Orkney Sustainable Fisheries Ltd

Lobster preliminary Trial

The following methodology is a draft outline of the proposed experiment. Any area is subject to change regarding cost and logistical issues before commencement.

Aim of Research

To assess gabions as suitable sites for juvenile European Lobster's *Homarus gammarus* settlement and their use as a low cost habitat enhancement tool.

Rational

Attempts in locating juvenile European lobsters *Homarus gammarus* in-situ has been limited or periodic (Howard & bennet, 1979; Jensen & Collins, 1995). In contrast to its American Cousin *Homarus americanus* extensive research into population structure and geographical variation in stocks has highlighted strong correlations between environmental variables affecting its abundance and seasonal variations in distributions, successfully aiding in its management.

This American research has highlighted cobble habitat as the primary habitat preference for early benthic phase (EBP) *H. americanus (*5mm – 40mm carapace length (CL)) due to the creation of interstitial spaces (Hudon, 1987; Wahle & Steneck, 1991). Similar habitat preferences have been exhibited in EBP *H.gammaurs* within experimental studies (Linnae *et al*, 2000; Ball *et al*, 2001), but has not been observed in naturally occurring populations but is believed to be the case. These studies however have highlighted the lack of suitable EBP lobster habitat as a potential significant bottleneck in recruitment (Caddy, 1986; Wahle & Steneck, 1991; Wahle & Steneck, 1992), with these habitats becomes highly saturated over the course of a settlement season due to their limited availability (Wahle & Incze. 1997). Wahle & Steneck (1991) demonstrated that within 60.2km of Maine coastline only 11% was identified as suitable EBP lobster habitat and was sparsely distributed. Such specific requirements needed for settlement can have significant effects on populations, creating recruitment bottlenecks. Potentially decreasing reproductive potential outside of current existing management strategies, such as V-notching and maximum landing sizes.

However research into the use of artificial habitat has shown success in increase carrying capacity. Bologna & Steneck (1993) investigated the use of artificial kelp forests as habitat enhancement tool for adult *Homarus americanus*, showing positive benefits of increased carrying capacity in comparison to non- enhanced areas and alongside areas of existing habitat. More specifically to EBP lobsters, artificial reef structures within Poole Bay have demonstrated effectiveness by harbouring EBP *H.gammarus* lobsters (27mm CL) and subsequent larger lobsters, including berried hens (Jensen & Collins, 1995).

Such success in the deployment of artificial structures within the USA and Southern England presents the opportunity to trial such habitat enhancement projects within Orkney waters as part of a larger management scheme.

Specific Objectives

We will investigate the deployment of gabions as a habitat enhancement tool, establishing the correct size aggregate need to replicate the desired crevices required for settlement and the appropriate size of EBP lobster needed for such a deployment.

Methodology

Time Frame

The experiment will take place From October 2014 – April 2015, allowing for the collection of stage IV and VII hatchery reared larvae to be acquired at the beginning of the study.

Site

The Experiment will be undertaken with Orkney Fisherman Society "Ponds". This site benefits from being positioned centrally within Storminess Harbour with in-house pump facilities allowing EBP lobsters to be exposed to seasonal variation on sea temperature and salinity.

Holding Tanks & Trial Gabions

8 Tanks (Fig 1) will be used; each will be filled to a height of approximately 35cm providing a volume of 394Ltrs allowing sufficient submergence of trial gabions (Fig 2). Each tank is has 1inch of insulation reducing the effect of water temperature changes. Each Tank will be fed a constant supply of sea water through a filtration system. 32 black Trial gabions will be used (Fig 2), divided into 4 treatment groups, comprising of 8 replicates per treatment. Treatments (T) consist of varying gravel chip size (inches); T1: 1", T2: 2", T3: 3", T4: 4". Each treatment gabion will have a different mesh size allowing for the transition of lobster from one to another. These mesh sizes are; T1: 6mm X 18mm, T2: 6mm X 31mm, T3: 15mm X 31mm, T4: 14 mm X 50mm. Individual tank temperatures will be also recorded daily.

