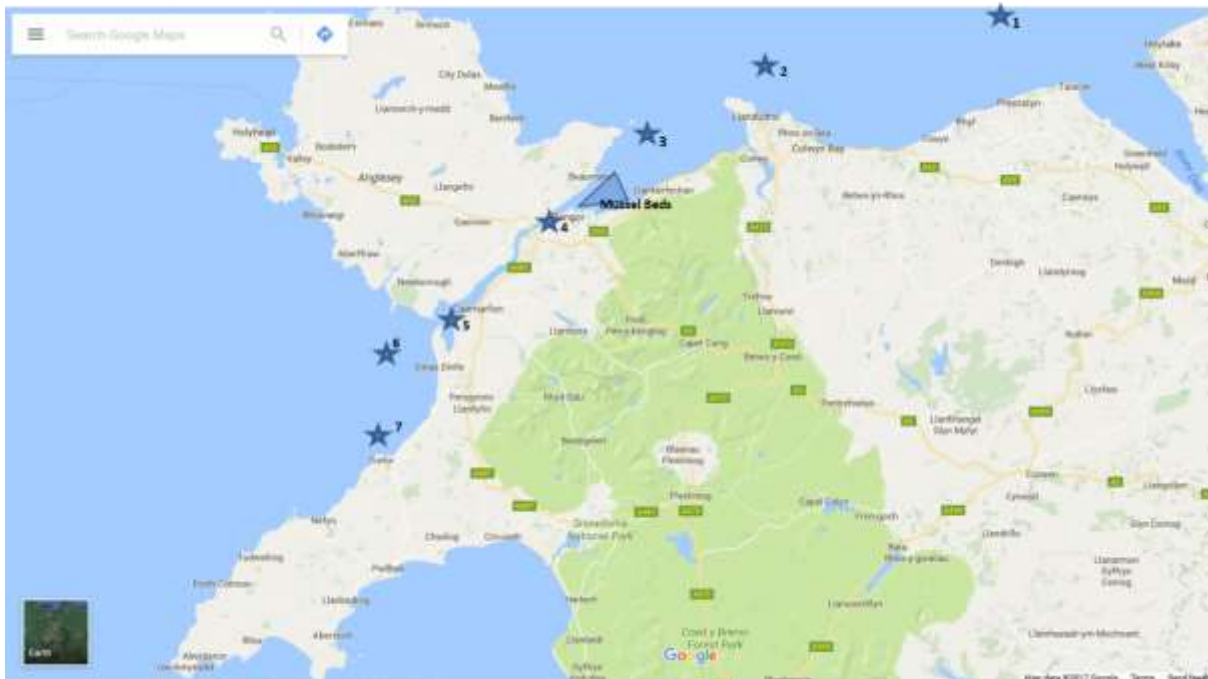


## Workpackage 4b. Monitoring of the Bivalve larvae to determine spawning patterns

In an attempt to establish the timing of a mussel spawning event and to quantify and assess the planktonic mussel larvae in the Menai area, we selected 7 sites along a transect extending West and East of the Bangor mussel beds for regular sampling. Sites 2-5 were sampled weekly throughout April and May and then fortnightly. Sites 6 and 7 were sampled alternately. Site 1 sampling is irregular. All sites are sampled in triplicate.

Location is based on a number of factors: proximity to known brood stock, knowledge on current direction, historical seed mussel settlements and practicality of access. The sampling points are:

- |   |                          |
|---|--------------------------|
| 1. Gwynt y Mor, offshore wind farm (boat):    | 53°29'30.6"N 3°32'04.7"W |
| 2. Orme (constable bank) open water (boat):   | 53°22'58.9"N 3°48'50.2"W |
| 3. CAMS pilot aquaculture designation (boat): | 53°18'60.7"N 3°59'39.2"W |
| 4. Bangor Pier (over half grown husbandry)    | 53°14'26.0"N 4°07'33.4"W |
| 5. Fort Belan (boat):                         | 53°07'21.9"N 4°19'48.4"W |
| 6. Caernarfon Bar (boat):                     | 53°06'53.4"N 4°21'17.9"W |
| 7. Trefor (boat):                             | 53°00'00.7"N 4°25'19.6"W |



## Method

Sampling began at the end of March at the chosen locations and has continued throughout the summer, sites 2 -7 are sampled by Bangor University, whilst site 1 is sampled on our behalf by Gwynt y Mor windfarm staff on the turbine transfer vessel. Initially sampling was undertaken weekly to coincide with peak levels in bivalve larvae, this dropped to fortnightly as bivalve larvae levels in the plankton decreased (August).

