



FISHNISH A, SOUND OF MULL

NEWDEPOMOD REPORT

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| Report To | Scottish Environment Protection Agency |
| Report ID | 0522-1 |
| Status | V1 |
| Date | 31 May 2022 |

Scottish Sea Farms Ltd

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EXECUTIVE SUMMARY

Modelling has been carried out by Scottish Sea farms Ltd (SSF) to recover the historical biomass consent of 1300 tonnes at the recently reconfigured marine cage fish farm Fishnish A (CAR/L/1003493).

This site has been subject to cuts in the past due to the high bed speeds at the site being poorly represented in the previous modelling tool AutoDEPOMOD. This report will show that a biomass of 1300 tonnes comfortably meets SEPA standards using the Standard Default Approach as outlined in the current SEPA guidance (SEPA 2019).

A maximum consented biomass of **1300 tonnes** with a stocking density of **10.6356 kg/m³** is applied for this configuration. Marine modelling has been carried out with regards to Bath Medicine modelling and has been provided with this application in the report *Fishnish A, Sound of Mull Bath Medicine Dispersion Report*. New transects and sample stations, in line with current SEPA regulation, have been identified.

As per the SEPA technical guidance document *Application of the interim position statement on emamectin benzoate discharges* (SEPA 2021) we do not intend to change the cage layout or increase the authorised total allowable quantity (TAQ) at this site and therefore no change to the footprint is expected. For that reason Slice modelling has not been presented in this report, however we do request that the maximum treatment quantity (MTQ) is amended to 455 g to reflect the proposed change in maximum biomass.

Table 1: Consent limits for Biomass and treatment chemicals at Fishnish A.

| Treatment | Recommended consent mass |
|----------------------------|---|
| Biomass | A maximum consent biomass of 1300 t and stocking density 10.6356 kg/m³ is recommended for this site. |
| SLICE (Emamectin Benzoate) | A maximum treatment quantity (MTQ) of 455 g and a total allowable quantity (TAQ) of 1245 g. This is enough chemical to treat the maximum biomass 2.7 times |

1. Introduction

1.1 Site Details

The MCFF Fishnish A is located within Fishnish Bay, Sound of Mull. The site is sheltered from the wind from most southerly directions with the greatest exposure to the wind from northerly directions, and in particular the northwest.

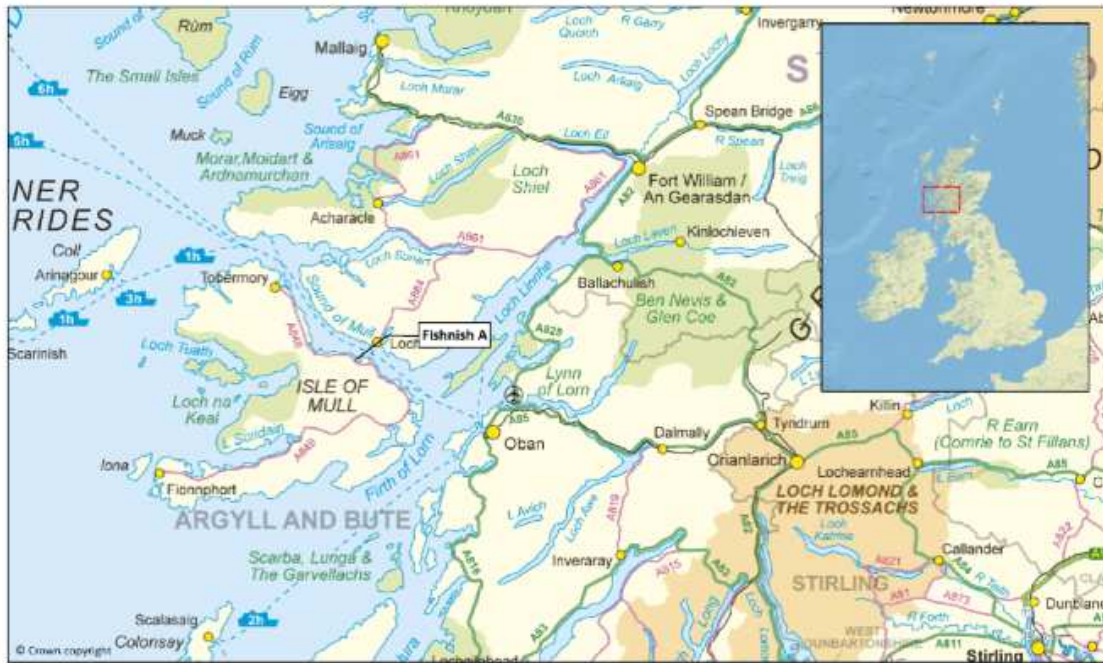


Figure 1: Location of the proposed site relocation for MCFF Fishnish A, Sound of Mull.