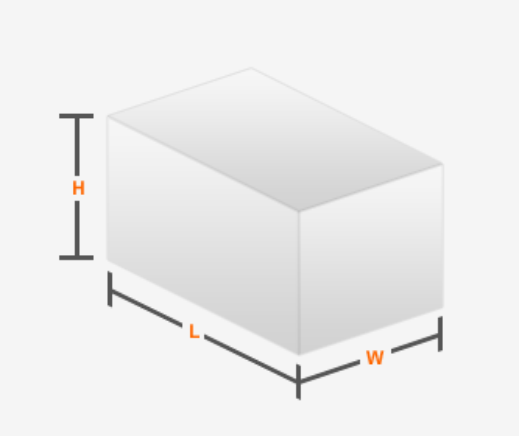

Figure 1. Internal dimensions of tanks (cm): H: 60, L: 116, W: 97

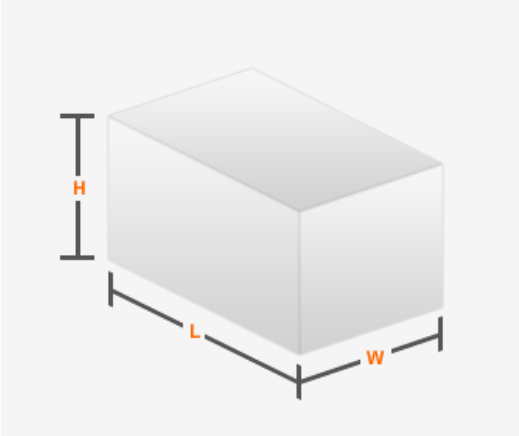

Figure 2. Internal dimension of gabions (cm): H: 20, L: 26, W: 27

Lobster Larvae

350 EBP *H.gammarus* Larvae will be required and will be provided by The Orkney Lobster hatchery. This will comprise of 175 stage IV individuals (fig 3) and 175 stage VII Individuals (fig 3).

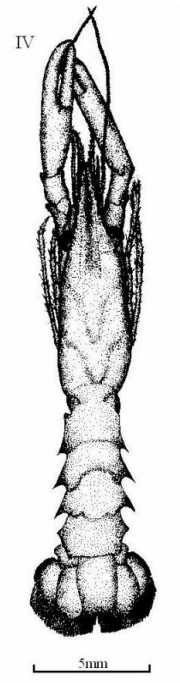

Figure 3. European Lobsters larvae *Homarus gammarus* . Stage IV measure ~ 30mm, Stage VII measure ~80mm.

Filtration – Approximate cost £300

One of two following filtration systems can be used depending of cost and future use of the system.

Filtration System 1:

Filtration can be achieved through the use two K1 moving bed filter media tanks, sediment settlement tanks and reservoir tanks within a closed loop filtration system (Fig5). K1 moving bed filters provide excellent biological filtration through the use of small media with high surface area (Fig4). This filtration system works by media being forced around the filter knocking off old aerobic bacteria facilitating new growth, subsequently ensuring efficiency. One K1 filter set up can filter 4 tanks. The K1Filter will provide both mechanical and biological filtration and require minimum maintenance over the duration of the experiment. Filtration will be left to mature for a period of 3 weeks prior to lobster introduction.

Figure 4. K1 filtration media.

Filtrations System 2:

Filtration can be achieved through individual sumps per tank (Fig6). This allows for individual maintenance of filters per tank and quarantine of individual tanks if required. Filtration will be left to mature for a period of 3 weeks prior to lobster introduction.

Gabion Experiment

Each tank will be filled with 4 gabions, one per treatment group. Each tank will be seeded with approximately 200ml of amphipod biomass and left to settle for 3 weeks, allowing of seeded amphipod to colonize and filtration media maturation. The use of amphipods biomass has been selected to replicate natural occurrence of soft bodied invertebrates that inhabit interstitial spaces which are a significant food source (Cooper & Uzmann, 1980).

After 3 weeks, 175 stage IV EBP lobsters will be introduced into 4 tanks and 175 stage VI EBP lobsters into the remaining tanks.

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Early Settlement Experiment

Rate of Colonization will be examined immediately after *H.gammarus* introduction, with the number of individual present outside of gabion structures recorded in 5 minute intervals.

This will allow for a comparison between the rates of colonization of the two size classes .Colonization rate will be sampled by recording the number of individuals visible outside of gabions at 5 minute intervals. Gabion preference will not be recorded due to primary interest relating to differences in predation avoidance behaviours between the two size classes.

