Participatory case definition between stakeholders and implication for early detection: a case study of the oyster production in France

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Keywords: aquatic animal surveillance, mortality, shellfish, early warning surveillance, case definition

Abstract
Aquatic animal health surveillance is notably based on the observation of any increased shellfish mortality by shellfish farmers and its immediate mandatory notification to the local competent authority. According to current EU regulation, increased mortality is defined using a participatory approach: case reporting is based on individual farmer perception, which then can be turned into notification in cooperation between the farmer and the competent authority. All the challenge relies on starting from individual perception and knowledge of increased mortality to a collective alert onset informing potential control actions having a community interest.
We made an inventory of the criteria used by surveillance stakeholders to define and detect increased oyster mortality, and of their perceptions of the system purpose and usefulness. This constitutes the prerequisite to bridge the gap between theory and application for a stable and sustainable early warning surveillance.

Introduction

As classical control measures usually implemented in terrestrial animal productions are of limited use in marine systems, successful control of disease is very unlikely once established in marine shellfish populations. Thus, reliable disease detection remains one of core elements of timely and efficient disease control.

Shellfish health surveillance notably aims at early detecting the appearance of any exotic or emerging pathogen in the territorial waters, in order to react promptly to outbreaks and limit their spread. This timely detection and identification of disease incursion or emergence is partly based on the observation of any increased shellfish mortality by shellfish farmers and its immediate mandatory notification to the local competent authority (1). Indeed, as diseased shellfish seldom show symptoms, any unexplained mortality is a potential indicator for pathogen introduction or emergence. Then, anamnesis and laboratory diagnosis based on biological samples enable to confirm or not the alert.

According to current European regulation, 'increased mortality' means *"unexplained mortalities significantly above the level of what is considered to be normal for the farm or mollusc farming area in question under the prevailing conditions. What is considered to be increased mortality shall be decided in cooperation between the farmer and the competent authority"* (1). This suspect case definition contains two steps: detection by individual farmers (i.e. reporting) followed by validation involving a participatory approach between the farmer and the local competent authority (i.e. notification). However, this definition is pretty subjective whereas reliable case detection is essential if early alerts constitute essential factor in the efficiency of the system (2). As different stakeholders are involved in the alert onset, it may be worthwhile exploring their interpretation of this suspect case definition to assess its sensitivity. This may be related to the perceived purpose and usefulness of the mortality notification system. Heterogeneous sensitivity among the stakeholders may hinder the early warning surveillance purpose, and consequently the policy purpose to limit the spread of an emerging or exotic disease outbreak.

Thus, we conducted a study among the stakeholders to investigate (1) their interpretation of the shellfish 'increased mortality' definition and their detection practices, and (2) their perception of the goals of the mortality notification system. This may contribute to a better understanding of interactions between stakeholders, bridging the gap between theory and application, with the ultimate aim of improving early detection of exotic or emerging disease outbreaks.

Materials and methods

Population:
The study population was the stakeholders of oyster production, i.e. oyster farmers, local and national competent authorities, in Charente Maritime, one of the main French oyster production area (3).
Farmers were selected from a retrospective case-control survey conducted in 2012 as part of larger study of farmer reporting behaviour (4). All representatives of national and local competent authorities concerned with shellfish health were included.

Data collection:
Information was collected from face-to-face semi-structured interviews. Two open-ended questions were asked: (1) '*how do you define (and detect) an increased mortality?*' and (2) '*according to you, what is the goal of the mortality notification system*?'. All the interviews were recorded with the participant's authorization.

Data analysis:
Qualitative data were analyzed using content analysis (5) to identify thematic categories. All the interviews were

transcribed and anonymised. An interpretative coding of the responses was used, being driven by the data itself and not by predetermined categories (5). Responses were then grouped together by thematic categories.

Results and Discussion

Sample description:

A total of 120 oyster farmers (89 reporting and 31 non-reporting farmers) participated to the survey. Two representatives of local competent authority and two representatives of central competent authority were interviewed.

Increased mortality definition:

Oyster farmers used both qualitative and quantitative criteria to define an increased mortality whereas representatives of competent authority used quantitative ones (Table 1).

Table 1. Criteria used to define increased mortality in oysters by stakeholder, Charente-Maritime, France

Criteria cited	*Nb. reporting farmers (N=89)*	*Nb. non reporting farmers (N=31)*	*Nb. local CA[1] (N=2)*	*Nb. national CA (N=2)*
Nauseating odour	55	14	0	0
Empty shells	84	27	1	0
Flesh in shells	36	16	0	0
Specific noise when manipulating oyster bags	10	7	0	0
Dying oysters	3	0	0	0
Counting dead oysters	75	20	2	1
Counting method			0	0
on a whole bag	17	5		
on a few bags	7	2		
on parts of a few bags	4	2		
on 1 kg of oysters	7	1		
on a handful of oysters	9	0		
Threshold mortality %				
0-9%	5	2	0	0
10-19%	20	11	2	0
20-29%	24	6	0	1
30-39%	18	5	0	0
40-49%	8	2	0	0
≥50%	8	3	0	0

Counting dead oysters to estimate a mortality rate was a common practice for farmers and was a criteria cited by both representatives of local and national competent authority. However farmers used various methods to estimate this rate. A threshold value was often given to distinguish 'increased' mortality from 'normal' one, but this threshold greatly varied within and between stakeholders.

