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RESOURCES
DIRECTION FOR ENVIRONMENTAL LICENSING AND QUALITY
GENERAL LICENSING COORDINATION
OFFICE FOR LICENSING OIL AND NUCLEAR ACTIVITIES

GUIDE FOR MONITORING
MARINE BIOTA DURING SEISMIC DATA ACQUISITION ACTIVITIES
(APRIL 2005)

LICENSING STAFF OF ACTIVITY FOR ACQUISITION OF MARITIME AND TRANSITION
ZONE SEISMIC DATA

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1. INTRODUCTION

This guide has the main purpose of establishing guidelines for procedures to, in addition to establishing temporary restriction areas, minimize the impacts from the activity for acquisition of seismic data of the marine biota, particularly the maritime mammalian and chelonian.

Another purpose is to standardize the procedure for monitoring the biota in order to obtain information (i) to provide subsidies for the assessment of the efficacy of the adopted control measures, (ii) allow checking any potential behavior impacts (see Technical Information ELPN/IBAMA in 12/03) and, (iii) to serve as input for creating the data base about the interaction of the seismic survey with the marine biota. As additional product, we understand that we may generate relevant information for the knowledge of the biology of these animals, thus providing subsidies for the conservation of the maritime mammalian and chelonian.

It is important to mention that this guide is only about the monitoring of the biota conducted on board of the seismic vessel. Depending on the location of the seismic survey, other projects may be required for monitoring and mitigation such as, for example, beach monitoring.

The production of this document used as starting point the guidelines adopted in other countries, such as for example the United Kingdom and the USA, which were assessed and adapted to the Brazilian conditions based upon the experience of IBAMA for licensing the seismic activities and marine fauna conservation.

This is the first version for the *Guide for Monitoring*. We expect to improve it based upon the experience from its application and the contribution of the other interested parties. Suggestions and questions about the application may be forwarded to ELPN/IBAMA, in the e-mail elpn.sismica.rj@ibama.gov.br or by the telephone 21 2506-1727.

1.1. Terms

In order to facilitate understanding the procedures described in the Guide, we present as follows the definition of some terms used in this document:

Safety area: area formed by a 500 m radius with origin in the center of the air gun array. This is the limit where the air guns shall be turned off in case a marine mammalian or chelonian is seen during the normal operation situation.

Warning area: area formed by a 1000 m radius with origin in the center of the air gun array except for the safety area. This works as a restriction for starting the shots and to alert those responsible for the operation about the possible request for air gun stopping.

Gradual increase: procedure for gradual increase of the seismic pulse power. This procedure is known, in the area language, as *soft start* or *ramp up*.

On board observer: professional dedicated to the observation of the marine biota during the activity for acquisition of marine seismic data. He/she shall have experience or specific training for the observation of aquatic mammalian.

On board observation: standard procedure adopted by the on board observer for monitoring the biota during the activities for acquisition of seismic data.

2. GENERAL PRECAUTIONS FOR REDUCING DISTURBANCES DURING SEISMIC DATA ACQUISITION

2.1. Acquisition Planning

- Consult the available scientific literature and the most recent version of the Guide for Environmental Licensing of the Activities for Oil and Natural Gas Exploitation

(<http://www.ibama.gov.br/licenciamento>) about the areas of occurrence and restriction for marine mammalian and chelonian;

- Plan the activity in order to avoid overlapping the reproduction periods and areas of marine mammalian and chelonian, particularly marine turtles and humpback whales (*Megaptera novaeangliae*) and right whales (*Eubalaena australis*);
- Use qualified and experienced on board observers (see item 3.1);
- Use seismic arrays with the lowest possible power.

2.2. During the acquisition

- Assure the correct application of the procedure for gradual power increase of the air guns (*soft start*) (see item 3.2);
- Do not conduct shooting beyond the necessary for the normal operation, for example, out of the seismic lines;
- Assure that the On Board Observers have effective communication channels with those responsible for the operation, in order to request the immediate cessation of the airgun array(s) whenever necessary. Thus, the On Board Observers shall be clearly consulted 30 minutes before beginning the *soft start* procedure, in order to check the possibility for activating an airgun. Notice that the shooting shall only start, even with the gradual increase procedure, after a period of 30 minutes without seeing any maritime mammalian or chelonian in the safety area and in the warning area, i.e., less than 1000 meters for the center of the air gun array.