Three samples were collected at each site using a 100µm, 35cm opening plankton net, weighted to allow a vertical haul through the entire water column. To ensure parity between Irish and Welsh surveys, this is in line with the protocol used by project partners BIM. The net was deployed to

within a few meters of the sea bed, depth noted and then slowly hauled to the surface. Net contents were washed into a 250ml pre-labelled bottle and fixed with Lugols Iodine or ethanol depending on onward processing. The following environmental parameters were noted for each site:

<i>Date and time</i>	<i>Depth (sounder reading where possible)</i>
<i>Water temp</i>	<i>Weather conditions (wind and sea state)</i>
<i>Current speed and direction</i>	

Those samples taken by Gwynt y Mor (site 1) were delivered to Menai Bridge for processing. Following collection, a 5 ml sub-sample from each 300 ml sample bottle was removed, with each sample being fixed in 90% Ethanol and stored in 70% Ethanol prior to storage in a -80 °C freezer for genetic analysis. A further five, one ml sub-samples were removed from each 300 ml sample bottle and placed on a Sedgewick-Rafter counting cell in order to count the number of bivalve larvae present under a compound microscope. This data was used to determine the number of bivalve larvae present per cubic meter in the water column at each site. The remaining samples were then preserved in Lugol's iodine for later analysis.

