

# DR COBY L NEEDLE

PhD MSc BSc (Hons) CMath MIMA CSci

## PERSONAL DETAILS

*Positions* Fishery Analysis and Assessment Group Leader (C1 grade), Marine Laboratory, Aberdeen  
Honorary Lecturer, School of Biological Sciences, University of Aberdeen

## EDUCATION

**University of Strathclyde: Ph.D. in Mathematics and Statistics, September 2005 – September 2011**

*Title:* Fleet dynamics in fisheries management evaluations

*Abstract:* Fisheries managers use scientific evaluations of management plans to determine whether such plans will be sustainable. Most extant evaluations do not account for changes in fleet dynamics in response to management measures, and are likely to be flawed as a result. In this thesis, I develop a new simulation model to address this issue. I present motivating case studies of management strategy evaluations for haddock, survey-based management approaches, and multi-species catch quotas, in order to highlight the need for an improved spatio-temporal fishery modelling framework. I characterise the response of the Scottish whitefish fleet to short-term real-time area closures, as an example of the type of fleet dynamics that a new model would need to be able to simulate for cod in the North Sea. I demonstrate using two complementary methods that such closures are unlikely to have directly encouraged skippers to avoid cod-important areas, and are therefore unlikely to have reduced cod mortality. I develop and implement a new spatio-temporal fishery simulation model which is flexible and powerful enough to account for fleet responses and thereby enable insightful quantitative analysis and evaluation of the wide range of management approaches. Finally, I report initial tests of the model, which demonstrate that a vessel seeking to maximise weekly profit will act differently (and with different fish stock implications) to one that is allowed a maximum weekly catch. With this model and the further future developments of it that I outline, scientists will be in a much better position to advise fisheries managers on stock sustainability over long-term time scales.

### **University of Strathclyde: M.Sc. in Industrial Mathematics, 1992–1993**

*Courses taken:* Perturbation methods, Numerical methods, Fluid dynamics, Statistics, Stochastic modelling, Coding, Heat and mass transfer, Viscous flow, Computational Fluid Dynamics, Environmental modelling, Experimental designs, Chaos, Transforms, Cryptography, Finite Element Methods, Mathematical computing.

*Prizes:* Distinctions in Mathematical computing, Heat and mass transfer, Stochastic modelling.

*Projects:* Team projects on aeronautic turbulence, heat transfer in fluid flow, and buckling of viscous flow. Summer placement with FRS Marine Laboratory, Aberdeen. Thesis: “Application of a two-dimensional hydrodynamic model to the north-west European shelf seas”

### **University of Aberdeen: B.Sc. (Hons) in Computing and Mathematics, 2(ii), 1987–1991**

*Courses taken:* Topology, Probability, Analysis, Algebra, Differential equations, Logic, Database programming and management, Software engineering, Formal languages, Networks, Physics, Linear programming.

*Prizes:* Distinction in 1st year Physics, credits in 2nd year Mathematics and Computing Science.

*Project:* Bayesian maximum entropy in image processing.

### **Broughton High School, Edinburgh, 1981–1987**

3 CSYS passes (Maths II-B, Maths IV-C, Physics-D), 5 Higher passes (Maths-A, Physics-A, English-A, History-A, Chemistry-B), 7 O-grade passes (Maths-A, Arithmetic-A, Physics-A, Chemistry-A, English-A, History-A, French-B)

### **PRESENT AND PREVIOUS EMPLOYMENT**

#### **MSS Marine Laboratory, Aberdeen, Nov 1996 – present**

Principal Scientific Officer (C1 grade) and Group Leader of the Fishery Analysis and Assessment Team: also Honorary Lecturer in the School of Biological Sciences, University of Aberdeen. Advisor for fisheries managers in Edinburgh and Brussels. Working on the stock assessment and population dynamics of marine fisheries, with particular attention to methodological improvement of stock-recruitment modelling, the incorporation of biological process models of recruitment into fish stock assessment procedures, survey-based assessment methods, and management strategy evaluation. Teaching for the University of Aberdeen’s MSc/MRes in Marine and Fisheries Science, and occasional courses on stock assessment methods.