Farmers mentioned that the threshold level of mortality should be differentiated by flock characteristics such as production type (diploid vs. triploid oysters) for 42% (13/31) non reporting farmers and 39% (32/83) reporting farmers, or by class of age. For the representatives of the national competent authority, threshold level of mortality should account for the farming context; they cited season, localization of the production area and farming practices. They also highlighted that this threshold should be defined at the individual level, farmer by farmer, considering that abnormality was an individual perception.

"Not a proportion because it relies on each farmer, considering his practices and knowledge of his own production to appreciate this abnormality" (national representative n°2).

The threshold of 15% cited by the representatives of the local competent authority comes from the previous EU regulation, defining '*observed abnormal mortality'* as *'sudden mortality affecting approximately 15% of stocks and occurring over a short period between two inspections (confirmed within 15 days*)' (6). Setting an arbitrary threshold level for notification to the competent authority has been abandoned in the new Directive, because this threshold should be differentiated by production type and farming system but also because 2 weeks might be too long before the alarm is raised. Indeed, as sick shellfish seldom show symptoms, oysters are mostly found dead, up to 100% flock mortality within only a few days. Mortality patterns are not enough oyster disease specific, which implies that the time needed for ultimate detection of a new infection (exotic or emerging) by laboratory tests would provide time for the pathogen to spread quickly. Maybe having a threshold of a certain percentage of daily mortality, processing for a few consecutive days should be more appropriate, as it is the case in most terrestrial productions. But accessibility of farmed oysters is challenging (7) and this study shows that various counting methods are used among the same production area, hindering any comparisons between farmers at a local level, and even more at a national level.

Thus, notification rules changed and current suspect case definition encourage participatory approach, which is not much easier. Farmers are the first stakeholders to detect increased oyster mortality, based on individual increase perception. This study shows that they use different criteria to assess this increase, and this knowledge is not standardizable. The competent authority then becomes involved for participatory case validation in collaboration with the individual farmer, to turn reporting into notification. The strength of such a participatory approach lies in its flexible and qualitative nature, which complements quantitative criteria (8). However, the criteria which can be shared out between stakeholders are: date of the event, place, oyster flock characteristics, and counts of mortality. Other criteria pertain to individual perception, which cannot be used to a tick boxes on a notification form, but must be accounted for to improve data quality for warning alert onset. Each kind of knowledge can be internally validated with its own criteria, but, if all are recognized as valid knowledge, none can be taken as a standard against which to evaluate others. Hence, when it comes to combining knowledge, the crucial point is their mutual consistency and compatibility. For reconciling and

[1] CA : competent authority

combining knowledge, the first step is to elucidate the differences in understanding (9).

Perceived purposes of the mortality notification system:
Table 2 summarizes the perceived purposes of the notification system by stakeholder.

Table 2. Perceived purposes of the mortality notification system by stakeholder, Charente-Maritime, France

Purposes cited	*Nb. reporting farmers (N=89)*	*Nb. non reporting farmers (N=31)*	*Nb. local CA[2] (N=2)*	*Nb. national CA (N=2)*
Shellfish health surveillance	5	0	0	1
Warning alert onset	3	0	0	1
Describe the mortality phenomenon	44	21	0	1
Understand the mortality phenomenon	37	18	0	0
Informing other farmers	10	4	0	1
Informing policy measures	8	0	1	1
Find mitigation solutions	3	3	0	0
Obtain financial compensation	40	11	2	1
Useless	9	3	0	0

Among the oyster farmers, the perceived goals of the mortality notification system were often inaccurate. Only 3% reporting farmers and none of the non-reporting farmers knew that reporting oyster increased mortality was mandatory. Health surveillance and warning alert onset were evoked by a few reporting farmers. Descriptive purpose and improvement of the understanding of the mortality phenomenon were the main cited purposes by farmers:
"Understanding the how and the why, even if we can't do anything about it" (non-reporting farmer n°71).
Obtaining financial compensation was also evoked as, since 2008, a system for financial compensation for oyster production losses was put in place and, since 2010 mortality notification has become mandatory to access to the financial compensation (10), diverting the disease surveillance aim of the reporting system.
Finally, less than 10% of farmers believed that this system was useless:
"This can't avoid the problem, knowing what is going on won't change anything" (reporting farmer n°19)
From an individual point of view, this is understandable that notifying increased mortality is useless for the reporter: it is too late as oysters are dead. A previous assessment of farmers' awareness of the reporting system and their understanding of it has shown that financial incentives were insufficient to motivate farmer sustainable participation to the surveillance system and that lack of knowledge about the major issue of timely reporting oyster mortality contributed to late reporting (4).
Among the representative of competent authority, heterogeneous perceptions were observed. Health surveillance and warning alert onset were even not evoked by the local representatives who intervene on the field with farmers.

Challenge of the participatory case definition is to start from individual perceptions of abnormalities to a collective alert onset informing control actions having a community interest. This can't be effective without a broad sense of ownership, achieved through the participation of stakeholders in the design and oversight of the system and a perception that the output is useful and serves the needs of stakeholders (8), which is clearly not the case in our study. Efforts should include providing feedback to data providers and increasing their awareness about hazards and surveillance activities. For example, farmers should not be considered as data providers only; they should become users of these surveillance data, designing actions that are meaningful to them. Representatives of local competent authority should be trained to improve their awareness of the early warning surveillance and their understanding of it. Ultimately, inclusion of common concerns among stakeholders in the communication related to surveillance may help them to empower the early warning surveillance interest, e.g. environment protection which can be hampered by disease incursion or emergence. This may help enhancing their sense of ownership of and commitment towards sustaining the notification system.

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Acknowledgements
The authors thank the farmers and the representatives of the competent authority for their participation in the study.

[2] CA : competent authority