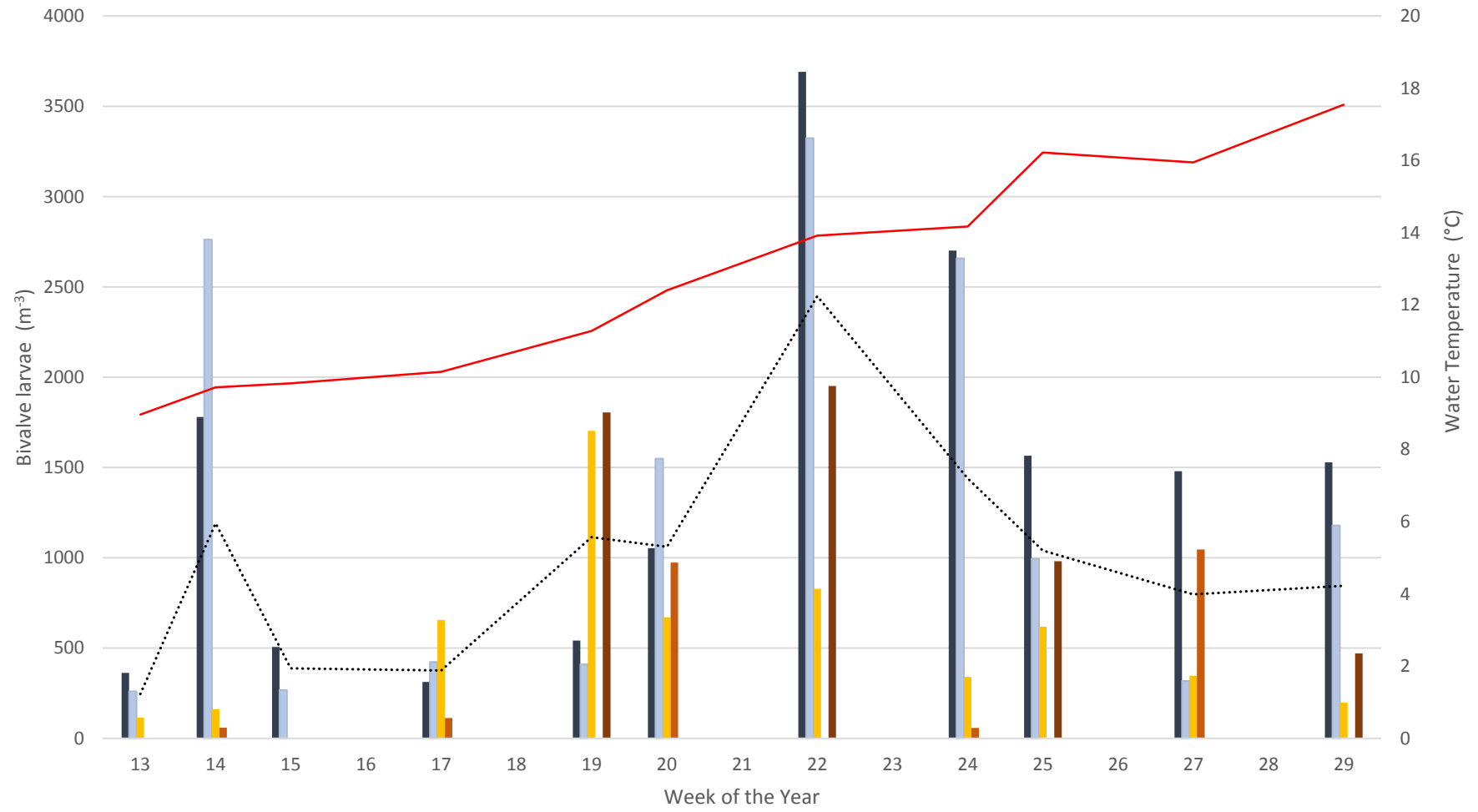
## Results

Given that it was not always possible to visit all the selected sites on the same day due to tides/weather conditions it was often necessary to sample over a number of days as such specific sampling dates haven't been used to present the data and instead have been grouped into the week of the year they were taken (table 1). Initially plotting of the data showed 2 clear peaks in larvae concentrations, at week 14 and then at week 22 (figure 2). However, there appears to be a clear geographical split in the data sets; Menai East and Menai West (figs 3 and 4). Sites East of the Menai Straits showed an early peak at week 14 (see fig 3) which was not observed in Menai West samples (fig 4). From week 19 onwards bivalve larvae concentrations in all samples began to increase, peaking during week 22 (figure 2). This presence dropped away quite rapidly in Menai West samples by week 24 (fig 3) and although numbers crept back up they were much less than those observed in Menai East samples. By comparison, following an initial drop between week 22 and week 24 the samples taken in Menai East maintained a fairly steady concentration between weeks 24 and 29 with a mean of 898 – 1353 mussel m<sup>-3</sup> (fig 3).

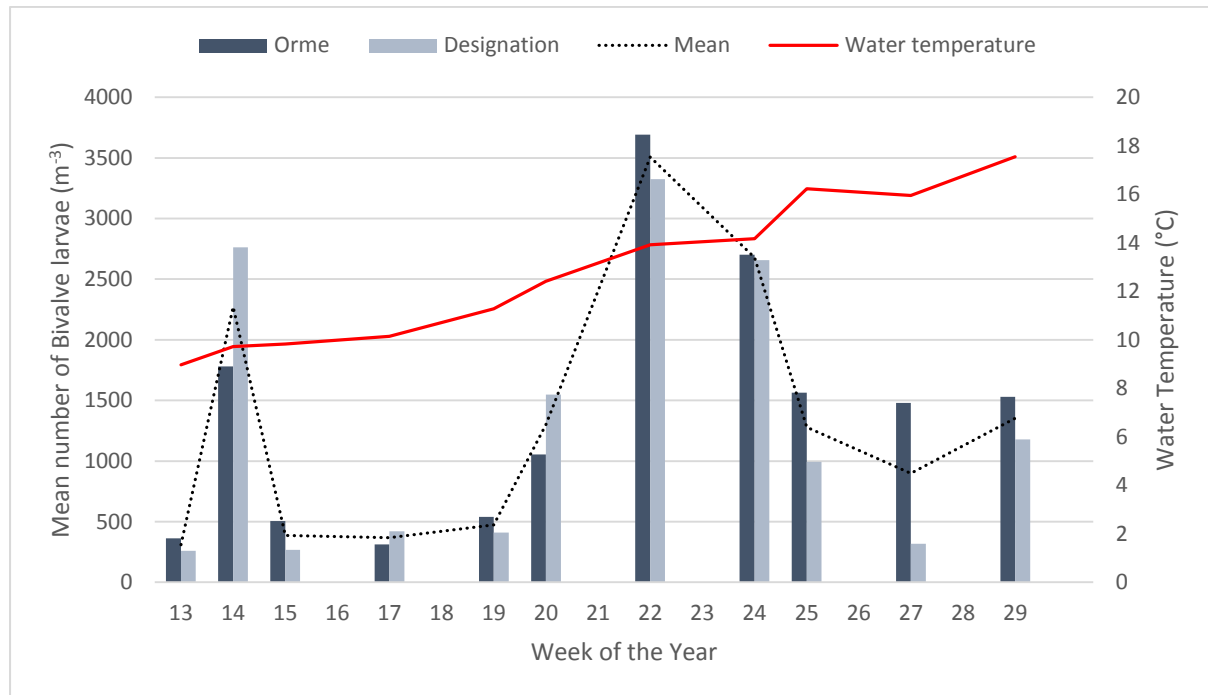
**Table 1. Table showing the dates for each week of the year.**