#### **University of Aberdeen, Aberdeen, May 1994 – Nov 1996**

Research Assistant in the Department of Geography. Worked on models of the transition from shrinking to expanding forests. Used statistical and time-series techniques in the analysis of historical spatial data on land cover, demography, quality of life and economic performance. Also responsible for data acquisition and collation from several European countries, and for extensive dissemination of results.

**Institute of Terrestrial Ecology, Banchory, Oct 1993 – May 1994**

Temporary Higher Scientific Officer. Studied the relationship between seabird colony size and local geographic features. Research was concentrated on shag colonies on the eastern Scottish coast, and used statistical and spatial analyses in GIS.

**Blackwell Scientific Publications Ltd, Edinburgh, Mar 1992 – Sep 1992**

Computer Officer.

**Gebi's Ski Hire, Fall's Creek, NSW, Australia, Jun – Sep 1990**

Ski equipment technician.

ADDITIONAL INFORMATION

- Member of The Institute of Mathematics and its Applications.
- Professional status as a Chartered Mathematician and a Chartered Scientist.
- Foreign languages: Danish (intermediate), other Scandinavian (written only), French (school-level).
- Secretary and founder of the Marine Golf Club.
- Accredited Wudang T'ai Chi instructor with the Aberdeen Tai Chi Association.
- Member of the Senior School Liaison Group of Robert Gordon's College, Aberdeen.
- Occasional reviewer for *African Journal of Marine Science*, *Aquatic Living Resources*, *Biometrics*, *Canadian Journal of Fisheries and Aquatic Science*, *Ecology*, *Fisheries Oceanography*, *Fish and Fisheries*, *Fisheries Research* and the *Journal of Environmental Management*.

INTERESTS

My professional interest lies in the field of mathematical and statistical modelling of environmental processes, and human impacts upon them. My long-term career goal is to act as a consultant on such matters to academia, government and industry, and to use my training to seek to improve aspects of our natural environment.

My leisure pursuits include the study of the guitar and foreign languages, various team sports (football, cricket etc), running (two half-marathons completed), swimming, t'ai chi chuan, skiing, squash, badminton, golf, cooking, gardening, reading and (first and foremost): entertaining my teenage children.

## TEACHING

- Five-day course for DFO, Canada (“Introduction to fish stock assessment: model fitting and interpretation”): Dalhousie University, Halifax, Nova Scotia, Canada, 2009.
- Two-day course (“Survey-based fish stock assessment with SURBA”): DFO, St. John’s, Newfoundland, Canada, 2008.
- One-day course on fisheries management and stock assessment, King’s College (London) MSc on Aquatic Resource Management and Queen Mary’s University MSc on Marine Ecology and Environmental Management: University Marine Biological Station, Millport, Isle of Cumbrae, 2005, 2006, 2009.
- Lectures, practicals and examination marking for Aberdeen University’s MSc/MRes in Marine and Fisheries Science, 1998–2008; MSc/MRes in Applied Marine and Fisheries Ecology, 2009–2014.
- Three-day course (“The Ins and Outs of ICA”) on the ICA stock assessment model: 1999–2001.
- Lecturer and co-convenor (with Chris Darby, CEFAS) of the ICES Workshop Course on Fish Stock Assessment Techniques (WKCFAT): 2002–2003.
- Taught first- and second-year Computing Science tutorials during the Senior Honours year of my B.Sc. at the University of Aberdeen.
- Staff member on University of Aberdeen 2nd-year Geography field-trip to York, Mar 1995.

## STUDENTS

- Rocio Siemens, MRes in Marine and Fisheries Science, University of Aberdeen, May–August 2002. Thesis title: *Recruitment modelling using a morpho-physiological condition index as a proxy for egg production*.
- Alan Baudron, Fisheries Research Fund PhD Studentship, University of Aberdeen, January 2008 – December 2010 (co-supervised with C. T. Marshall). Thesis title: *Modelling growth rates of North Sea fish*.
- Alyson Little, NERC Studentship, University of Aberdeen, October 2010 – September 2013 (co-supervised with C. T. Marshall). Thesis title: *Modelling the decision making behaviour of the fishing industry using spatially resolved data*.
- Rosanne Dinsdale, Honours summer placement, University of Aberdeen, May – August 2010. Project title: *Estimating species composition of fish discards using CCTV*.
- Ewan Edwards, MASTS Studentship, University of Aberdeen, October 2010 – September 2013 (co-supervised with Paul Thompson and Jason Matthiopoulos). Thesis title: *Do commercial fisheries influence the distribution and dynamics of northern fulmars?*

