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Offshore Installation Activities and Marine Mammals' Protection

Abstract

During installation activities of four platforms in the Italian sector of the northern Adriatic Sea, in addition to the technical performance, special attention had to be dedicated to the protection of marine mammals from the noise produced. Acoustic and visual methods were applied 24 hours a day during the months of installation to monitor the movement of marine mammals. Project installation activities, especially piling and mooring, raise underwater noise level concentrated in a relatively limited area, which can interfere with the normal life of marine mammals.

The goal of the research conducted in the framework of this paper is to describe the working methodology, the measures of marine mammals' protection and to present the final monitoring results.

Key words: offshore installation, underwater noise, marine mammals, monitoring

1. Introduction

During two years, 2014 and 2015, Saipem S.p.A. Croatian Branch (SACRO) installed four platforms for the client ENI E&P through two campaigns. The platforms were incorporated into a wide context of gas field development in the Italian sector of the northern Adriatic Sea – offshore Ancona – by means of connection pipelines.

ENI Campagna Mare 2014 included the installation of two platforms, Elettra (57 km from the Italian coast – offshore Ancona – at 78 meters depth) and Fauzia (45 km from the Italian coast – offshore Ancona – at 70 meters depth). ENI Campagna Mare 2015 included the installation of additional two platforms, Bonaccia NW (67 km off

the Italian coast – offshore Ancona – at 87 meters depth) and Clara NW (48 km off the Italian coast – offshore Ancona – at 76 meters depth).

Human activities in the marine environment are generally regarded as having negative effects on cetacean populations [1]. Hence, installation activities within these campaigns required the environmental impact assessment to be developed, on the basis of which the Italian Ministry of the Environment, Land and Sea, in cooperation with the Ministry of Cultural Heritage and Activities, issued four Decrees of environmental compatibility (one for each platform) prescribing environment and nature protection measures. One of the measures prescribed the protection of marine mammals from underwater noise produced during the months of platform installation activities for which Marine Mammal Observers (MMOs) had to be present onboard working vessels [2-5]. Monitoring and protection measures were part of SACRO work activities on a daily basis.

During these campaigns, underwater noise sources included working mechanization, machines and devices and moving vessels. An elevated underwater noise, especially during piling and mooring activities, was concentrated on a relatively limited area.

1.1 Marine mammals in the northern Adriatic

Although past and recent reports may suggest that the Northern Adriatic contains diverse cetacean fauna, most of the recorded species are incidental in the region [6]. Historically, only two cetacean species are considered to be regularly present in the Adriatic Sea: the common bottlenose dolphin (*Tursiops truncatus*), and the short-beaked common dolphin (*Delphinus delphis*). Other species – the striped dolphin (*Stenella coeruleoalba*), the fin whale (*Balaeno pteraphysalus*), the sperm whale (*Physeter macrocephalus*), Risso's dolphin (*Grampus griseus*), Cuvier's beaked whale (*Ziphius cavirostris*) and the long-finned pilot whale (*Globicephala melas*) - are considered visitors or vagrant individuals [7].

The only studies in the Adriatic Sea have been done on the eastern coast of Croatia. Information elsewhere in the Adriatic Sea is generally limited to opportunistic sightings [1]. Among those few studies, Triossi et al. [1] analyzed the behavior of the common bottlenose dolphins around and within the offshore gas fields off Ravenna (Italy). Their analyses showed that dolphin density was approximately 80% higher within a range of 750 m around gas platforms (compared to densities >750 m from platforms). In addition, they noticed that slightly higher frequencies of feeding and milling behavior were observed closer to gas platforms, whereas dolphins observed further away exhibited higher frequencies of socializing and traveling. As gas platforms are known to provide a refuge habitat for demersal fish and act as aggregation points for pelagic fish, they concluded that common bottlenose dolphins may utilize gas platforms opportunistically as feeding sites. Oil and gas platforms in this region essentially act as a highly dense network of small marine protected areas [8]. Under the Italian law,

it is forbidden to anchor, fish or navigate within the 500 m zone of the 130 platforms scattered over the Adriatic Sea [8].

The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and the Contiguous Atlantic, ACCOBAMS, serves also to benefit the Adriatic dolphins. ACCOBAMS parties take coordinated measures to achieve and maintain a favorable conservation status for the cetaceans. Parties prohibit and take all necessary measures to eliminate, where this has not already been done, any deliberate taking of cetaceans and shall cooperate to create and maintain a network of specially protected areas to conserve them [9].

The Mediterranean subpopulation of the common bottlenose dolphin is listed as “Vulnerable” under the IUCN (International Union for Conservation of Nature) criterion A2cde and the Mediterranean subpopulation of the short-beaked common dolphin is listed as “Endangered” under the IUCN (World Conservation Union) criterion A2abc [8].

