

and the Environment (RAE) and have given evidence to the RAE Parliamentary Committee of the Scottish Government.

(Annually) Seiche Ltd., NPL London. *Consultancy:* Provision of lectures on Fisheries Acoustics at National Physics Laboratory, Teddington.

2001-2006 FRS Marine Laboratory Aberdeen. *Fisheries Independent Methods Group Leader.* Head of FIM group which provided a focus for the collection of fishery independent data and the development of associated methods to quantify and reduce uncertainties in stock assessments. Duties included: **(1)** Management of FIM activities, budget (2006/07: approx £0.5 million, excluding research vessel costs) and personnel (six scientists); **(2)** Acoustic assessment of the abundance and distribution of herring and mackerel stocks; **(3)** Research into fisheries survey methodology: geostatistical analyses for spatial modelling of fish population dynamics and uncertainty in survey estimates; development of acoustic signal processing algorithms; development of autonomous underwater vehicles for fisheries research; **(4)** Co-ordination of FRS' inputs to the University of Aberdeen's Marine and Fisheries Science MRes/Msc; **(5)** Representation for FRS at ICES expert groups (Chair of ICES Workshop on Survey Design and Analysis; Chair of the Planning Group for Herring Surveys; member of WGFASST & PGAAM) and the Scientific, Technical and Economic Committee for Fisheries (STECF) of the European Commission.

1998-2001 FRS Marine Laboratory Aberdeen. *Senior Scientific Officer*
As above, items (2), (4) and part (3).

Mar 2002 IRD, Chile. *Consultancy:* Provision of a course on fisheries geostatistics.

Aug 2001 EC, Lake Victoria. *Consultancy:* Cruise leader of an acoustic survey of the fish populations of Lake Victoria, Africa.

1995-98 FRS Marine Lab./ University of Aberdeen. *Postdoc. Research Fellow.* Studied the application of geostatistical techniques to marine survey data, in particular acoustic surveys, under the EC funded AIR programme. Investigated the application of multi-beam sonar to pelagic fish school behaviour studies and stock assessment surveys. Also undertook acoustic stock assessment surveys for herring in the UK (ICES Division VIaN as cruise leader), the Republic of Ireland (ICES Divisions VIaS, VIIb, VIIj, and VIIg) and the EC (Atlanto-Scandian herring ICES Division IIa as cruise leader).

1997 & 1998 EC, Brussels. *Consultancy:* FAIR Project Evaluator, fisheries expert.

1994 Fisheries Research Centre, Dept. Marine, Ireland. *Acoustic Scientist.* Responsible for the acoustic stock assessment of herring in Irish waters under the EC funded STRIDE project. Also assistant to DANI in assessment of herring in Irish Sea. Responsibilities included full development of methods; survey design; implementation of cruises; complete data analysis; and production of final estimates and reports. Also attended ICES FAST working group and workshops and reviewed the role of acoustic assessments in deep-sea fisheries.

1993 Overseas Development Administration. *Associate Professional Officers Scheme.* Attachment to London HQ. Prepared internal review paper entitled "Remote sensing applications in aquatic resource assessment and management". Assisted the senior fisheries advisers, reviewing research projects and updating ODA FIPIS files for the FAO. Simrad fisheries acoustics courses.

1992-93 Overseas Development Administration. Associate Professional Officers Scheme.

Attachment to Bolivia. Fisheries biologist on the Lake Titicaca Fisheries Development Project, La Paz, Bolivia. Responsibilities included: Collection and analysis of fish samples for length frequency, sexual maturity and gut contents; advising Bolivian authorities on fisheries management; working with riverside communities to regulate fishing activity, and develop educational programmes aimed at self-motivated law enforcement; acting as principal advisor to European Community project on plans for an acoustic fish stock assessment of Lake Titicaca; administration of an artisanal fishermen's association; supervision of local counterpart.

1989 The University of Liverpool / Department of the Marine, Ireland. Assistant Fisheries Acoustician. Stock assessment of Herring in the Celtic Sea.

1988 The University of Liverpool. Research Assistant.

Worked on defensive behaviour in limpets, based at Port Erin and Plymouth Laboratories.

TEACHING RESPONSIBILITIES

2012-present. Practical supervision of Statistical Analysis of Biological Data.

