Annex C
High survivability

Despite the lack of studies on the striped venus clam survivability returned at sea after the sieving process, Morello et al. (2006) carried out a laboratory study in experimental tanks to study the rebury capacity of the clams. In the study two factors were considered: 1) the disturbance due to fishery activity splitted into two categories "Dredge" ("D" – specimens harvested in the collecting box) and dredge + Sieve ("S" specimen harvested before the return at sea); 2) temperature (12°C and 20°C). The harvested specimens were kept separated in different tanks with the same physical condition accordingly to the type of disturbance (D or S); and the experiment was replicated for three times. A total of 4 tanks (40x40x30) were used with 20 specimens inside each. Two tanks were set at 12°C (20 "D" and 20 "S") and the other two at 20°C (20 "D" and 20 "S"). After 4 hours the unburied clams were counted. The study showed that any significant difference between treatments occurs both for the percentage of unburied individuals after 4 hours (< 35%) and for the time required to 50% individuals to rebury (< 10000 seconds). So, that clams were mainly able to rebury independently from temperature and the type of disturbance D or S.

A study on the survival of venus clams was carried out by ISPRA during the construction of the LNG terminal at Porto Viro (Rovigo), analyzing the clams fished and screened on board a hydraulic dredger.

The specimens of C. gallina destined for the survival test (40 for each station) were placed in plastic tanks on the bottom of which is a layer of absorbent paper saturated with moisture. The tanks are kept at a constant temperature in a thermostatic cell at 18±0.5°C.

Every day there are dead individuals, which can be recognized by the open valves and by the fact that they do not respond to mechanical stimuli.

Survival data were processed using the Kaplan and Meier method (1958), thanks to which it is possible to calculate the value of LT 50, i.e. the number of days in which 50% of organisms die. The data were represented graphically via cumulative survival curves. The comparison of the trend of the curves was made through the Cox F test. The differences were considered not significant for $p>0.05$.

The average values of LT 50, with relative standard deviation, are shown in the following Figure 1.

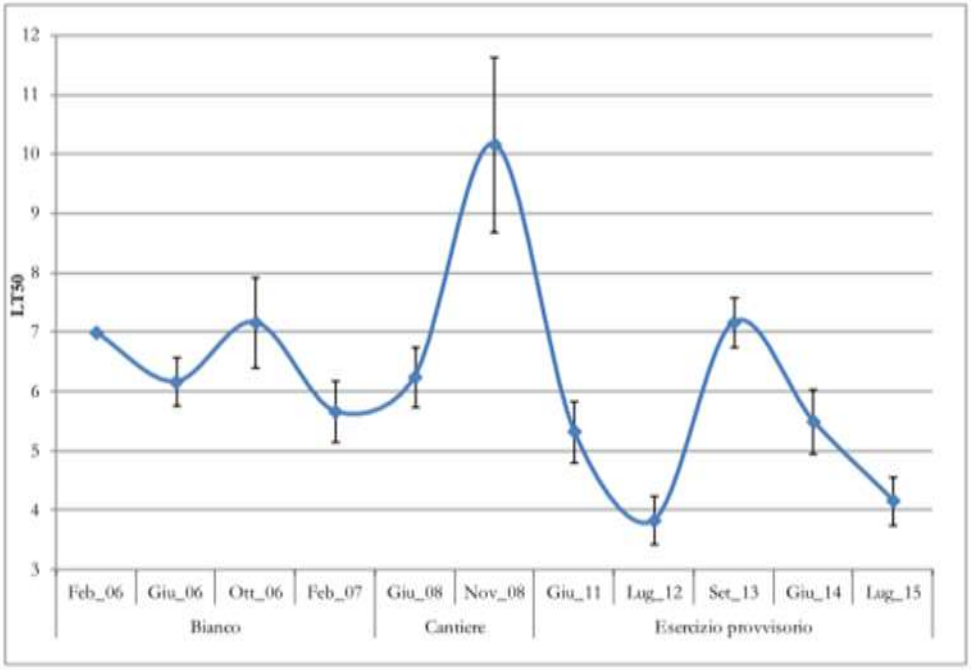

Figure 1. Survivability of clams in the ISPRA study LT 50 is. the number of days in which 50% of organisms die.