2. Model Input Details

2.1 Hydrographic Data

Three separate Acoustic Doppler Current Profiler (ADCP) surveys were carried out at this location in order to collect the 90 days of current speed and direction data required for this site. The details of these surveys are reported in *Fishnish A 2022 Modelling Data Collection Report* (Report No. H0522-1). Data was collected in 2015, 2017 and 2018, appropriate subsets were selected from each of these periods and matched for tidal level and phase where possible and connected together into one 90 day period (Report No, H0522-1) the data has been corrected to grid north ($^{\circ}$ G). The summary statistics for this 90 days is shown in table 2 below.

Table 2: Statistics for the 90-day composite current meter dataset at Fishnish A

| | Near-bed | Pen-bottom | Sub-surface |
|--|-----------------|-------------------|--------------------|
| Mean velocity (m s⁻¹) | 0.118 | 0.123 | 0.121 |
| Min velocity (m s⁻¹) | 0.002 | 0.002 | 0.000 |
| Max velocity (m s⁻¹) | 0.445 | 0.432 | 0.428 |
| Ranked percentage 0.095 m s⁻¹ | 39 % | 35 % | 39 % |
| Major axis (°G) | 135 | 120 | 120 |
| Amplitude anisotropy | 1.74 | 1.9 | 1.75 |
| Residual velocity (m s⁻¹) | 0.04 | 0.06 | 0.05 |
| Residual direction (°G) | 115 | 138 | 135 |
| Parallel Residual (m s⁻¹) | 0.036 | 0.057 | 0.049 |
| Normal Residual (m s⁻¹) | -0.014 | 0.019 | 0.013 |
| Parallel tidal amplitude (m s⁻¹) | 0.158 | 0.157 | 0.161 |
| Normal tidal amplitude (m s⁻¹) | 0.091 | 0.083 | 0.092 |

2.2 NewDepomod Modelling

SSF have used the precautionary Standard Default Approach as outlined in *Regulatory Modelling Guidance for the Aquaculture Sector* (July 2019 – Version 1.1) (SEPA 2019). Model parameters were set as defined in Appendix A of the same document.

A single point 90 day current meter dataset located at (164055.9, 742616.8) was used in combination with a uniform bathymetry at a depth of (29.57 m). The model domain is a 2 km x 2 km regular grid made up of 25 m grid cells with bounding coordinates

Domain.spatial.minX=162870
 Domain.spatial.maxX=164870
 Domain.spatial.minY=741900
 Domain.spatial.maxY=743900

2.3 Run Details

The model was configured to 4 x 160 m circumference cage with a 15 m sidewall and a SD of 10.6356 kg m⁻³ (equivalent to 1300 tonnes) details in table 3 below:

Table 3: Cage setup for model runs 1-4 in FishnishA_2022.

| | CageGroup1 |
|-------------------|------------|
| Origin X (m) | 164167.45 |
| Origin Y (m) | 742615.02 |
| X spacing (m) | 80.00 |
| Y spacing (m) | 80.00 |
| Bearing | 323.00 |
| Cages X | 1 |
| Cages Y | 4 |
| Type | Circles |
| Diameter (m) | 50.93 |
| Net Depth (m) | 15.00 |
| Circumference (m) | 160.00 |

The vertical dispersion coefficient for the resuspension phase ($\sigma_{z,r}$) is set using:

$$\sigma_{z,r} = 0.0003 u^{0.762}$$

where u is mean flow speed at the bed (m s⁻¹).

The 90 day mean flow speed at this site (u) is 0.118372 ms⁻¹ which gives an $\sigma_{z,r}$ of 0.001525128 m² s⁻¹.

Single runs were carried out with 10 particles for 365 days. The model was set to produce output every 3 hours for the last 90 days of the model run. These surfaces were then used to create an aggregated footprint averaged over the last 90 days of the model run.

Bed Residual

In instances where the residual current is >35% of the mean speed at the bed it is required that additional model runs with the residual current removed are included with the application. In this instance, although the residual current is 32.8% of the mean bed current we have chosen to include model runs with the residual speed removed as the more conservative option. We find that these conservative runs are more in line with the results seen in the field during 4 transect benthic surveys. The $\sigma_{z,r}$ of 0.001566987m² s⁻¹ is used for these runs.