<b>Week of the year</b>	<b>Week commencing</b>	<b>Week commencing</b>	<b>Week of the year</b>
<b>13</b>	27 March	<b>22</b>	29 May
<b>14</b>	3 April	<b>23</b>	5 June
<b>15</b>	10 April	<b>24</b>	12 June
<b>16</b>	17 April	<b>25</b>	19 June
<b>17</b>	24 April	<b>26</b>	26 June
<b>18</b>	1st May	<b>27</b>	03 July
<b>19</b>	8 May	<b>28</b>	10 July
<b>20</b>	15 May	<b>29</b>	17 July
<b>21</b>	22 May	<b>30</b>	24 July

Orme
  Designation
  Belan
  Trefor
  Caernarfon Bay
  Mean
  Water temperature

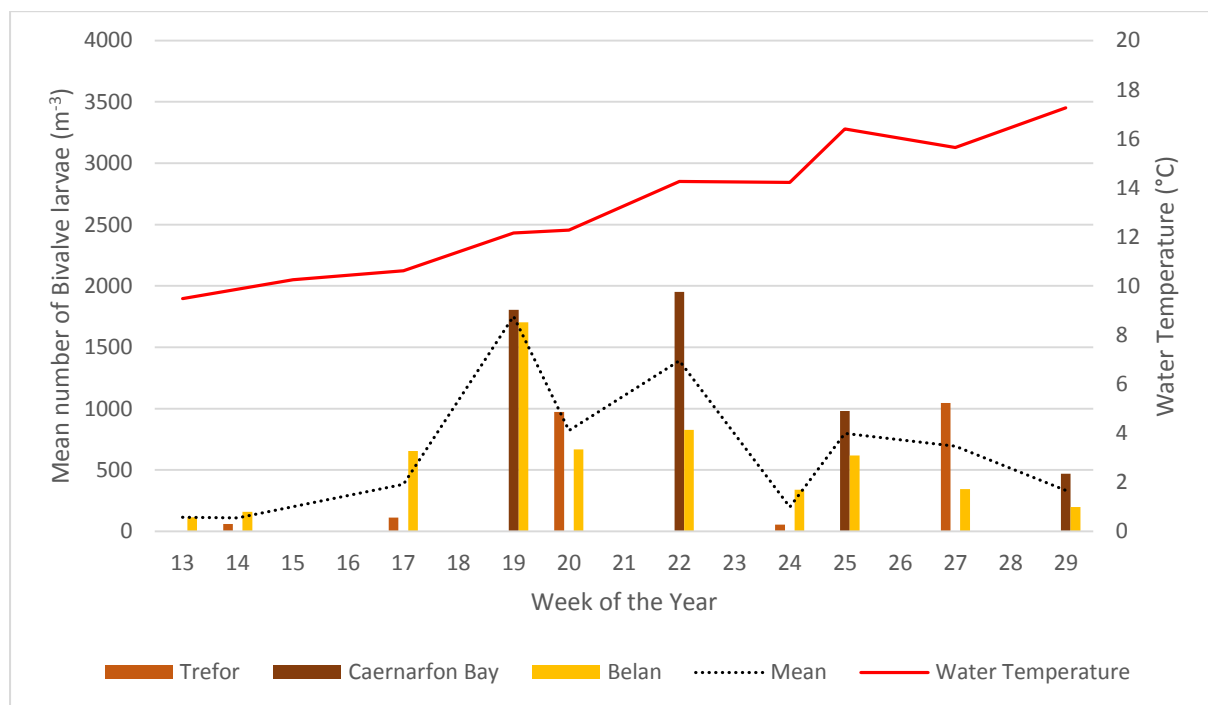


### Menai East



**Figure 3. Water Temperature and site specific and overall mean concentration of bivalve larvae (m<sup>-3</sup>) observed over a period of 17 weeks in the water column at constable Bank off the great Orme and at an open water site designated for aquaculture situated between Penmaenmawr and Puffin Island.**

### Menai West



**Figure 4. Water Temperature and site specific and overall mean concentration of bivalve larvae (m<sup>-3</sup>) observed over a period of 17 weeks in the water column at 3 sites: Trefor, Caernarfon Bay and Fort Belan at the mouth of the Menai Straits .**

## Husbandry Maturity Monitoring - Establishing a spawning event

Mussel meat yield in the local mussel population (wild and farmed) ranges from 20 – 30% in reproductively mature stocks and following a spawning event will reduce rapidly by around 5%. By monitoring mussel meat yield in wild and farmed mussel stocks at selected locations we will have some indication of spawning in the Menai Straits and wider Anglesey mussel populations.