2012-present. Lecturer for Marine Ecology and Ecosystems

2011- Joint Programme Co-ordinator: Applied Marine and Fisheries Ecology MRes/MSc/PGDip see <http://www.abdn.ac.uk/graduate/study/taught.php?code=fish>; Course co-ordinator: Fisheries Technologies and Surveys (MSc); Course co-ordinator: Marine Top Predator Ecology (MSc); Course co-ordinator (2nd semester): Personal Research Development (MSc). Undergraduate teaching on Ocean Biology and Marine Biology courses.

2006-2011 Course co-ordinator for the Applied Marine and Fisheries Ecology MSc, at the University of Aberdeen. Responsible for organising the Fisheries Technologies and Surveys course of 21 lectures and 3 practicals; personally undertaking 6 lectures and 2 practicals on fisheries acoustics.

2000-2006 Co-ordinator of the Fisheries Module of the Marine and Fisheries Science MSc at University of Aberdeen. This involved: setting a timetable of 54 lectures and 15 practicals over the course of 6 weeks using over 30 lecturers; setting essays and multiple choice exam questions; marking essays and practical reports; arranging project topics; and personally undertaking 6 lectures and 2 practicals, as well as supervising student projects (see below).

2012-present PhD supervision. Nial Fallon. Assessment of mackerel icefish.

2011-present PhD supervision. Fiona McIntyre. Development of marine visual surveys. One peer reviewed paper accepted to date.

2011-present PhD supervision. Ben Scouling. Mackerel acoustics. One peer reviewed paper in prep.

2006-2009 PhD co-supervision. Sascha Fässler, registered at St. Andrews University, developing acoustic target strength models of pelagic fish. Five peer reviewed papers to date.

2004-2007 PhD co-supervision. Juan Zwolinski, registered at University of Lisbon, "Aspects of the ecology of the Portuguese sardine". One ICES paper published and two peer reviewed papers to date.

2003-2006 PhD co-supervision. Angus Mair, registered at St. Andrews University, "An investigation into the North Sea low frequency scattering layer". Completed successfully in Feb 2008. One ICES paper and one peer reviewed paper to date.

2001-2006 MSc thesis supervision. Lorna MacDonald* (2001), Alicia Mosteiro*+ (2002), Norma Garcia Nunez*# (2003), Rita Santos+*# (2004), Sarah Clarke (2005), Victoria Allen# (2006) and Lorenzo Scala (2008). All those marked* produced ICES papers from the work of their thesis; those marked+ gave presentations on their work at the ICES ASC; and those marked# produced a peer reviewed paper.

2000-2006 Lectures. Ad-hoc lectures given to Heriot Watt University MSc students on fisheries assessment.

2005- Lectures. Three lectures given each year on Fisheries Acoustics as part of the professional development course on Acoustic Monitoring of Marine Wildlife (see employment record above).

RESEARCH INTERESTS

I am head of the Fisheries Ecosystems and Advanced Survey Technologies (FEAST) research group. Our research focuses on the assessment and management of marine living resources, particularly those commercial fisheries of importance to Scotland, but extends to understanding the marine ecosystems which these resources are part of. The specific research interests are: the biology and ecology of commercially exploited fish and their associated ecosystems; developing methods to estimate the abundance and distribution of fish and associated marine fauna; improving the accuracy and precision of the various methods to assess the status of marine fish; and ultimately, how best to manage our marine resources sustainably. My specific areas of expertise are: fisheries acoustics (the use of echosounders and other sonar equipment for studying marine life); fish stock assessment; and sampling (survey) statistics, particularly geostatistics. Currently, we are engaged in four specific areas of research which combine my interests and expertise: anglerfish assessment; fisheries acoustics; fisheries management; and new survey technology.

Very little is known about the abundance, distribution and life cycle of anglerfish (a.k.a monkfish, or goosefish in the North America), yet it continues to gain in popularity as a food source: this, coupled with the demise of other demersal fish, such as cod, has increased the pressure on anglerfish as a fishery. Whilst as Marine Scotland Science I conducted several multi-vessel surveys with the co-operation of the Scottish fishing industry, gathering data on the abundance and distribution of anglerfish. We are developing a novel assessment model based on survey data to determine the abundance at age of anglerfish and their exploitation. We are also aiming to develop a management strategy evaluation to test a number of potential harvest control rules that may be applicable so that the stock can be managed sustainably.

Active acoustic instruments (SONAR) are used to detect, quantify and identify marine flora and fauna. We are particularly interested in methods for identifying objects which scatter sound (of multiple frequencies) according to their physical, physiological, and behavioural characteristics. We are keen to develop classification algorithms, using theoretical target strength [scattering] models where appropriate, and validating these with empirical data, paying particular attention to the biology and physiology of the organisms which scatter sound. We have forged links with physics and engineering colleagues from around the world to pursue this area of research with appropriate expertise.