3. SPECIFIC PROCEDURES

3.1. Observation of marine biota

The On Board Observers shall have attested experience in the area for observation of maritime mammalian or updated specific training provided by a specialized institution and their work shall be concentrated, exclusively, in monitoring the biota.

The On Board Observers shall be identified at IBAMA before each survey.

The Observers shall report directly to ELPN/IBAMA, without the interference of the entrepreneur. For this, at the end of each acquisition (*survey*), all the used monitoring tables (original and digital media) shall be forwarded by the on board observers directly to Ibama. They shall be forwarded by an official document and shall not exceed the term of 5 working days from the end of the acquisition.

The entrepreneur shall make available to the On Board Observers all the material necessary for conducting their work, such as binoculars, cameras and others.

The following procedures shall be adopted in order to standardize the observation and assure the efficacy of the sighting effort:

- Each seismic vessel shall be provided with, minimum, three (3) on board observers so that at least two (2) may divide simultaneously the visual field in two parts, and thus, cover not only the safety area, but also the warning area (Figure 1).
- During the rest and feeding periods, a shift system shall be adopted, in order to have at least two On board observers active in monitoring.
- The Observers shall be positioned at the high points in the vessel, allowing the largest possible reach and cover for the sighting effort.

- Use binocular with reticule during the day (to allow calculating the distance). In order to calculate the approximate distance from the animal to the ship and to the array, the angle of the animal below the horizon shall be estimated. For this, place the upper reticule in the horizon and count the number and fractions of the reticule to the animal.
- The sighting effort shall start as early as possible, as soon as allowed by the sun light and shall continue without interruptions until the lack of light at the afternoon no longer allows the observation. The monitoring shall be conducted independent of the ship being or not shooting the air guns, such as for example, during the maneuvers for changing line.
- The work shift of the observer shall be in the ratio of 1 hour and 30 minutes of observation to 30 minutes of rest. This shall be changed only if there are cetaceous or chelonian in the area; in this case the observer shall remain in the post for 30 minutes after the last observation, after this the normal work shift shall be restarted.
- Any reason for suspending the sighting effort shall be reported in the Daily Sighting Effort Table (Annex I), in the Notes and comments field.
- Before starting the air gun shooting, the observers shall observe with special attention the safety area and the warning area during, minimum, 30 minutes, in order to assure that no marine mammalian or chelonian is close by.
- During the operation, when seeing any marine mammalian or chelonian in the warning area, the observer shall warn the responsible for the operation to be ready for an eventual need to abort the shooting (Figure 1).

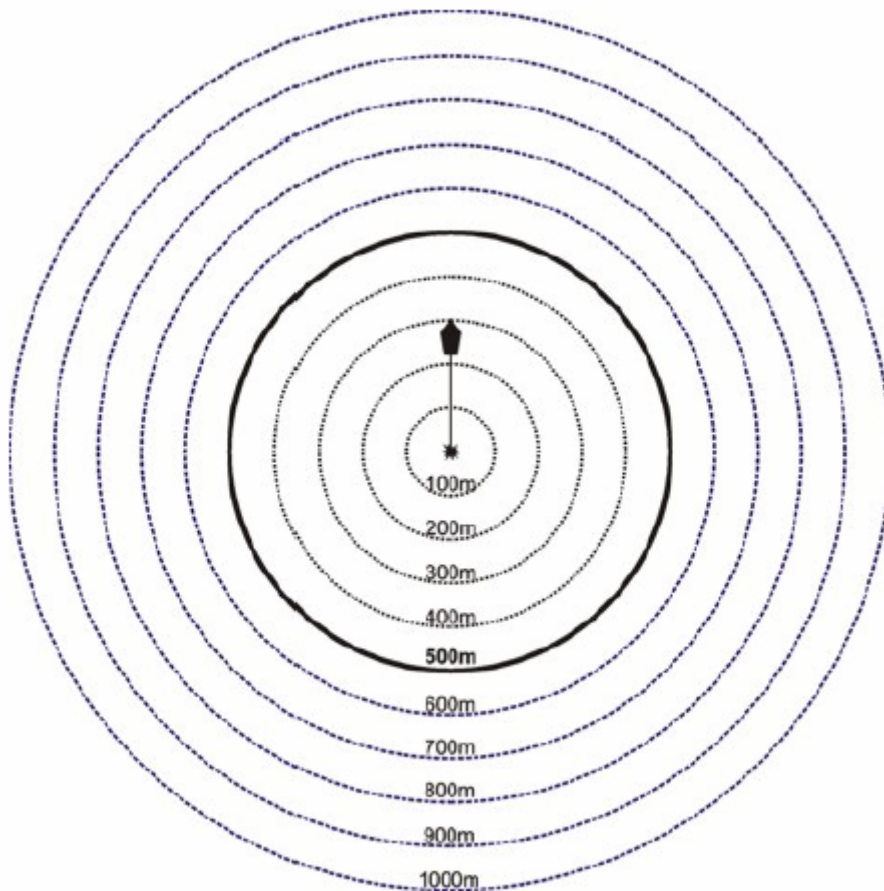


Figure 1 – Biota observation diagram with the representation of: air gun array center (figure center), Safety Area of 500 m and Warning Area between 500 m and 1000 m.