- Nico Butler, MSc in Applied Marine and Fisheries Ecology, University of Aberdeen, May–August 2013. Thesis title: *Developing allometry to estimate the length frequency distribution of partially occluded fish via Remote Electronic Monitoring* (Butler 2013).
- Tanja Buch, MarCRF Studentship, University of Aberdeen, January 2014 – present (co-supervised with C. T. Marshall). Thesis title: *Integration of size-structured information in the management of data-rich and data-poor fish stocks*.
- Andrew Ferguson, MSc in Informatics, University of Edinburgh, May–August 2014. Thesis title: *Identifying Fish Species From CCTV Video Of Discards*.

## MEETING PARTICIPATION

### *ICES Assessment Working Groups and related*

- ICES Working Group on the Assessment of Northern Shelf Demersal Stocks: 1997-1999, 2001-2004, 2007. Assessing Division VIa haddock and whiting.
- ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak: 1997, 2000-2006, 2008-2014. Assessing North Sea haddock and whiting, and Northern Shelf haddock. **Chair 2004-2006**.
- ICES Annual Meeting of Assessment Working Group Chairs (AMAWGC): 2005-2006.
- ICES Annual Meeting of Advisory Working Group Chairs (WHCHAIRS): 2010.
- ICES Benchmark Workshop on Roundfish and Pelagic Stocks (WKBENCH): 2011. Benchmark analysis for North Sea haddock.
- ICES Workshop on the Analysis of the Benchmark of Cod in Subarea IV (North Sea), Division VIIId (Eastern Channel) and Division IIIa (Skagerrak) (WKCOD): 2011.
- ICES Workshop to evaluate the EU–Russian proposal for the harvest control component of the management plan for Rockall haddock (WKROCKHAD): 2012.
- ICES Benchmark Workshop on Roundfish Stocks (WKROUND): 2012-2013. Benchmark analysis for Division VIa and North Sea whiting.
- ICES Benchmark Workshop on Northern Haddock Stocks (WKHAD): 2014. **Co-chair** with Noel Cadigan, Memorial University, Canada.

### *Review Groups*

- Invited External Reviewer for the DFO Newfoundland Regional Groundfish Assessment Meeting, St. John's, Canada 15–26 Oct 2001.
- NSCFP North Sea Review Group, ICES Copenhagen, 2004-2005.

- ACFM Review Group for the Assessment of Demersal Stocks in the North Sea and Skagerrak (RGNSSK), 2004-2006.
- ICES Review Group on Cod Management Plans (RGCODMP): 2009.
- Invited external reviewer for the NOAA/NMFS/NEFSC Groundfish Assessment Review Meeting (GARM-III): Data Meeting, Woods Hole MA, USA, 29–31 October 2007.
- ICES Advice Drafting Group for the Celtic Seas Ecoregion: 2011, 2013, 2014.

#### *Other ICES Groups*

- ICES Study Group on Stock-Recruitment Relationships for North Sea Autumn-Spawning Herring: 1998.
- ICES Working Group on Recruitment Processes (WGRP): 1998, 2000.
- 4th ICES/GLOBEC Backward Facing Workshop of the Cod and Climate Change Working Group (The gadoid stocks in the North Sea during the 1960's and 70's): 1999.
- ICES Study Group on the Incorporation of Process Information into Stock-Recruitment Models (SGPRISM): 1991, 2001-2002.
- ICES Workshop on Rockall Haddock: 2001.
- ICES Working Group on Methods of Fish Stock Assessments (WGMG): 2001, 2003, 2004, 2006-2010. **Chair 2007-2009.**
- ICES Study Group on Growth, Maturity and Condition in Projections (SGGROMAT): 2002, 2004. Co-chair with Tara Marshall, IMR/University of Aberdeen.
- ICES Study Group on Stock Identification and Management Units for Whiting (SGSIMUW): 2005.
- ICES Ad Hoc Group on Long Term Approaches (AGLTA): 2005.
- ICES Workshop on Limit and Target Reference Points (WKREF): 2007.
- ICES Ad Hoc Group on the Cod Recovery Management Plan (AGCREMP): 2008.
- ICES Ad Hoc Group on Criteria for Reopening Fisheries Advice (AGCREFA): 2008.
- ICES Workshop on Reviews of Recent Advances in Stock Assessment Models Worldwide – Around The World In AD Models (WKADSAM): 2010. **Co-chaired** with Chris Legault, USA.
- ICES Working Group on Improving use of Survey Data for Assessment and Advice (WGISDAA): 2012.
- ICES Workshop to Consider Reference Points For All Stocks (WKMSYREF2): 2014.