3. Modelling Results

3.1 Biomass Results

3.1.1 Full Modelled Flow

A passing run was achieved for a consent biomass of 1300 tonnes and a stocking density of $10.6365 \text{ kg m}^{-3}$.

Available mixing zone area (cage composite area) - 108639 m^2

Predicted mixing zone - 0 m^2

Average intensity within predicted mixing zone - $0 \text{ g m}^{-2} \text{ yr}^{-1}$

The predicted mixing zone for this configuration is 0 % of the available mixing zone area.

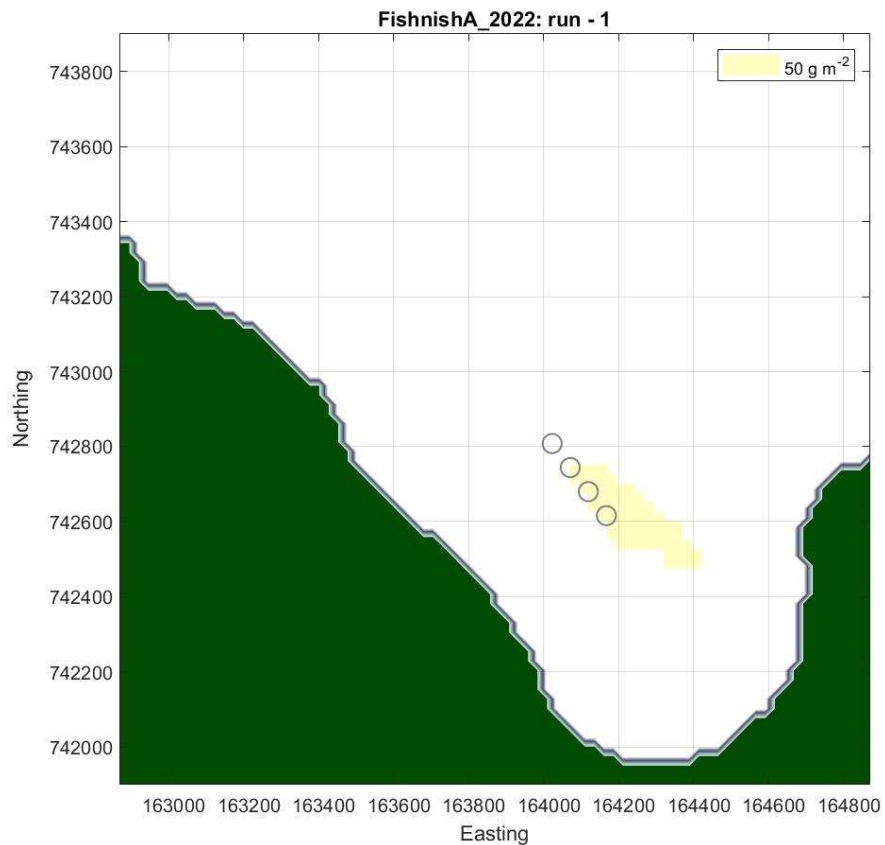


Figure 2: Averaged output from the last 90 day of model run FishnishA_2022-1

3.1.2 No Bed residual flow

A passing run was achieved for a consent biomass of 1300 tonnes and a stocking density of $10.6365 \text{ kg m}^{-3}$.

Available mixing zone area (cage composite area) - 108639 m²
Predicted mixing zone - 31875 m²
Average intensity within predicted mixing zone - 324.6 g m⁻² yr⁻¹

The predicted mixing zone for this configuration is 29.3 % of the available mixing zone area.

