

OPERATIONAL GUIDE



Response in Mangroves

OPERATIONAL GUIDE

Information Decision-making Response

Guide produced by Cedre with funding from Total SA, Perenco and the French Ministry of the Environment, Energy and the Sea

Author: Loïc Kerambrun

All rights reserved. The formatting, photos, figures and tables, unless stated otherwise, are copyrighted and the property of Cedre and cannot be reproduced in any form or by any means without prior written permission from Cedre. The text in this guide is the property of Cedre and cannot be reproduced or used without acknowledgements and without prior written permission from Cedre.

The information contained within this guide is a result of the research and experience of Cedre. Cedre cannot be held responsible for the consequences resulting from the use of the data herein.

Cite this document as follows:

KERAMBRUN L. Response in Mangroves, Operational Guide. Brest: Cedre, 2016, 93 pages.

Published: March 2017

Legal deposit upon publication. Printed by Cloître Imprimeurs, 29800 Saint Thonan, France



Cover photo: Mangrove in Gabon © Cedre

Purpose of this guide

An oil spill in a mangrove can have detrimental effects whose intensity and duration will vary according to a number of factors: the type and quantity of oil spilt, the diversity and sensitivity of plant and animal species and communities affected, the fragility of resources and activities, but also the quality of the actions implemented to respond to the spill and mitigate the damage caused.

Response in these highly sensitive and very often hostile environments deserves special attention given that:

- it can cause harmful effects on the environment, sometimes even more so than the spill itself
- responders are required to work in a hostile environment in which the environmental constraints mean difficult, or even arduous, working conditions, and sometimes hazardous situations.

The aim of this guide is two-fold:

- to mitigate the negative impacts of the spill and the response on the mangrove environment
- to facilitate the response and ensure greater responder safety and less arduous working and living conditions.

This guide presents the main aspects to be aware of and considered for response or to decide not to respond. It draws upon a literature review and Cedre's experience in spill response in mangroves. The specificities of mangroves as well as those of the oil spilt in the environment are presented. The broad principles of response in mangroves are outlined and the guide also includes practical datasheets detailing the implementation of specific techniques.

Contents

Purpose of this guide	4
A RESPONSE PREPAREDNESS	7
A.1 - What are mangroves?	8
A.2 - Highly varied formations and evolving environments	9
A.3 - Heterogeneous vegetation suited to environmental constraints	11
A.4 - A wide range of fauna	13
A.5 - Fragile environments with high ecological value	14
A.6 - Behaviour of oil spilt in mangroves	16
A.7 - Fate of spilt oil	18
A.8 - Impact of spilt oil	19
A.9 - Defining priorities before a spill occurs	22
B SITUATION ASSESSMENT	23
B.1 - Methodology	24
B.2 - Response strategies in mangroves	25
RESPONSE - WHAT TO DO IF THE MANGROVE IS AT THREAT	27
C.1 - Assessing the threat	28
C.2 - Assessing the risks related to response at sea	29
C.3 - Determining priority response areas	30
C.4 - Leave alone	31
C.5 - Protecting sensitive sites	32
C.6 - Recovering the oil on the water, in front of the mangrove	33
C.7 - Chemically dispersing the oil	34
D RESPONSE - WHAT TO DO IF THE MANGROVE IS AFFECTED	37
D.1 - Assessing the situation	38
D.2 - Determining priority response areas and defining appropriate techniques	39
D.3 - Leave alone	40
D.4 - Protecting the mangrove from the edge	41
D.5 - Recovering floating oil at the edge of the mangrove	43
D.6 - Organising the overall response	45
D.7 - Ensuring responder safety	47
D.8 - Channelling the oil within the mangrove	49
D.9 - Scything and cutting vegetation in a reasoned manner	50
D.10 - Facilitating responder movements within the mangrove	51
D.11 - Filtering at the surface within the mangrove	52
D.12 - Setting up containment systems within the mangrove	53
D.13 - Selectively recovering the oil within the mangrove	54
D.14 - Cleaning emerged substrates	55
D.15 - Cleaning vegetation	57
D.16 - Managing recovered waste	58
D.17 - Practical datasheets	61
FURTHER INFORMATION	91
E.1 - Glossary and acronyms	92
E.2 - Bibliography	93

Α

В

С

D

E

Response preparedness

What are mangroves?	- A1
Highly varied formations and evolving environments	A2
Heterogeneous vegetation suited to environmental constraints	A3
A wide range of fauna	A4
Fragile environments with high ecological value	- A5
Behaviour of oil spilt in mangroves	A6
Fate of spilt oil	A7
Impact of spilt oil	- A8
Defining priorities before a spill occurs	A9

Heterogeneous vegetation suited to environmental constraints

Many environmental stress factors

The various parts of the mangrove are exposed to different environmental stress factors, which are potentially strong and highly fluctuating in the course of the day or indeed of the year, in terms of flooding, temperature, salinity, turbidity and wave exposure. Mangroves are very lively environments which are constantly changing in response to variations in the water which floods them. This creates disturbing conditions which its flora and fauna are able to overcome thanks to their physiological and morphological adaptation.