In this test it is observed that the value of LT50 varies from 3.8 to 10.2 days, with an average of 6.2 days. In each monitoring campaigns it can be noted that the LT50 value generally tends to decrease in the Terminal operating phase (infrastructural work), remaining below the average in 4 out of 5 samples.

Periodicity, together with other biotic and abiotic factors, influences the condition of organisms (Boscolo et al., 2003) and therefore survival in the air. The differences observed in terms of the average of LT 50 between white and exercise are partly attributable to the fact that in the latter the useful data refer only to medium-warm seasons (spring and summer), when organisms naturally tend to have a minor resistance to air exposure (Boscolo et al., 2003). It is also to be considered that the LT 50 is strongly influenced negatively by changes in salinity and anoxias: the resistance to exposure to air of clams in laboratory tanks with salinity of 28 and 40

significativamente decreases significantly, and the values of LT 50 go from 7 (to 34) to 4 (28 ‰) and 5 days (40 ‰) (Matozzo et al., 2005; Matozzo et al., 2007). The area in which the stations are located (in particular the C035 and the C036) is certainly subject to the fresh water supplies of at least one branch of the Po (Po di Maistra), especially since an outlet to the sea was opened (winter 2007-2008).
Furthermore, fishing can also increase the stress to which organisms are subjected due to the shaking action inside the dredger cage (Ballarin et al., 2003; Marin et al., 2003). During the construction phase, it can be assumed that the interruption of fishing due to the laying of the pipeline in the area may have resulted in less stress conditions for individuals and therefore greater resistance.
Another study was carried out with venus clams placed in airtight boxes, in saturated humidity conditions and at a temperature of 18 ° C (Eertman et al., 1993).
As for M. galloprovincialis, also for C. gallina the p-value comparison of the Kruskal-Wallis ANOVA was performed by testing Fisher combinations for independent tests. Salinity was significantly influencing the value of LT50. Values of 34 psu and 28 psu are the conditions with a greater survival (LT50 of 6 days) compared to 40 psu (LT50 of 4 days). Comparing the response obtained to the different combinations of temperature and pH at each salinity, with respect to the control, no comparison was significantly different.
Moschino et al. (2008) studied the shell damage to the clam Chamelea gallina captured by hydraulic dredging in two sites along the north-western Adriatic coast (Lido and Jesolo). They detect and quantify shell damage caused by fishing operations on both captured and discarded clams. The mortality of dredging at high water pressure (inlet pressure ~2.5 bar) ranges between 2-20% with an average around 10 %. This corresponds thus to a survival rate of at least 80%. However, the study above was performed with a jet pressure of 2.5 bar, whereas the fisheries operate now with lower pressure (1.8 bar), which may infer lower mortality.

Ongoing studies

The Italian Ministry for Food, Agriculture, Fisheries and Tourism Policies (MiPAAFT) recently financed projects to improve the selectivity of dredging fishery and to study the survivability of clams rejected after sorting.
Basing our knowledge on this previous study the CNR-IRBIM of Ancona will carry out, by 31th December 2019, two survival experiments: one in experimental tanks and the other at sea.
In the experimental thanks natural sea conditions will be recreated as much as possible using natural sand as sediment, keeping the water oxygenated, the temperature constant similar to the sea water one, and by feeding the clams on microalgae. A minimum period of 21 days of survival will be examined to assess survivability. Specimens under the minimum landing size discarded after sieving process will be used as test.

At sea fixed metal cage designed not to allow clams escapement will be adopted as well to assess survivability. The inferior side of the fixed cage will be covered with sand and specimens under the minimum landing size will be used as test again.

In both the experiments it will be even possible to investigate the survival potential of specimens stressed and damaged by the dredge and/or the sieve.

Another project on the survival of clams will be carried out by Agriteco in the northern Adriatic Sea to evaluate the survival of the clams after the passage of a dredger on the bottom. This study will be carried out with underwater cameras and will also focus on evaluating the time required for clams to rebury.