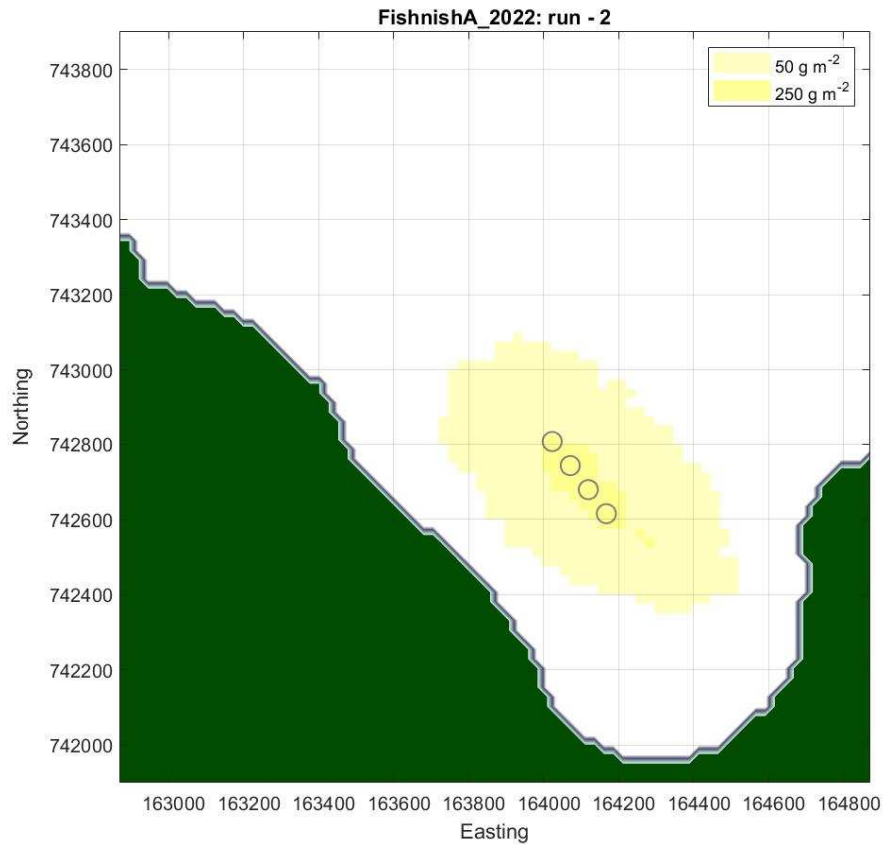


Figure 3: Averaged output from the last 90 day of model run FishnishA_2022-2

In line with the new Environmental Monitoring Protocol four sampling transects have been positioned at orthogonal angles (Fig. 4). Seven sampling stations have been placed along each transect at regular intervals. Stations are detailed in table 4 below.

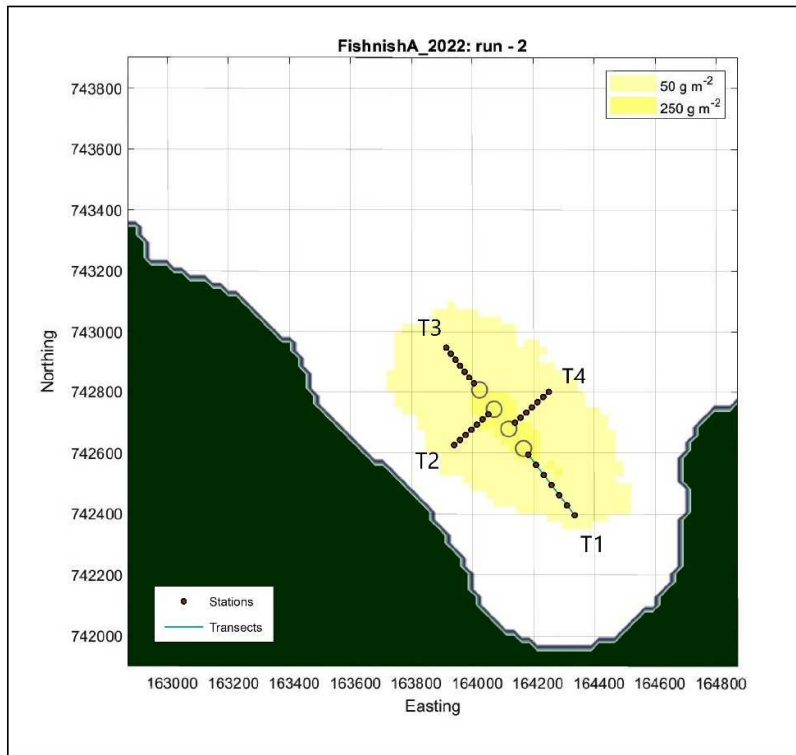


Figure 4: Suggested transects and stations for Fishnish A

Extended 4 transect surveys carried out at this location at the existing maximum biomass of 975 tonnes indicate that the footprint extends between 100 and 200 m meters from the cage edge along the SE transect and up to 50 m along the NE transect with little to no impact along the remaining transects. The EMP transects have been designed with this survey data in mind.