- If the animal comes into the safety area the shooting shall be suspended immediately.
- The procedure for communication between the on board observer and the operation manager shall be clear and simple in order to allow aborting the operation at any time under the command of the on-board observer. There shall be no intermediate procedures that may delay turning off the air guns. Questions and discussions shall happen after stopping the shooting.
- All the observed marine animals shall be recorded, even when they are beyond the warning area.
- All the information shall be collected according to the standard tables (annex) added with all the details considered relevant by the observers.
- The tables shall be completed according to the instructions of item 2.6 – *Instructions for completing the monitoring tables*. Whenever possible, the photographic record of the observations shall be conducted.
- Other animals such as turtles and fishes (schools) may be recorded whenever possible.

3.2. Procedures for gradual increase of the seismic pulse

The gradual increase procedure, internationally known as *soft start* or *ramp up*, shall be used whenever the air guns will start shooting, be it for normal operation or just for testing the guns.

The main idea of the procedure is to start the operation with low intensity shooting in order to provide to the marine organisms with locomotion capacity the opportunity to go away from the noise source.

The On Board Observers shall be consulted 30 minutes before starting the ramp up procedure, to check for the presence of animals in the safety zone and warning zone.

The On Board Observers shall maximize the observation efforts during the 30 minutes before the gradual increase of the seismic pulse. The main steps to be followed during this stage are presented as follows.

- **To Observe** – pay special attention to the observation, minimum, 30 minutes before any shooting;
- **To Postpone** – if maritime mammalian or chelonian are seen within the Warning and Safety Areas, the shooting start shall be postponed until no animals are seen in these areas, for at least 30 minutes.

Note that, in no case, shall be done any attempt to conduct the animals out of the determined perimeter. The operation shall be postponed until the organisms leave the area spontaneously or until 30 minutes without seeing any animals within the Warning and Safety areas. In this case, the ramp up procedure may be restarted.

- **To Ramp Up** – the gradual increase of the intensity of the seismic pulse shall start by shooting the smaller gun of the array, in terms of released acoustic energy (dB) and volume (inch³). Gradually, the other guns shall be started until reaching the total power of the array.

The ramp up procedure shall last at least 20 minutes until reaching maximum power. In order to minimize the emission of sound energy in the maritime environment, the procedure shall not last over 40 minutes.

If, for any reason, the shooting is suspended and does not started for at least 5 minutes, the complete ramp up procedure shall be adopted (i.e. 20 minutes).

3.3. Night operation

Since it is not possible to conduct appropriate visual monitoring of the safety and warning areas during the night, it is not possible to detect the presence of marine mammalian or chelonian next to the seismic source.

Thus, starting the shooting of air guns during the night shall not be allowed, nor under precarious visibility conditions (fog, heavy rain, etc), even using ramp up of the seismic pulse.

If the activity is interrupted, for any reason, during the night period, wait for the morning light in order to allow the observation of the biota during at least 30 minutes before starting shooting, always using ramp up.

Also, if the visibility conditions are precarious (fog, heavy rain, etc), allowing appropriate sighting effort, the restarting of the operation shall be postponed until the conditions improve allowing the visual inspection of the safety and warning areas.

As an alternative mechanism in order to avoid delays in the operation schedule, it will be allowed to continue with low power shooting during the change of line or due to any operation needs. In these cases, the power of the array shall be reduced until the noise level of the source is equivalent to 160 dB re 1 μ Pa-m (*rms*). The return to the operation power shall be accomplished progressively.

3.4. Procedure for changing seismic line

When passing from one seismic acquisition line to another one (Figure 2) the seismic vessel may take some minutes up to some hours, in the case of 3D surveys.

