

## Discussion

The littoral survey, in front of the proposed fendered berth, revealed six different biotopes. Starting at the sublittoral fringe, the biotope was an overlap of the upper infralittoral biotope, IR.LIR.K.Lsac.Ldig and the lower eulittoral biotope, LR.LLR.F.Fserr. Sheltered boulders, cobbles and pebbles were covered by a canopy of the kelp, *Laminaria digitata* and to a lesser extent, *Fucus serratus*. Above this was a lower eulittoral community of abundant *Fucus serratus* on stable boulders, cobbles and pebbles with an associated community (LR.LLR.F.Fserr). This led onto the mid eulittoral biotope of *Ascophyllum nodosum* on full salinity sheltered rock (LR.LLR.F.Asc.FS). Above this was a narrow band of upper eulittoral boulders and cobbles covered by the brown seaweed, *Fucus spiralis* (LR.LLR.F.Fspi.FS). Further up the upper eulittoral, the biotope changed to *Pelvetia canaliculata* on bedrock and boulders (LR.LLR.F.Pel). The final biotope, in the supralittoral fringe, was yellow and grey lichens (LR.FLR.Lic.YG) on bedrock and boulders.

The littoral site in front of the proposed slipway and barge ramp was less steeply sloping, with significantly more gravel and coarse sand. It showed a similar, classic, biotope pattern. At low water the biotope was *Fucus serratus* on full salinity, sheltered, lower eulittoral, mixed substrata (LR.LLR.F.Fserr.X), leading onto *Ascophyllum nodosum* on mid eulittoral mixed substrate (LR.LLR.F.Asc.X). The upper eulittoral was *Fucus spiralis* on boulders, cobbles and pebbles (LR.LLR.F.Fspi.X), below *Pelvetia canaliculata* on a substrate of cobbles, pebbles and stone gravel (LR.LLR.F.Pel). Finally a maritime lichen community occurred in the supralittoral on small boulders and cobbles (LR.FLR.Lic.YG).



Both sites illustrate a typical low energy, littoral rocky shore zonation, prevalent throughout the area. Presumably significant damage will occur to the foreshore during construction. However, rocky shores are not in short supply, nor is their physical structure particularly sensitive to anthropogenic impact (Hill, 1998). Rocky shores communities generally recover naturally from anthropogenic impacts, with any construction structures often providing new habitats for the recovering communities.

Four principle biotopes were found during the sublittoral survey. The upper infralittoral (0-3.2m bcd) revealed a hard substrate of upper infralittoral small boulders, cobbles, pebbles and gravel, with encrusting red coralline algae. The kelp, *Laminaria saccharina*, growing in its sheltered waters cape form was the characterising species, alongside *Laminaria digitata* and rare *Laminaria hyperborea*. Beneath the kelp canopy an understorey of red seaweeds was present (IR.LIR.K.Lsac.Ldig). A sparse animal fauna was recorded.

Below this biotope was a modified hard substrate of highly silted, lower infralittoral (3.2-9.2m bcd), small boulders, cobbles, pebbles and gravel, with occasional encrusting red coralline algae. *Laminaria saccharina*, growing in its sheltered waters cape form was the characterising species. Beneath the kelp canopy were a limited number of associated red

seaweeds (IR.LIR.K.Lsac.Pk). The high quantities of silt and the reduced light intensity beneath the kelp presumably contributed to the sparse epiflora. Again, a sparse animal fauna was recorded.

The upper circalittoral (9.2-17.0m bcd) was a similarly modified, hard substrate of highly silted, small boulders, cobbles, pebbles and gravel, with a very sparse fauna of *Protanthea simplex*, *Asterias rubens*, *Pagurus bernhardus*, and *Inachus* and *Macropodia* species. All other species recorded were found to be rare. This biotope was impossible to accurately assign a biotope code and a habitat complex was assigned to it (CR.LCR).

The lower circalittoral (17.0-26.6m bcd) habitat comprised an expansive plain of cohesive mud or silt, overlying a cobble and pebble matrix, that was bioturbated by burrowing megafauna with a conspicuous population of seapens, predominantly *Pennatula phosphorea* (SS.SMU.CFiMu.SpnMeg).

The three biotopes from the upper infralittoral to the upper circalittoral were all in poor condition with a generally sparse flora and fauna. The *Laminaria* plants from the first two biotopes are not classed as sensitive (Hiscock, 1997); they are relatively tolerant of organic and inorganic pollution and show a relatively quick recoverability (strong recruitment and reach maturity within a few years). The sensitivity of most other species in these biotopes is very poorly understood. However the level of siltation present and tolerated, suggests that only the communities close to any construction works are likely to be affected and recovery should be reasonably rapid as long as best management practices are implemented.

The lower circalittoral biotope, sea pen and burrowing megafaunal communities, is considered a valuable habitat.

Sea pens are pennatulid anthozoans of which there are three British species, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*. They are the most conspicuous epibenthic species in the seven bioturbated mud biotopes found in Scottish sea lochs (Hughes, 1998). Under the MNCR marine biotope classification system, the mud habitat type, SS.SMU.CFiMu.SpnMeg usually contains a high percentage occurrence of two of these sea pens, *Virgularia mirabilis* and *Pennatula phosphorea*. These sea pens and their associated mud habitats and burrowing



*Pennatula phosphorea*



*Virgularia mirabilis*

megafauna are on the list of Priority Marine Features for Scottish Territorial waters (final draft).

Almost nothing is known about the population dynamics of the British sea pens, but data from other species suggest that they are likely to be long-lived and slow-growing, with patchy and intermittent recruitment.

The sensitivity of individual species of sea pen to anthropogenic factors is poorly known. Observational evidence from towed video and diving surveys (Hughes, 1998) suggests that organic pollution and trawling for *Nephrops norvegicus* are the two human activities most likely to affect their biotope complex.

The most important known agent of change in soft-sediment communities is organic enrichment, leading to oxygen depletion. Oxygen depletion can occur naturally as a result of warm summer temperatures combined with prolonged stratification of the water column, but can also be induced by human activities (eg. sewage disposal or cage aquaculture). Wilding (2011) has shown sea pen abundance to reduce in close proximity to a salmon farm.

The surveyed biotope was not a classic example of a seapen and burrowed mud community with only occasional *Nephrops norvegicus*, frequent *Pennatula phosphorea* and rare *Virgularia mirabilis*. The habitat is presumably quite extensive, but also a significant distance away from the proposed development. It is a biotope thought to be effected by organic enrichment, but is unlikely to be affected by moderate inorganic siltation and with careful mitigation the Eisein Marine Access proposals should have no significant effect on it.