*Advisory meetings (not including stakeholder liaison meetings)*

- North Sea Regional Advisory Council (NSRAC) Demersal Working Group: 2005.
- SGMD New Entrants introduction sessions: 2009
- EU-Norway Bilateral Negotiations: 2005-2013.
- SeaFAR meeting on “Scottish Whitefish Stocks: Medium to Long Term prospects”: 2006.
- Joint NSRAC/NWWRAC Symposium on the Cod Recovery Plan: 2007.
- Invited witness to the Scottish Parliament Rural Affairs and Environment Committee, Holyrood, Edinburgh: 2007, 2008
- Conservation Credits Steering Group: 2008.
- Scottish Inquiry into Future Fisheries Management: 2009.
- CFP Reform Management Group meeting: 2009.
- SGMD Branch Heads meeting on CFP Reform: 2009.
- NWWRAC Focus Group on Management of West of Scotland haddock: 2009.
- Marine Science Strategy meeting: 2009.

*European and national projects*

- SAP Symposium on “Fish Stock Assessments and Predictions: Integrating Relevant Knowledge”: 2000.
- METACOD: 2002-2003.
- MATES: 2002.
- EFIMAS: 2004-2008.
- FISBOAT: 2004.
- MASTS (Marine Alliance for Science and Technology Scotland) Science Board: 2009-2010.
- SENSOFLEET and DiscardLess (planning meetings): 2012-2014.

*EU Expert Group meetings*

- EU-Russia Expert Group Meeting on Rockall haddock: 2003, 2004, 2008-2012.
- EU-Norway Expert Group on Multiannual Management Plans: 2004.
- EU STECF-SGRST Cod Recovery Evaluation: 2005.
- EU STECF Expert Working Group on Management Plans (EWG12-07): 2012.

### Conferences and symposia

- Symposium on Applications of Multilevel Modelling: University of Manchester, 1994.
- Scottish Interest Group on Mathematical Modelling of Biological Populations: University of Strathclyde, Glasgow, 1998.
- Fishing 2001 Exhibition, SECC, Glasgow: 2001, 2009.
- *Scotia* Open Day, Peterhead, 26 Jul 2001.
- ICES Annual Science Conference, Marina Conference Centre, Helsinki, Finland, 2007.
- University of New Hampshire Sea Grant Symposium on “Haddock 2007”, Sheraton Harborside Hotel, Portsmouth NH, USA, 2007.
- Workshops and symposia on Fully Documented Fisheries and CCTV monitoring: 2011-2014.
- World Fisheries Congress, Edinburgh, April 2012.
- World Conference on Stock Assessment Methods, Boston, July 2013.
- Second Fishery Dependent Information Conference, Rome, March 2014.

### FIELDWORK

- Hydrochemical survey cruise on FRV Clupea, western North Sea, 2 Hydrochemical survey cruise on FRV Clupea, western North Sea, 2–7 Jul 1993.
- Demersal trawl survey cruise on FRV Scotia, eastern Atlantic and Irish Sea, 25 Feb–17 Mar 1997.
- Sampling of demersal, pelagic and shellfish ports and markets: Shetland, 18–22 Aug 1997; Mal-laig/Troon, 19–23 Jul 1999; Ullapool/Kinlochbervie 21–25 Aug 2000.
- Monkfish and megrim trawl survey cruise on FRV Scotia, St. Kilda and shelf edge, 27 Mar–10 Apr 2000.
- Joined FRV *Scotia* for a day off Ullapool in November 2013 as part of filming for the BBC *Coast* series.