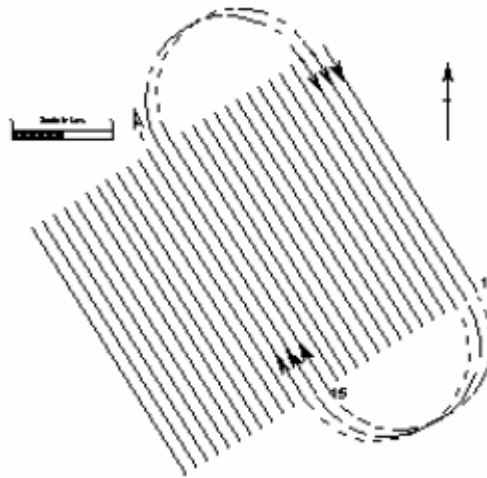


Figure 2 - Procedure adopted for changing seismic line. The parallel lines represent the seismic data acquisition lines and the semicircles represent the maneuver trajectories for changing lines.

Relative to the ramp up procedure during line change, we define:

- When the line changing time is longer than the ramp up time (20 minutes), the shooting shall be suspended at the end of each line and started again according to the normal ramp up procedure;
- When the line changing time is less than the ramp up time (20 minutes), the shooting shall not be interrupted.

3.5. Undershooting technique

When using the *Undershooting* technique, or any other acquisition geometry using more than one seismic vessel, the On Board Observers shall be located in the source-vessel.

All the other provisions of this guide are valid for these operations.

3.6. Passive acoustic monitoring (PAM)

The questions about the efficacy of the visual monitoring, particularly during the night or during periods of low visibility, have stimulated the adoption of passive acoustic monitoring (MAP) in some countries. However, since this technology is still in development, Ibama does not require its obligatory use as mitigation measure. However, we encourage the companies to test the MAP or other methods with the view to allow the application of an alternative for visual monitoring in the near future for the environmental control of the seismic activity.

3.7. Instructions for completing the monitoring tables.

For recording the information, the On Board Observers shall use the tables of annex I. The additional information considered relevant by the observer shall be presented on the back of the Sighting Table or in *the notes and comments* field in the Daily Sighting Effort Table. The tables shall reflect the joint observation of the observers, i.e., should avoid to produce more than one table for a certain observed fact or seen animal.

As follows are presented some additional recommendations for completing the tables.

Front page

Up to 5 working days after the end of the activity, the responsible observer shall forward to ELPN/IBAMA, by official document, the original observation tables (spiral bound) with the front page duly completed and signed by each observer.

We request the observers to include general comments, critics and suggestions for improving the project for monitoring the marine biota on board of the seismic vessel.

Daily Sighting Effort Table

The observation *start hour* (start hour - HI) and *final hour* (final hour - HF) shall be informed considering the daily observation period, independent of the operation stage (ex.: presence or absence of shooting).

The field for *sighting time* with shooting shall be completed with the total time when the guns were shooting during the daily observation period. In other words, we recommend the On Board Observer to maintain a personal record of all the time when the guns were active between the Start Hour and Final Hour of the sighting effort (or to have a reliable source for this information). The objective is can stimulate of the ratio of the shooting time to the total sighting time.

The notes and comments fields may be presented all the information considered as relevant by the observers, besides those informing:

- The predominant *status* of the activity during the observation (ex.: normal activity, activity interrupted due to weather conditions, loss of cables, etc.);
- The weather conditions (i.e. sea condition, visibility and waves);
- The moments when ramp up was adopted;
- Any reasons that may have disturbed the sighting effort (ex.: strong waves, surface reflection, etc)

Sighting Recording Table

The table shall be completed whenever animals are seen, considering the following guidelines.

Latitude and Longitude – the geographical coordinates of the position of the seismic vessel shall be presented in degrees, minutes and seconds (up to hundreds of seconds).

Depth and Vessel Direction – shall be obtained herein the control panels of the vessel. Depth in meters (m).

Sea Conditions – the sea conditions shall be classified as *calm* (mirror or crested with small scale format ripples, no crests), *crested* (slight short swells, about 30 cm, crests, but without breaking up to sea conditions with 60 cm swells starting to break and some white caps), *agitated* (small waves, the longer ones with 1.5 m, with frequent white caps) and *heavy* (moderate long waves about 2.4 m, many white caps and possibility of some spray). *The heavy* category shall also include all the sea conditions more harsh than the gross category. The correspondence with the Beaufort scale is shown in the table (next to each category), and shall be used to help those already familiarity with the scale, considering that the sea condition may not correspond to the wind force at time.