1.2 Marine mammals and noise

Marine mammals use hearing as their primary sense [10]. Cetaceans are heavily dependent on sound for food-finding, communication, reproduction, detection of predators and navigation [10].

Dolphins produce loud bursts of echolocatory clicks (15 –130 kHz) that are designed to function at relatively close range (rarely beyond a few kilometers) and are therefore likely to function primarily for local exploration and the detection and capture of prey [11]. With low ambient noise or during confinement, these pulses are often between 20 and 60 kHz [12]. With higher ambient noise, or when detecting more distant targets, higher amplitude pulses between 100 and 130 kHz may be generated [13]. It has been suggested that pure tone whistles are used to maintain group cohesion over large distances and may be used to contact separate groups [14, 15]. The distances at which these whistles appear to be effective (i.e. their active space) range from 14 to 25 km [11]. Marine mammals are therefore likely to be sensitive to the introduction of anthropogenic noise into their environment [10].

Marine mammals have demonstrated various responses to specific noise exposures ranging from changes in their vocalizations (shifts in frequency, becoming silent, etc.) and displacement or avoidance (including shifting their migration paths) through alterations in their diving, swim speed, respiration or foraging behavior, to hearing damage and stranding [16]. In order to protect them from negative influence of high noise during offshore installation activities, Bailey et al [17] in his research discovered that the soft start to the pile-driving was a key measure for the protection of marine mammals from underwater noise as gradual increase of sound pressure could potentially alert animals before levels became harmful and enabled them to swim away. Pile-driving sound can be detected at ranges of up to 70 km [17].

2. Materials and methods

Monitoring of marine mammals' movement, in cooperation with SACRO, was conducted by the CNR-ISMAR – National Research Council – Institute of Marine Sciences, Ancona, from January till September 2014 for the first and from April 2015 till March 2016 for the second ENI Campagna Mare, for a part of SACRO project activities.

Monitoring was performed by four marine mammal observers – MMOs (2 MMOs for visual and 2 MMOs for sound tracking). For the purpose of marine mammals monitoring activities, a container with monitoring equipment was positioned on the main working vessel. Sound tracking was conducted 24/7, while visual monitoring was carried out only during daylight.

Visual monitoring was covered by two MMOs, divided into two shifts during daylight, where possible (due to safety reasons), from the highest point of the vessel to cover a wider range of the area. The observers were equipped with binoculars, a compass and distance calculation pattern, as well as headphones enabling them to hear sounds picked up by the hydrophone, filtered to more effective means of isolating the frequencies typical for cetaceans.

Hydrophone type COLMAR GP0190 (with cage and ballast) was used for acoustic detection of marine mammals in the area. The hydrophone was lowered from the vessel to a water depth of 18-30 meters. The choice of the hydrophone position in the water was defined for each installation activity on the basis of the constructive and operational characteristics of the working vessels involved in the various phases of the project and the potential necessity of having to recover the hydrophone in emergency situations, avoiding the exposure of MMO personnel and equipment to the risk.

Recorded sounds were visualized through computer software (Figures 1 and 2).

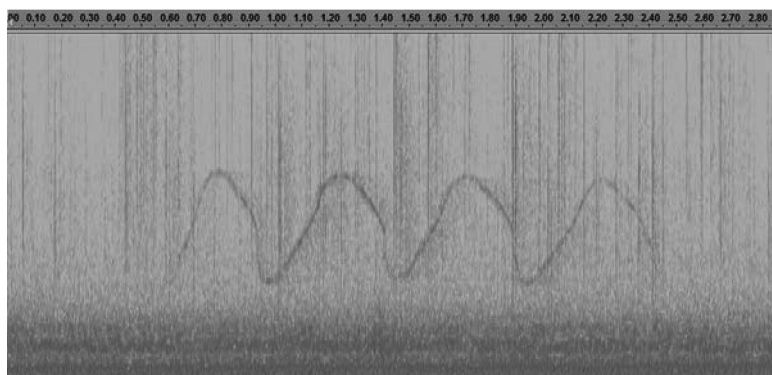


Figure 1 - Signs of vocalization (whistles) recorded on Fauzia

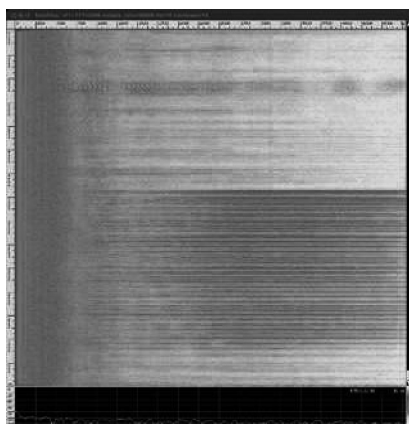


Figure 2 - Click signals recorded on Bonaccia NW

The acoustic system used aimed at sampling the sounds, filtering them and converting them to digital format and then processing them with an information system.