From this data we will assess time taken for colonization to occur and which size class is most suitable for the seeding of sea going structures. Depending on the outcome of this experiment recommendations will be passed onto Orkney Lobster hatchery concerning current release sizes.

Long Term Experiment

After introduction tanks will be left for 1 week after which gabions will be removed and dismantled. EBP lobster numbers will then be recorded per gabion and morphometric measurements taken. Gabions will be re- assembled and both EBP lobsters and gabions returned to tanks. The process will be repeated at 2 weekly intervals for the duration of the study.

The frequency of sampling will allow accurate changes in movement between gabions to be recorded, whilst allowing for rates of decline in individuals to simultaneously monitored. Morphometric measurements will be measured with Vernier callipers in the form of carapace length, along with cheliped number for each individual. Cheliped number will provide an insight into EBP lobster interaction. Gabions will be dismantled as carefully as possible to reduce stress and mortality to EBP lobsters; however some degree of mortality is expected to occur.

From this data we aim to calculate the carrying capacity of larger gabions used for sea deployment and statistically analyse changes in distribution of juveniles between treatments over time.

Expected Conditions, Limitations or Restrictions

Expected limitations can be broken into three main categories; artificial environment, water quality and food availability.

The use of tanks presents a number of limitations including the removal of important chemical cues that would influence behaviour such as the presence of existing adult lobsters and other predators. This could result in gabions not being used at all due to their absence. The placement of filtration inflow and outflow must also be identical across all replicates so as to negate the effect of water turbidly in isolated areas or onto single gabions.

Water quality presents an issue relating to the use of harbour water within experimental tanks and the effects of potential containments e.g., engine oil, silt. However the use of harbour water reduces costs linked with artificially producing the required amount of salt water. Therefore saltwater purification will be achieved through passive means. Tank water quality will simultaneously be maintained through weekly 50% water changes.

Due to the nature of the artificial environment it is expected that there will be a high level of EBP lobster mortality at the begging of the experiment with the primary concern being the cannibalization behaviour exhibited. However this is expected to occur within the wild but consideration must be taken to the reduced ability to exhibit a flee response due to experimental conditions, potentially resulting in a higher level of cannibalization than would naturally occur.

Providing suitable nutrients to EBP lobsters over the duration of the project raises its own issues, primarily due to lack of information surrounding feeding habits at these life stages. Existing literature focus on hatchery reared lobsters to stage 4 and housing lobsters of commercially landable size after capture. Therefore a combination of the two strategies will be used; the initial seeding of amphipod biomass and subsequent use of brine shrimp (*Artemia sp*.) when the collection of large quantities become unfeasible.

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Figure 5. K1 Filtration schematic per 4 tanks. Illustrates the use of one K1 filter, reservoir and the placement of Pumps and shut off valves.