Visibility – the visibility shall be classified into good (> 5 km), *moderate* (between 2 and 5 km) or *weak* (< 1 km). The meteorological conditions (i.e. clear skies, partially cloudy, cloudy, heavy sky and low clouds, rain, haze, fog, fog spots and rain and fog) shall be informed in the back of the table.

Swell – the swell shall be classified into low (< 2 m), medium (2 – 4 m) and weak (> 4 m).

Sighted Animal – all the sighted animals shall be identified whenever possible. The blank space shall be used: (i) for the species that are not in the list or (ii) when the identification of the species is not *definitive*. In this case inform the generic taxonomic group (ex.: mysticetes, odontocetes etc) or any other category that may help to identify the sighting (ex.: large whale, long nose dolphin, etc).

Confidence in the identification – this field shall be used associated to the sighted animal field even for the cases when the confidence level is not definitive. I.e., even when the identification is limited to the taxonomic group (ex.: mysticetes, odontocetes etc) the confidence degree shall be informed.

Diagram – we suggest completing the diagram using arrows in order to identify the distance (using the scale), the time and the movement direction of the animal relative to the seismic vessel (Figure 3). However, the observer shall assess the best way for graphic description of the accomplished sighting. When the sighted animal is beyond the radius of 1 km, this information shall be added in the back of the table. The time for the movement of the animal between two points is important information and shall be provided whenever possible.

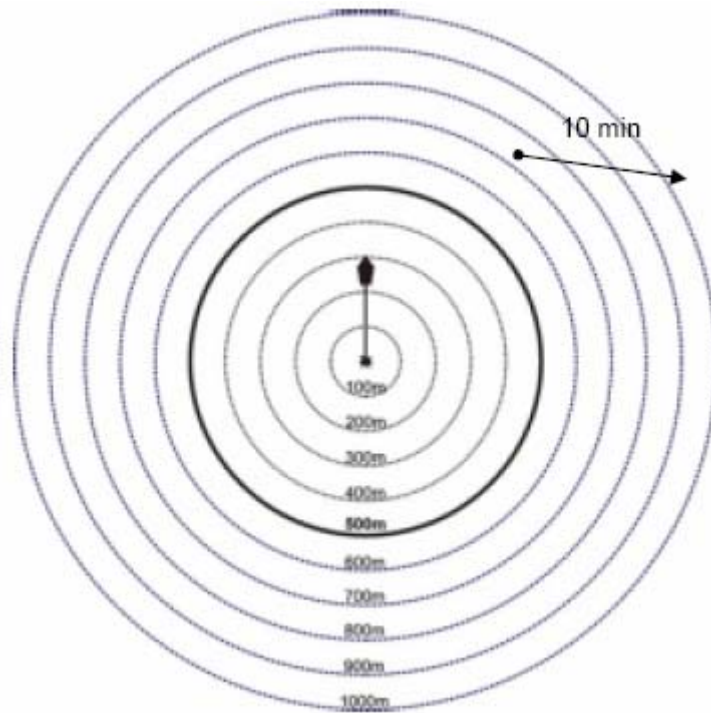


Figure 3 – Example for using the biota observation diagram. The arrow base shall inform the distance, the location relative to the vessel and the movement direction of the animal or of the group.

Air guns – inform if the air guns were operating normally (full power), under soft start, under tests or turned off at the sighting moment. Inform if there was a request to stop the guns and if this request was duly complied with. If positive, inform in the *total activity interruption time* field the time between the gun (*shutdown*) and the restarting of the shooting with power ramp up. It is important to remember that this time shall not be under 30 minutes after the last animal sighting.

Present in the back of the Sighting Table:

- A detailed description of the sighted animal (even when the *confidence* level of the *identification* is definitive) added with the observed characteristics that allowed the identification (i.e. animal size and color, size, format and location of the dorsal fin, etc.);
- Additional information about changes in the behavior of the animal or possible interactions with the operation (e.g.: swimming next to the arrays);
- Short report of the sighting (e.g.: “*the animal was seen only once at a distance of 200m from the ship. After the second spray the animal dived and was not seen again as a function of heavy sea conditions*”);
- Whenever it was necessary to postpone the shooting start up due to animal sighting;
- Whenever the shooting was suspended due to animal sighting;
- Whenever animals are sighted, but was not necessary to stop the shooting (e.g.: beyond the safety zone);
- Information about the existence or not of photographic records, including the number of obtained records;
- Any irregularity in the monitoring (e.g.: operation chief refused to stop the operation or there was a delay in complying with the request).