The dolphin detector data acquisition system was designed and developed specifically by Rocco De Marco of the ISMAR CNR of Ancona with four main purposes:

- to offer a database for storing the MMO monitoring activities, sightings and information on current activities;
- to visualize the spectrogram in real time to analyze the sound even at high frequencies;
- to store the sounds detected by the hydrophone in a continuous cycle;
- to provide a parametric acoustic equalizer to filter the sounds to be sent to the MMO operators' headphones [18-21].

When marine mammal(s) were observed, MMOs noted: date and time, observed acoustic/visual, coordinates, type and number of specimens, behavior (direction of movement), meteorology, distance, current noise sources/types, working activities, and mitigation measures (if used).

2.1. Measures of Prevention

The MMOs started their observation 30 minutes before the beginning of works. Only following the confirmation from the MMOs that no marine mammals have been observed in the radius of 1nm from the working area, the installation activities could start. In case marine mammals were observed in the area, all planned working activities had to be delayed for 30 minutes after the last observation of marine mammals in the

mentioned radius. If the observation was within the radius of 1-3 nautical miles from the working area, all the mechanization and equipment had to be in soft start 30 min after the last marine mammal left the mentioned area.

3. Results

Installation activities for ENI Campagna Mare in 2014 and 2015 lasted 140 days in total, during which the MMOs monitored the area for the presence of marine mammals.

Marine mammals were observed within 49 days, some days even for several times. Altogether there were 92 sightings and sound detections (38 times during the installation activities on Fauzia, 24 times on Elettra, 16 times on Bonaccia and 14 times on Clara), shown in Figure 3.

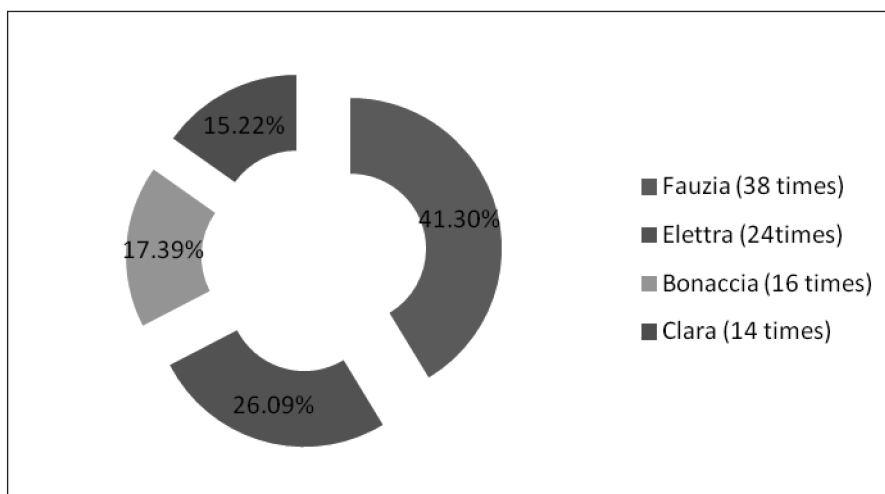


Figure 3 - Individual share of marine mammals' observation

Marine mammals were observed in the spring and summer months. During a small part of the activities performed in the winter months, marine mammals were not observed. Distribution of observations during the day was almost the same (54% during daylight, 46% during night time).

Generally marine mammal groups were observed (2-15 individuals, adults with cubs). Individuals were observed only in isolated cases. Distance at which marine mammals were observed was between 3 nautical miles from the work activities up to the work activities themselves (working vessels or platforms).

The majority of marine mammals were detected by hydrophone (55 times), shown in Figure 4.

