information collected shall include:
 - the vessel identification,
 - the most recent geographical position of the vessel (longitude, latitude) with a position error which shall be less than 500 metres, at a confidence level of 99%, and
 - the date and time of the fixing of the said position of the vessel.
4. Each Contracting Party and Cooperating non-Contracting Party shall take the necessary measures to ensure that their land-based national Fisheries Monitoring Center (FMC) receives through the VMS the messages requested in paragraph 3
5. Each Contracting Party and Cooperating non-Contracting Party shall ensure that the masters of fishing vessels flying its flag ensure that the satellite tracking device are at all times fully operational and that the information in paragraph 3 is transmitted, preferably once every 6 hours.
6. Each Contracting Party and Cooperating non-Contracting Party shall ensure that a fishing vessel with a defective satellite tracking device shall communicate, at least daily, reports containing the information requested in paragraph 3 to the FMC by other means of communication (radio, telefax or telex).
7. Each Contracting Party and Cooperating non-Contracting Party shall report annually to the Commission on the progress and implementation of its pilot VMS programme or VMS programme.
8. The Commission shall evaluate the pilot programme at its meeting in 2005, with a view to establishing

a comprehensive VMS programme.