Table 4: Transect and station details.

| Transect | Bearing | Distance (m) | Latitude | Longitude | Easting | Northing |
|----------|---------|--------------|-------------|-------------|-----------|-----------|
| T1 | 140 | 0 | 56° 30.964' | -5° 50.092' | 164183.37 | 742593.46 |
| T1 | 140 | 42 | 56° 30.947' | -5° 50.066' | 164208.74 | 742560.39 |
| T1 | 140 | 83 | 56° 30.930' | -5° 50.039' | 164234.11 | 742527.32 |
| T1 | 140 | 125 | 56° 30.913' | -5° 50.013' | 164259.48 | 742494.25 |
| T1 | 140 | 166 | 56° 30.896' | -5° 49.986' | 164284.85 | 742461.18 |
| T1 | 140 | 208 | 56° 30.879' | -5° 49.960' | 164310.21 | 742428.11 |
| T1 | 140 | 250 | 56° 30.862' | -5° 49.933' | 164335.58 | 742395.04 |
| T2 | 225 | 0 | 56° 30.983' | -5° 50.313' | 163959.38 | 742642.18 |
| T2 | 225 | 25 | 56° 31.022' | -5° 50.244' | 164033.71 | 742709.12 |
| T2 | 225 | 50 | 56° 30.974' | -5° 50.330' | 163940.8 | 742625.44 |
| T2 | 225 | 75 | 56° 31.002' | -5° 50.279' | 163996.55 | 742675.65 |
| T2 | 225 | 100 | 56° 31.012' | -5° 50.261' | 164015.13 | 742692.39 |
| T2 | 225 | 125 | 56° 30.993' | -5° 50.296' | 163977.96 | 742658.91 |
| T2 | 225 | 150 | 56° 31.031' | -5° 50.227' | 164052.29 | 742725.86 |
| T3 | 320 | 0 | 56° 31.085' | -5° 50.278' | 164005.2 | 742828.16 |
| T3 | 320 | 25 | 56° 31.095' | -5° 50.294' | 163990.07 | 742848.07 |
| T3 | 320 | 50 | 56° 31.105' | -5° 50.310' | 163974.94 | 742867.98 |
| T3 | 320 | 75 | 56° 31.116' | -5° 50.326' | 163959.81 | 742887.89 |
| T3 | 320 | 100 | 56° 31.126' | -5° 50.342' | 163944.68 | 742907.8 |
| T3 | 320 | 125 | 56° 31.136' | -5° 50.357' | 163929.55 | 742927.72 |
| T3 | 320 | 150 | 56° 31.146' | -5° 50.373' | 163914.42 | 742947.63 |
| T4 | 45 | 0 | 56° 31.019' | -5° 50.141' | 164139.57 | 742698.59 |
| T4 | 45 | 25 | 56° 31.029' | -5° 50.124' | 164158.15 | 742715.33 |
| T4 | 45 | 50 | 56° 31.038' | -5° 50.106' | 164176.74 | 742732.06 |
| T4 | 45 | 75 | 56° 31.048' | -5° 50.089' | 164195.32 | 742748.8 |
| T4 | 45 | 100 | 56° 31.057' | -5° 50.072' | 164213.9 | 742765.54 |
| T4 | 45 | 125 | 56° 31.067' | -5° 50.055' | 164232.48 | 742782.27 |
| T4 | 45 | 150 | 56° 31.076' | -5° 50.038' | 164251.06 | 742799.01 |

4. Results and Conclusions

NewDEPOMOD simulations using SEPA's standard default approach demonstrate that the proposed increase to the site's historical biomass of 1300 tonnes would meet the relevant EQS criteria. At the proposed biomass the model demonstrates that 29.3% of the available mixing zone area would be utilised indicating that 1300 tonnes is a conservative biomass for this location.

The near bed residual current (0.04 ms^{-1} at 115°) at the current meter location flows east south east towards the eastern side of Fishnish Bay. The modelled output shows no build-up of material at this location it is therefore likely that the current follows the contours of the bay until it eventually meets the more energetic flow of the Sound of Mull. Any material exported from the model grid is likely to be dispersed over the wider Sound of Mull area.

REFERENCES

Scottish Environment Protection Agency (SEPA) (2022) "NewDepomod Draft Guidance – 27/04/2022"

SEPA (2021) Application of the Interim Position Statement on emamectin benzoate discharges – Technical Guidance. Available at <https://www.sepa.org.uk/media/483186/application-of-theinterim-position-statement-on-emamectin-benzoate-discharges.pdf> (accessed: 01/06/22)

Scottish Environment Protection Agency (SEPA) (2019) "Regulatory Modelling Guidance for the Aquaculture Sector" Version 1.1. Available at <https://www.sepa.org.uk/media/450279/regulatory-modelling-guidance-for-the-aquaculture-sector.pdf> (Accessed on 01/12/20)