This monitoring programme commenced on the 22<sup>nd</sup> February 2017 and is ongoing, taking into account any secondary spawning events in late summer. Locations are as follows:

*Red Wharf Bay (wild stock)*  
*Brynsiencyn (wild stock)*

*Fort Belan (wild stock)*

Locations were selected for access on variable tides and proximity to farmed beds in relation to predicted current flow. It is worth noting that the husbandry was fished out before an obvious spawning event. There was an option to monitor the half grown husbandry but this is reliant on a spring tide so any yield data would be less consistent.

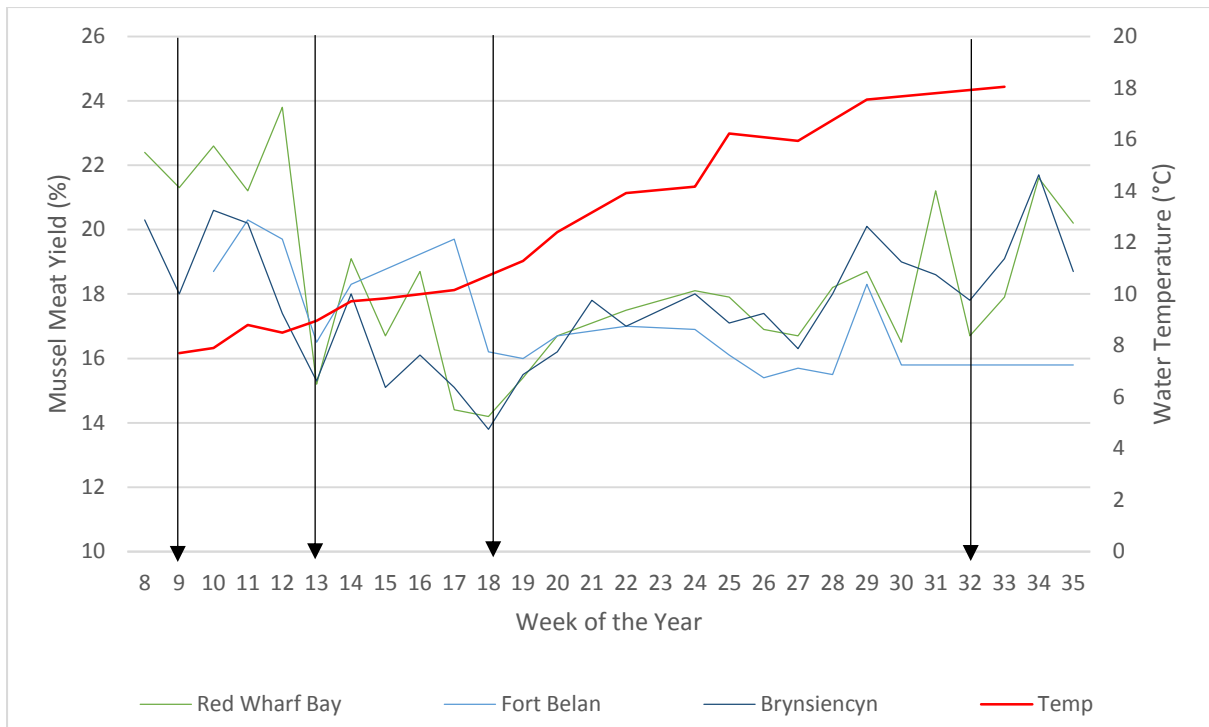
Meat Yield is calculated as:

$$\text{Meat Yield} = \frac{\text{Cooked meat wgt}}{(\text{empty shell wgt} + \text{cooked meat wgt})} \times 100$$