### REFERENCES

- Bacon, P. J., Needle, C. L., Harris, M. P. and Wanless, S. (1994). Modelling environmental effects on seabird foraging energetics, *Report of the Institute of Terrestrial Ecology 1993–1994*, NERC, pp. 67–70. **External report.**
- Bailey, N. and Needle, C. L. (2005). Catch forecasts for IV and IIIa haddock – applying a simple smoothing technique to mitigate the effects of large scale assessment variability. Non-paper to the EU-Norway Bilateral Negotiations, Brussels, 28 Nov – 1 Dec 2005. **External report.**

- Bailey, N., Campbell, N., Holmes, S., Needle, C. L. and Wright, P. (2010). Real-time closures of fisheries. Study PE XXX.YYY for the European Parliament. **External report.**
- Baudron, A., Needle, C. L., Rijnsdorp, A. D. and Marshall, C. T. (2014). Warming temperatures and smaller body sizes: synchronous changes in growth of North Sea fishes, *Global Change Biology*. **Peer-reviewed paper.**
- Baudron, A. R., Needle, C. L. and Marshall, C. T. (2011). Implications of a warming North Sea for the growth of haddock, *Melanogrammus aeglefinus*, *Journal of Fish Biology* **78**(7): 1874–1889. DOI:10.1111/j.1095-8649.2011.02940.x. **Peer-reviewed paper.**
- Beare, D. J., Needle, C. L., Burns, F. and Reid, D. G. (2005). Using survey data independently from commercial data in stock assessment: An example using haddock in ICES Division VIa, *ICES Journal of Marine Science* **62**: 996–1005. **Peer-reviewed paper.**
- Beare, D., Needle, C. L., Burns, F., Reid, D. and Simmonds, J. (2002). Making the most of research vessel data in stock assessments: examples from ICES Division VIa. ICES CM 2002/J:01. **ICES paper.**
- Bouchard, V., Danielsen, M., Kroisandt, G., Mourits, A. and Needle, C. L. (1993). Shape and intersections of cutter-tooth surfaces, in P.-J. Laurent (ed.), *Proceedings of the Sixth ECMI Modelling Week*, European Consortium for Mathematic and Industry, and Universite Joseph Fourier, Grenoble. **Conference proceedings.**
- Butler, N. (2013). *Developing allometry to estimate the length frequency distribution of partially occluded fish via Remote Electronic Monitoring*, MSc thesis, University of Aberdeen. **MSc thesis.**
- Campbell, N., Holmes, S. and Needle, C. L. (2006). Calculating availability, selectivity and sorting for haddock in the North Sea. EU-EFIMAS WP3/CS2 Meeting, Imperial College, London, England. 28 February 2006. **Presentation.**
- Catarino, R. D. M., Needle, C. L. and Fryer, R. (2014). Evaluation of variance and precision in determination of fishing activity using Vessel Monitoring Systems (VMS). Second Symposium on Fishery-Dependent Information, FAO Headquarters, Rome. March 2014. **Presentation.**
- Cook, R. M., Needle, C. L. and Fernandes, P. G. (2012). Comment on “Fisheries mismanagement”, *Marine Pollution Bulletin* **64**(10): 2265–2266. **Peer-reviewed paper.**
- Cotter, C., Fryer, R., Needle, C. L., Skagen, D., Spedicato, M.-T. and Trenkel, V. (2007a). A review of fishery-independent assessment models, and initial evaluation based on simulated data. Working Document for the ICES Working Group on Methods of Fish Stock Assessments Woods Hole, March 2007. Edited by Mesnil, B. **External report.**
- Cotter, C., Fryer, R., Needle, C. L., Skagen, D., Spedicato, M.-T. and Trenkel, V. (2007b). A review of fishery-independent assessment models, and initial evaluation based on simulated data. ICES Working Group on Methods of Fish Stock Assessment, North East Fisheries Science Center, Woods Hole, USA. 14 March 2007. **Presentation.**