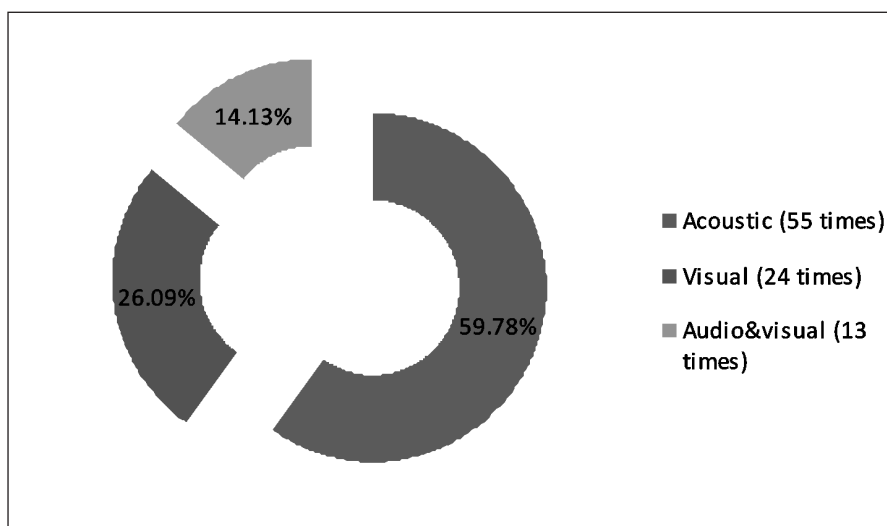


Figure 4 - Contribution of each method in observation results

Among the 150 specimens of dolphins sighted, 88 (59%) of them were identified as *Tursiops truncatus* or the common bottlenose dolphin. The rest were noted as unidentified.

Among the 92 sightings of dolphins near the working area, mitigation measures had to be applied only in 11 cases - in 12% of cases (most often at night) it was necessary to slow down the work or postpone the start of an activity for at least half an hour to protect marine mammals from potential dangers.

Applied mitigation measures caused around 6 hours of delays in the project schedule, 0.25 days or 0.18%.

4. Discussion

It is assumed that marine mammals were sighted during the spring and summer months because in that period they have cubs and stay close to the surface, or at night while they were attracted by fish gathered under the vessel lights. Sighted dolphins were either just passing or feeding on fish aggregated around platforms, in which cases some of them stayed even up to three hours.

The specimens were identified mostly visually because determining the type by acoustic detection is difficult. Identification of specimens detected by hydrophone is extremely hard, if not impossible. There is a vast number of sounds marine mammals use and only around 30 were identified for comparison. There is no database with which it would be possible to compare the detected sounds [18-21].

The common bottlenose dolphin (*Tursiops truncatus*) is the most common species in the Adriatic, so it is no surprise that most observations were related to it.

Mitigation measures, such as postponing the start of the activities, were employed during pipe laying on Fauzia, which caused delays in the launching of the pipeline in the sea, as well as during pile hammering activities on Clara NW platform causing delays in the commencement of hammering activity. During some of the activities, e.g. grouting, because of the peculiarity of the process, mitigation measures could not be applied. Those issues were discussed during morning meetings, attended by the vessel management team, a client representative and subcontractors' representatives, and presented to the MMOs. The communication between the project team and the MMOs was very important.

All personnel onboard were made aware of the need to inform the MMOs before starting any activity that could generate underwater noise.

According to decrees covering environmental compatibility, two MMOs were required for the observation in the working area, which was not sufficient in the opinion of the National Research Council – Institute for Marine Research. Consequently, four MMOs were constantly present to cover 24 hours of watch.

5. Conclusion

According to the requirements by the Italian Ministry of Environment, Land and Sea and the Ministry of Cultural Heritage, detailed registrations were made of all marine mammal observations in the radius of up to 3 nautical miles from the operation area (distance, number of individuals, species, meteorological conditions, types of works in progress and whether it was necessary to apply protection measures – stop or slow down the work or not). Given that there is very little information on marine mammals in the area, the Institute for Marine Research, Ancona, proposes further monitoring of marine mammals and the creation of a database.

Furthermore, the project showed that the number of MMOs prescribed by the relevant decrees is insufficient, therefore, it is suggested for the issue to be revised in the legislative acts covering this area and the number of MMOs increased for any future projects.

Also, it is suggested for such collaboration between the two ministries and between economic and ecological actors to become standard in respect of some future projects and human interventions into the marine environment for the purpose of improving the environment protection and ensuring sustainability of the marine environment. Moreover, the scientific research conducted in the framework of such projects may serve to create and expand any databases on marine mammals. Therefore, the cooperation of stakeholders in such projects will be beneficial to both parties.

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Odobalne instalacijske aktivnosti i zaštita morskih sisavaca

Sažetak

Tijekom radova na instalaciji četiri platforme u talijanskom sektoru sjevernoga Jadranskog mora, uz tehničku izvedbu, posebna se pažnja morala posvetiti zaštiti morskih sisavaca od proizvedene buke. Kretanje morskih sisavaca nadziralo se primjenom akustičnih i vizualnih metoda 24 sata na dan tijekom mjeseci instalacije. Instalacijske aktivnosti, osobito postavljanje stupova i sidrenje, podižu razinu podvodne buke koncentrirane na relativno ograničenom području, što može ometati normalan život morskih sisavaca.

Cilj provedenog istraživanja je opisati radnu metodologiju, mjere zaštite morskih sisavaca te predstaviti konačne rezultate nadzora.

Ključne riječi: odobalne građevine, podvodna buka, morski sisavci, nadzor