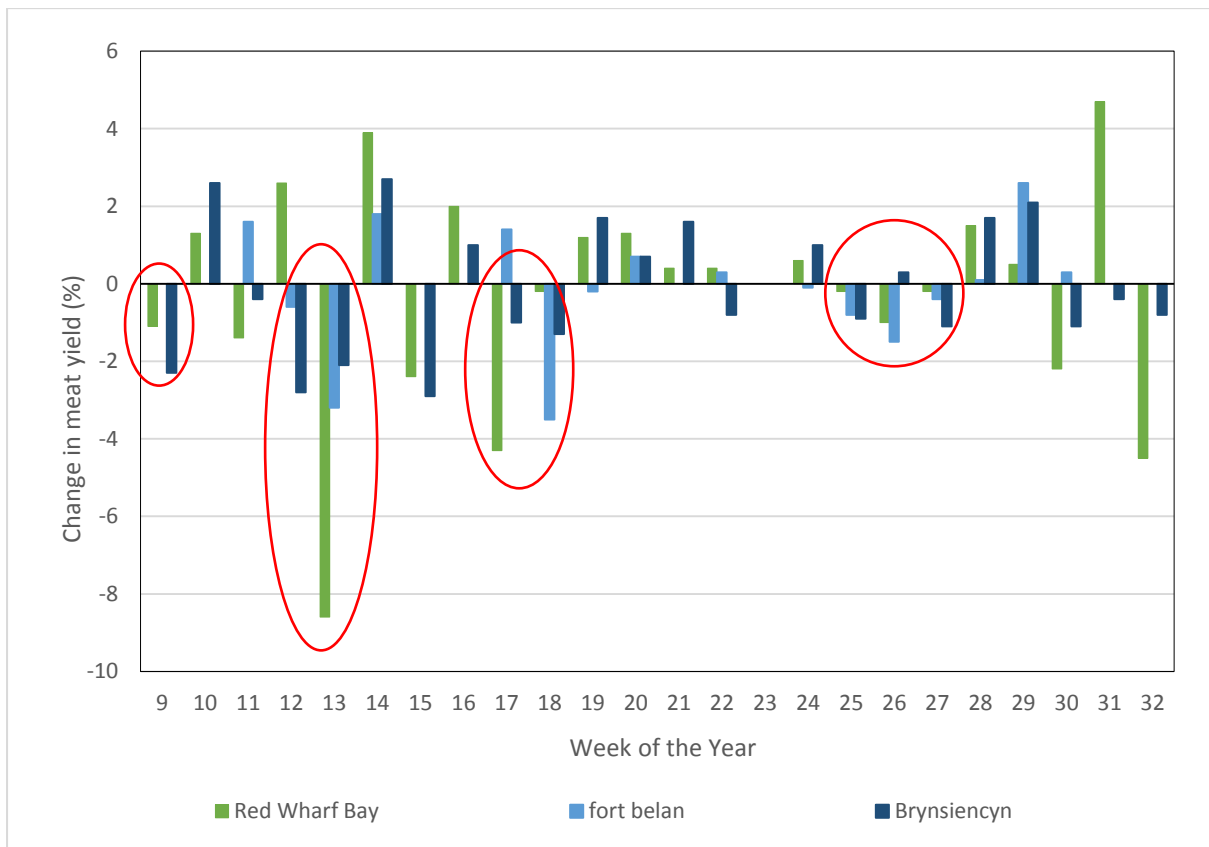
This information along with the daily temperature in the Straits is then entered into an online google sheet [Open in Sheets](#) accessible in real time by any invited parties. Mussel Farmers can track meat yield of the mussels they are supplying as well as monitoring the state of wild populations. In addition the sheet will allow us to gauge rising water temperature and the optimal temperature for a spawning event.

## Results

From figure 5 we can see that the meat yield showed 4 distinct decreases (a more than 2% drop) over the 17 week monitoring period at weeks 9, 13, 18 and 32. With indications of trickle spawning evident with populations showing build-ups in yield followed by minor losses across the sampling period. Interestingly the peak in larvae numbers at week 22 does not coincide with a preceding drop in meat yield. Increases in mussel larvae numbers to significant levels begins in week 19 and 20 and this coincides with a drop (fig 6) at week 17-18 however there were no significant meat yield losses preceding the greatest recorded larval numbers at week 22. Genetic evaluation of samples would be useful to indicate whether this sample is *m.edulis* or perhaps another bivalve species.



**Figure 5. The meat yield (%) observed in three wild *Mytilus edulis* populations in proximity to the Menai Strait: Red Wharf Bay and Brynsiencyn, Anglesey and Fort Belan, Caernarfon.**



**Figure 6. The weekly fluctuation in meat yield (%) observed in three wild *Mytilus edulis* populations in proximity to the Menai Strait: Red Wharf Bay and Brynsiencyn, Anglesey and Fort Belan, Caernarfon.**