- Cotter, J., Fryer, R., Mesnil, B., Needle, C. L., Skagen, D., Spedicato, M.-T. and Trenkel, V. (2007c). A review of fishery-independent assessment models, and initial evaluation based on simulated data. ICES CM 2007/O:04. **ICES paper.**
- Darby, C. D., Millar, C. and Needle, C. L. (2009). Errors in the WGNSSK May 2009 North Sea whiting and haddock forecasts. Working Paper for ACOM, September 2009. **External report.**
- Deroba, J. J., Butterworth, D. S., Methot, R. D. J., De Oliveira, J., Fernandez, C., Nielsen, A., Cadrin, S., Dickey-Collas, M., Legault, C., Ianelli, J., Valero, J., Needle, C. L., O'Malley, J., Chang, Y.-J., Thompson, G., Canales, C., Swain, D., Miller, D., Hintzen, N., Bertignac, M., Ibaibarriaga, L., Silva, A., Murta, A., Kell, L., de Moor, C., Parma, A., Dichmont, C., Restrepo, V., Ye, Y., Jardim, E., Blaylock, J. and Mood, M. (2014). Simulation testing the robustness of stock assessment models to error: some results from the ices strategic initiative on stock assessment methods, *ICES Journal of Marine Science.* , doi:10.1093/icesjms/fst237. **Peer-reviewed paper.**
- Fairbairn, J. N. and Needle, C. L. (1995). The forest transition in Italy, *Discussion Papers in Modelling The Forest Transition 2*, University of Aberdeen. **Internal report.**
- Farrington, J., Needle, C. L. and Sleightholme-Albanis, G. R. (1997). A contribution to the debate on fuel price increases: Some possible safety implications, *Journal of Transport Geography* **5**(1): 73–77. **Peer-reviewed paper.**
- Fryer, R. F., Needle, C. L. and Reeves, S. A. (1998). Kalman filter assessments of cod, haddock and whiting in VIa. Working Document WD1 to the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks, Copenhagen, June 1998. **External report.**
- Fryer, R., Needle, C. L. and Reeves, S. R. (1999). Yet more Kalman filter assessments of cod, haddock and whiting in VIa. Working Document to the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks, Copenhagen, June 1999. **External report.**
- Heath, M. R., Gallego, A., Hislop, J. R. G., Needle, C. L., Scott, B. and Wright, P. J. (1999). The importance of the late pelagic and demersal settlement phases for recruitment dynamics in North Sea haddock. ICES CM 1999/Y:11. **ICES paper.**
- Holmes, S. and Needle, C. L. (2005). Survey-based analysis of mortality and other population trends in different areas of the North Sea. EU STECF-SGRST Subgroup on the Cod Recovery Plan, Joint Research Centre, Ispra, Italy. 14 June 2005. **Presentation.**
- Holmes, S. and Needle, C. L. (2006). Simulation-based evaluation of the Cod Recovery Plan with respect to the North Sea and Skagerrak. ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES, Copenhagen, Denmark. 11 September 2006. **Presentation.**
- Kell, K. T., Kirkwood, G., Abaunza, P., Aps, R., Biseau, A., Korsbrekke, K., Kunzlik, P., Laurec, A., Mesnil, B., Needle, C. L., Pastoors, M., Pilling, G., Roel, B. and Ulrich, C. (2003). MATES (lot 2): Analysis of possibilities of limiting the annual fluctuations in TACs. Final report (FISH/2001/02). **External report.**

