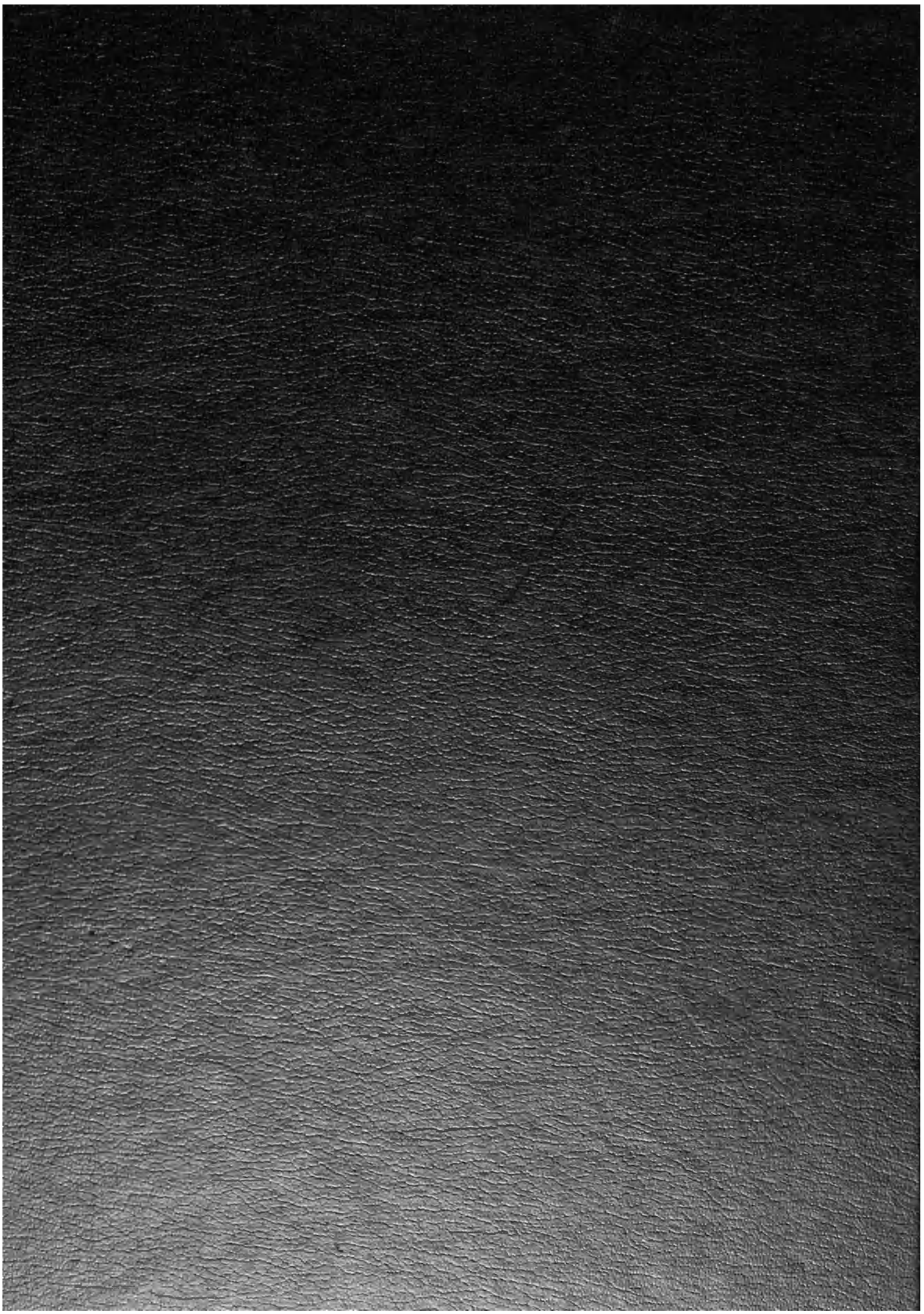

THE EFFECTS OF DIESEL OIL ON THE GROWTH OF THREE SPECIES OF MARINE PHYTOPLANKTON

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Statement of Originality

The work described in this thesis was conducted between 2001 and 2004 at Royal Holloway, University of London, Egham, Surrey, UK. This work was undertaken independently and has not been submitted for consideration previously for a higher degree at this or any other university.

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ABSTRACT

The effects of diesel oil on *Phaeodactylum tricornutm*, *Isochrysis galbana* and *Chlorella salina* and their potential application to bioremediation has been investigated. Phytoplankton growth inhibition tests were carried out using both batch and continuous culture conditions. Batch cultures were carried out to determine the 96 h 50% growth inhibition concentration (96 h IC50), the no observed effect concentration (NOEC) and the lowest observed effect concentration (LOEC). The degree to which diesel influenced the growth of phytoplankton varied with species, diesel concentration, pH of culture medium and the initial cell density. *C. salina* was the most tolerant species with the highest IC50 (241.9 mg/l) while *I. galbana* was the most sensitive to diesel. For *P. tricornutum* and *I. galbana*, the IC50 was lower at lower initial cell densities.

Continuous culture conditions designed to achieve a dynamic equilibrium between phytoplankton growth and nutrient input were established for all three species. Under these conditions, which are more environmentally relevant, the population is relatively fragile and responds to perturbations.

Changes in diesel content and composition in culture media and cells were determined by solid phase extraction followed by gas chromatography/mass spectrometry. The extraction method was optimized systematically. The most suitable absorbent was C_{18} (octadecyl), pH 2 was the optimum pH for the interaction of diesel and absorbent and *n*-hexane was used as eluting solvent with the minimum volume required of 1.5 ml.

This study also provides an evaluation of how phytoplankton can potentially perform bioremediation in water contaminated with diesel. Losses of diesel were attributed to processes such as volatilization and photo-oxidation in addition to adsorption and active uptake by cells. Live cells of *C. salina* and *I. galbana* were able to degrade *n*-alkanes faster than the unresolved complex mixture (UCM) of diesel, whereas, *P. tricornutum* only accumulated diesel and was unable to degrade any of the diesel fractions. All the dead cells showed adsorption ability with dead cells of *C. salina* showing the highest diesel accumulation.