Vegetation zonation

The vegetation differs according to its location within the mangrove (at the edge, in the middle,

or on the river banks), with pioneering species in the softer sediment or more established vegetation on the firmer ground which has gradually formed through sediment accretion. Vegetation zonation occurs based on tidal levels. This is the result of the preferential installation of certain formations in local environmental conditions according to the topographic elevation.

This zonation is not however simply due to a difference in height. In higher areas, less frequent flooding, together with high evaporation of the salt water during dry periods, leads to very high fluctuations in salinity and therefore induces greater stress in these areas than in the lower areas which are flooded on a daily basis and where the salinity gradient is therefore far lower.



Mangrove vegetation zonation

Situation assessment



Response strategies in mangroves



Response - What to do if the mangrove is at threat

	Assessing the threat	C1
	Assessing the risks related to response at sea	C2
	Determining priority response areas	C3
	Leave alone	C4
•	Protecting sensitive sites	C5
	Recovering the oil on the water, in front of the mangrove	C6
•	Chemically dispersing the oil	C7

Assessing the threat

Surveys carried out at sea from aircraft or vessels will confirm the alert and help to assess the extent of the incident.

A slick drift forecast for the coming hours can be made using simulation models which can take into account the prevailing and forecast weather conditions and the characteristics of the pollutant.

Knowledge of the physical, ecological and socioeconomic environment will help to assess the risks. The existence of shoreline sensitivity maps (in the form of printed atlases or a GIS) proves very useful here. Such maps provide information on the ecological value of the natural areas at threat and on the relative importance of the resources and activities liable to be directly or indirectly affected.







Aerial view of the edge of a mangrove forest

28

Response - What to do if the mangrove is affected

	Assessing the situation	D1
	Determining priority response areas and defining appropriate techniques	D2
•	Leave alone	— D3
•	Protecting the mangrove from the edge	— D 4
	Recovering floating oil at the edge of the mangrove	D5
	Organising the overall response	D 6
•	Ensuring responder safety	D7
•	Channelling the oil within the mangrove	D8
•	Scything and cutting vegetation in a reasoned manner	— D9
•	Facilitating responder movements within the mangrove	— D10
•	Filtering at the surface within the mangrove	— D11
•	Setting up containment systems within the mangrove	— D12
•	Selectively recovering the oil within the mangrove	— D13
•	Cleaning emerged substrates	— D14
	Cleaning vegetation	— D15
	Managing recovered waste	— D16
	Practical datasheets	D17

Determining priority response areas and defining appropriate techniques

The purpose of the initial survey is to determine the spread of the spill, to identify the most heavily oiled areas, to record visible impacts and to establish the main environmental constraints. This provides an overview of the situation, enabling response managers to determine where the pollution is significant enough to justify response actions. In this case, an initial action plan can be drawn up: first-line response resources, priority response areas, access, logistics required to implement the response.



Example of a map produced following an initial survey

This initial survey will be followed, as soon as possible, by more detailed surveys, carried out more systematically. These additional surveys will involve more technical resources and skills. Based on the information gathered, detailed mapping of the area will be possible, providing a basis for developing operational documents to be used throughout the response (operational segments, monitoring of the evolution of the situation and of clean-up operations, communication, etc.).



Detailed map produced based on in-depth surveys

Cleaning vegetation

To clean or not to clean?

The question of whether or not to clean vegetation often arises. For technical, ecological and/ or logistical reasons, roots often cannot be cleaned. Nevertheless, when this operation is viable, the favoured technique is the use of a low pressure hose, or possibly a high pressure washer.

Low pressure washing

The use of a low pressure (< 3 bars) hose (flat then solid jet) should be systematically tested. This is especially the case during the first few hours, or days, following the spill according to the type of oil. This technique is recommended if it is proven to efficiently remove thick layers of oil coating the aerial roots, or to simply rinse off a fine layer of very fluid oil.



Low pressure hosing to remove thick layers of oil from roots

High pressure washing

The use of a pressure washer, even with cold water (or rather lukewarm water given the ambient climate), is far more questionable as the powerful jet is liable to damage the roots (risk of removing the surface layer of the root for instance). Furthermore, after a certain amount of time, even this pressure becomes ineffective.

Practical datasheets

- Datasheet 1: Organising an on-land survey in dense vegetation
- Datasheet 2: Worksite layout and organisation
- Datasheet 3: Setting up a decontamination area
- Datasheet 4: Site safety
- Datasheet 5: Overall operation management
- Datasheet 6: Protecting operators
- Datasheet 7: Cutting vegetation in a reasoned manner
- Datasheet 8: Building walkways
- Datasheet 9: Installing filtration systems in the water column
- Datasheet 10: Trapping floating oil with used disposable suits
- Datasheet 11: Building a bottle boom
- Datasheet 12: Recovery from pirogues in shallow/very shallow waters (< 1 m)
- Datasheet 13: On-site settling and vegetation draining
- Datasheet 14: On-site incineration