- Kell, L. T., Pilling, G., Kirkwood, G., Pastoors, M., Mesnil, B., Korsbrekke, K., Abaunza, P., Aps, R., Biseau, A., Kunzlik, P., Laurec, A., Needle, C., Roel, B. and Ulrich, C. (2005). An evaluation of the implicit management procedure for some ICES roundfish stocks, *ICES Journal of Marine Science* **62**(4): 750–759. **Peer-reviewed paper.**
- Kell, L. T., Pilling, G., Kirkwood, G., Pastoors, M., Mesnil, B., Korsbrekke, K., Abaunza, P., Aps, R., Biseau, A., Kunzlik, P., Laurec, A., Needle, C., Roel, B. and Ulrich, C. (2006). An evaluation of multi-annual management strategies for ICES roundfish stocks, *ICES Journal of Marine Science* **63**(1): 12–25. **Peer-reviewed paper.**
- Little, A. S., Needle, C. L., Hilborn, R., Holland, D. S. and Marshall, C. T. (2014). Real-time spatial management approaches to reduce bycatch and discards: experiences from Europe and the United States, *Fish and Fisheries*. DOI: 10.1111/faf.12080. **Peer-reviewed paper.**
- Marshall, C. T. and Needle, C. L. (2003). Application of Age/Length keys for Northeast Arctic cod to growth modelling. Working Document to the ICES Arctic Fisheries Working Group, San Sebastian, April 2003. **External report.**
- Marshall, C. T. and Needle, C. L. (2006). Modelling growth rates of North Sea fish. Studentship application to the Fisheries Research Fund. **Contract/studentship proposal.**
- Marshall, C. T., Needle, C. L., Thorsen, A., Kjesbu, O. S. and Yaragina, N. A. (2006). Systematic bias in estimates of reproductive potential of an Atlantic cod (*Gadus morhua*) stock: Implications for stock-recruit theory and management, *Canadian Journal of Fisheries and Aquatic Science* **63**: 980–994. **Peer-reviewed paper.**
- Marshall, C. T., Needle, C. L., Yaragina, N. A., Aijad, A. and Gusev, E. (2004). Deriving condition indices from standard fisheries databases and evaluating their sensitivity to variation in stored energy reserves, *Canadian Journal of Fisheries and Aquatic Sciences* **61**: 1900–1917. **Peer-reviewed paper.**
- Marshall, C. T., Thorsen, A., Needle, C. L., Yaragina, N. A. and Kjesbu, O. S. (2003). Evaluating alternative estimates of reproductive potential for Northeast Arctic cod against spawning stock biomass. Working Document for the NAFO Working Group on Reproductive Potential, Woods Hole, MA, USA, 15–18 October. **External report.**
- Mather, A. S. and Needle, C. L. (1997). Trends in global forest cover: Issues in explanation and modelling, in Y. Himiyama and L. Crissman (eds), *Information Bases for Land Use/Cover Change Research: Proceedings of IGU-LUCC 97, Brisbane*, pp. 84–91. **Conference proceedings.**
- Mather, A. S. and Needle, C. L. (1998). The forest transition: A theoretical basis, *Area* **30**(2): 117–124. **Peer-reviewed paper.**
- Mather, A. S. and Needle, C. L. (1999). Development, democracy and forest trends, *Global Environmental Change* **9**: 105–118. **Peer-reviewed paper.**
- Mather, A. S., Fairbairn, J. and Needle, C. L. (1999a). The course and drivers of the forest transition: The case of France, *Journal of Rural Studies* **15**(1): 65–90. **Peer-reviewed paper.**

- Mather, A. S., Needle, C. L. and Coull, J. R. (1998a). From resource crisis to sustainability: the forest transition in Denmark, *International Journal of Sustainable Development and World Ecology* **5**: 182–193. **Peer-reviewed paper.**
- Mather, A. S., Needle, C. L. and Fairbairn, J. (1996). The human drivers of global land-cover change: the case of forests, *Global Change: Proceedings of the IGBP/BAHC-LUCC Joint Inter-Core Projects Symposium, Kyoto, Japan, September 1996*, pp. 1–5. **Conference proceedings.**
- Mather, A. S., Needle, C. L. and Fairbairn, J. (1998b). The human drivers of global land cover change: the case of forests, *Hydrological Processes* **12**: 1983–1994. **Peer-reviewed paper.**
- Mather, A. S., Needle, C. L. and Fairbairn, J. (1999b). Environmental Kuznets curves and forests trends, *Geography* **84**(1): 55–65. **Peer-reviewed paper.**
- Mesnil, B., Cotter, A. J. R., Fryer, R. J., Needle, C. L. and Trenkel, V. M. (2009). A review of fishery-independent assessment models, and initial evaluation based on simulated data, *Aquatic Living Resources* **22**: 207–216. **Peer-reviewed paper.**
- Needle, C. L. (1993). *Application of a two-dimensional hydrodynamic model to the north-west European shelf seas*, MSc thesis, University of Strathclyde. **Thesis.**
- Needle, C. L. (1995a). Data problems in forest modelling: Comparison of sources, *Discussion Papers in Modelling the Forest Transition 3*, University of Aberdeen. **Internal report.**
- Needle, C. L. (1995b). Modelling global forest trends. Department of Geography Research Seminars, University of Aberdeen, Aberdeen, Scotland. March 1995. **Presentation.**
- Needle, C. L. (1995c). Relating global forest and population change: a new approach, *Discussion Papers in Modelling the Forest Transition 4*, University of Aberdeen. **Internal report.**
- Needle, C. L. (1996a). Modelling the forest transition. Department of Geography Research Seminars, University of Aberdeen, Aberdeen, Scotland. April 1996. **Presentation.**
- Needle, C. L. (1996b). National and international models of forest change. University-MLURI-SAC Rural Economy Seminar Series, University of Aberdeen, Aberdeen, Scotland. Summer 1996. **Presentation.**
- Needle, C. L. (1997). Application of Integrated Catch-at-Age Analysis (ICA) to selected stocks, Working Document to the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks, Copenhagen, June 1997. **External report.**
- Needle, C. L. (1998a). Comparison of the effect of noisy data on ICA and XSA assessments of Irish Sea cod. Working Document to the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks, Copenhagen, June 1998. **External report.**
- Needle, C. L. (1998b). Stock recruitment modelling. University of Aberdeen MSc in Marine and Fisheries Science, FRS Marine Laboratory, Aberdeen, Scotland. 27 March 1998. **Presentation.**