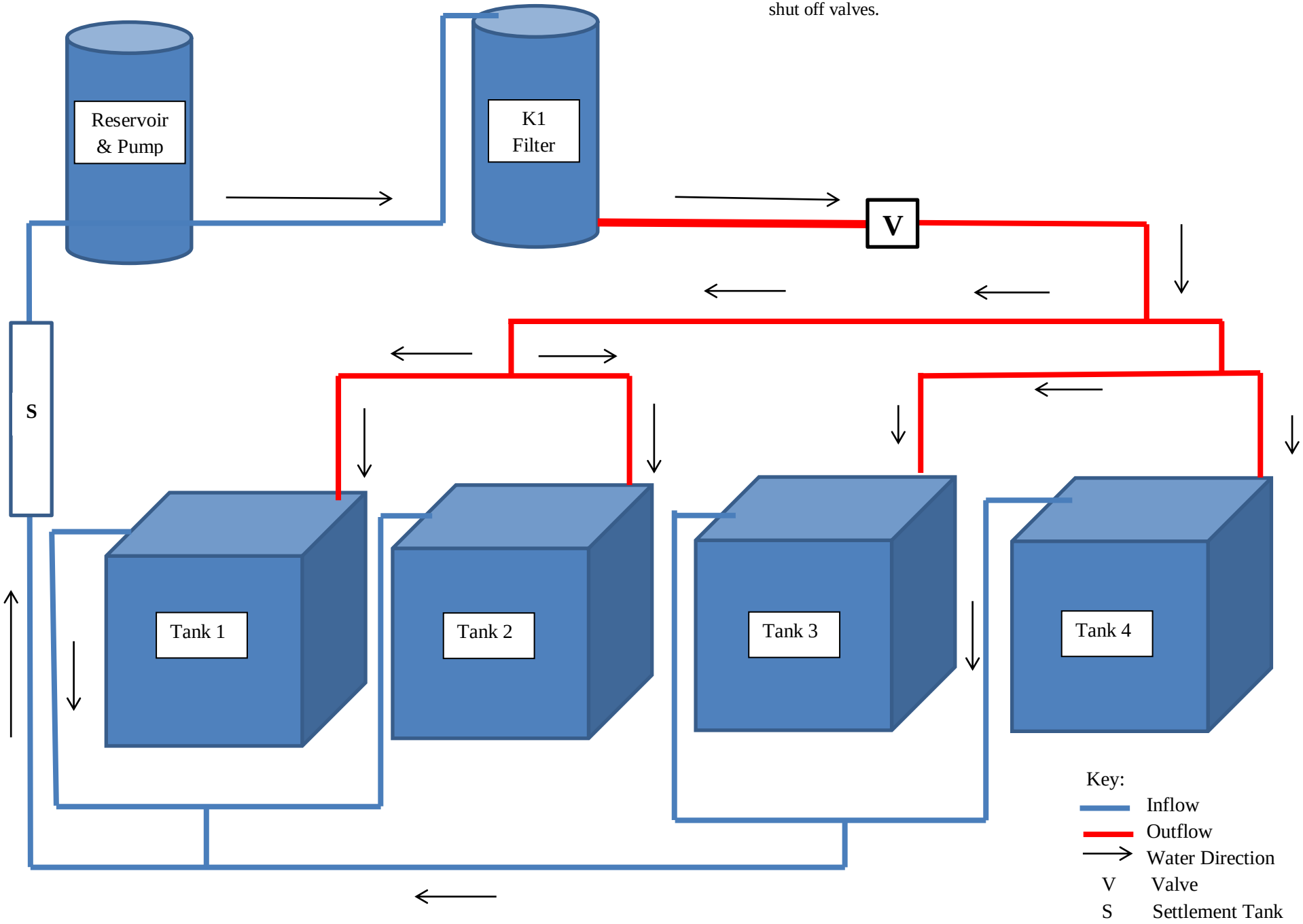
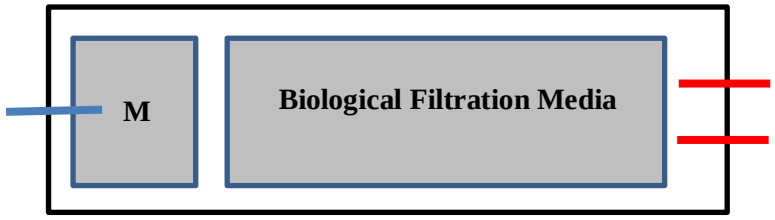
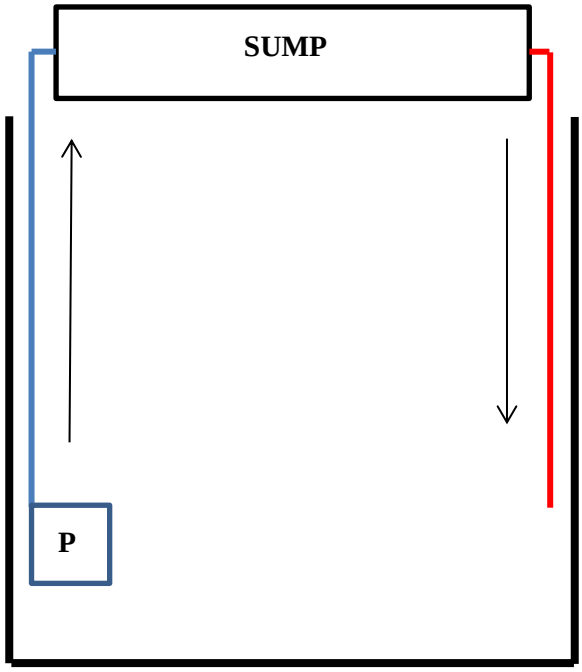


Figure 6. Sump Tanks Filtration Schematic





Key:

Inflow

Outflow

Water Direction

P Pump

M Mechanical Filtration Media

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