- Needle, C. L. (1999a). Modelling stock-recruitment relationships for assessment purposes. Working Document to the CFRD Working Group on the Application of Recruitment Models in Stock Assessment, FRS Marine Laboratory, Aberdeen, January 1999. **External report.**
- Needle, C. L. (1999b). Modelling stock-recruitment relationships for assessment purposes. Coordinator of Fisheries Research and Development (CFRD) Working Group on the Application of Recruitment Models in Stock Assessment, FRS Marine Laboratory, Aberdeen, Scotland. 8 January 1999. **Presentation.**
- Needle, C. L. (1999c). Six (6) lectures: ICA practice, ICA theory, projections, Bayes, other models, examples. Course on the ICA Stock Assessment Model: *The Ins and Outs of ICA*, IPIMAR, Lisbon, Portugal. 4–6 May 1999. **Presentation.**
- Needle, C. L. (1999d). Stock recruitment modelling. University of Aberdeen MSc in Marine and Fisheries Science, FRS Marine Laboratory, Aberdeen, Scotland. 19 February 1999. **Presentation.**
- Needle, C. L. (2000a). The Ins and Outs of ICA, Marine Laboratory, Aberdeen Report No 04/00. **FRS report.**
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- Needle, C. L. (2006p). Summary of SURBA 3.0. EU-FISBOAT Operating Model Workshop, FRS Marine Laboratory, Aberdeen, Scotland. 3 May 2006. **Presentation.**
- Needle, C. L. (2006q). Survey-based fish stock assessment and management advice. Postgraduate Seminar in Statistics and Modelling Science, University of Strathclyde, Glasgow, Scotland. 5 May 2006. **Presentation.**
- Needle, C. L. (2006r). Thirteen (13) presentations summarising the results of the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES Review Group for Demersal Stocks in the North Sea and Skagerrak, ICES, Copenhagen, Denmark. 2–4 October 2006. **Presentation.**
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- Needle, C. L. (2007e). Management strategy for North Sea haddock. Poster presented at the University of New Hampshire Haddock Symposium, Portsmouth NH, USA. **25-26 October 2007.**
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- Needle, C. L. (2012a). *Fleet Dynamics in Fisheries Management Strategy Evaluations*, PhD thesis, University of Strathclyde, Glasgow. **Thesis.**
- Needle, C. L. (2012b). A spatio-temporal fishery modelling framework for management strategy evaluation. World Fisheries Congress, Edinburgh. 10th May 2012. **Presentation.**
- Needle, C. L. (2013). A spatio-temporal simulation model to evaluate assessment methods and management strategies. World Conference on Stock Assessment Methods, Seaport Conference Center, Boston MA, USA. 18th July 2013. **Presentation.**
- Needle, C. L. (2014). Fisheries data as droplets or deluges: applying mathematics to data extremes. University of Strathclyde, Department of Mathematics and Statistics, Population Modelling and Epidemiology Group Annual Research Day, Hilton Grosvenor Hotel, Glasgow, Scotland. 28th May 2014. **Presentation.**
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- Needle, C. L., Catarino, R. M. D., Dinsdale, R. and Buch, T. (2014). Scottish science applications of Remote Electronic Monitoring. Second Symposium on Fishery-Dependent Information, FAO Headquarters, Rome. March 2014. **Presentation.**
- Needle, C. L., Marshall, C. T., Hoff, A. G. and Clarke, E. D. (2006a). Using parametric length-frequency distributions to characterise key dimensions of fish growth: A progress report. Working paper to the annual EFIMAS network meeting, Nantes, 4-7 April 2006. **External report.**
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