In the seas around Scotland most of our fish stocks are managed by the European Commission under the Common Fisheries Policy (CFP). This is largely because at various stages in their life cycle, fish occur in various territorial waters. Although it has had some notable successes, the CFP is not a popular policy and will be reviewed in 2013. We are partners in an EC project called EcoFishMan which aims to develop a results-based fisheries management system, developed in collaboration with the important stakeholders. The design of the system will take into account ecological, economical and social factors and will be based on the requirements

of stakeholders and utilise modern technology for surveillance, assessment of stocks and decision supports. Our specific role is to evaluate the new system for the North Sea mixed demersal fishery using an ecosystem model to simulate alternative management scenarios.

Traditionally, fisheries surveys have relied on trawl nets to sample fish near the seabed and SONAR devices to sample fish in midwater. In both cases, the results are usually presented as indices of abundance, i.e. relative measures of abundance, because the sampling devices are selective and this selectivity varies from species to species. These relative measures have served single-species fish stock assessments reasonably well, because they provide reasonable indicators of changes in abundance over time. As we move towards an ecosystem approach it becomes more desirable to consider absolute measures of abundance so that we can compare the abundance of one species with another using the same (absolute) metric. We are working on methods to account for whole gear selectivity so that absolute measures of abundance can be determined. We are also looking into alternative approaches to sampling fish, because new arrangements in the spatial management of our marine ecosystems, such as closed areas for example, do not allow trawling. To deal with this, we are developing visual methods to survey fish and other marine fauna. Presently, we are working with Marine Scotland Science using a towed body system as a platform for a digital video camera, but ultimately we aim to use novel platforms such as Autonomous Underwater Vehicles, which I have used successfully in the past.

RESEARCH EXPERIENCE

Current contracts and ongoing work

Marine Scotland (£68,000). A contract to develop survey-based assessment procedures for Northern Shelf anglerfish.

Marine Scotland (£9,000). A short contract to run training courses in survey sampling for fishermen and to analyse fish survey data.

Marine Scotland (£64,000). A three year PhD studentship award entitled “New science for new species”, looking at assessment methods for a selected number of data-poor stocks.

European Commission (£155,743). PI on a European Framework 7 project entitled Ecosystem-based Responsive Fisheries Management in Europe (EcoFishMan), a three year research project to study alternative management schemes for European fisheries. Postdoctoral research fellow Alan Baudron employed for 23 months from May 2012.

Government of South Georgia and South Sandwich Islands (£57,245). A three year PhD studentship award entitled “Managing the recovery of fish stocks in an uncertain environment: the case of mackerel icefish around South Georgia”

Marine Scotland (£28,623). A three year PhD studentship award entitled “The development of acoustic methods to investigate the distribution and abundance of mackerel”.

Marine Scotland (£28,623). A three year PhD studentship award entitled “The development of underwater visual surveys to support environmental monitoring and fisheries management”.

Previous contracts

Marine Institute (£1000). A short contract to train a scientist in acoustic survey techniques.

Scientific co-ordinator of “New developments in fishery independent methods”. A 48 month project (2005-2009) with a budget of £1,262,762 (no other PIs) funded by the former Scottish Executive Environment and Rural Affairs Department (now Marine Scotland). Aiming to assess the abundance and distribution of anglerfish on the northern European shelf in collaboration with the fishing industry using new multisensored nets, incorporating new developments in visual survey techniques and deployment of data storage tags.

PI for FRS on EC 6th framework project ‘Fishery Independent Survey Based Operational Assessment Tools’ (FISBOAT). A 36 month project (2004-2007) with a £1,023,000 budget and 13 partner institutes across Europe. I was involved with the project’s design and managed FRS’ budget of £124,000. Produced simulation software to determine how effective surveys alone may be in the management of fish stocks and also developed survey based spatial indicators.

Scientific co-ordinator of EC 5th framework project “Species Identification Methods From Acoustic Multifrequency Information” (SIMFAMI). A 36 month project (2001-2004) with a budget of £693,000 (£186,000 to FRS) and 5 partner institutes across Europe. This project developed techniques to identify the acoustic characteristics of several marine fauna groups using standard multifrequency echo sounders.

Initial PI of EC 5th framework project “Conservation of diversity in an exploited species: spatio-temporal variation in the genetics of herring (*Clupea harengus*) in the North Sea and adjacent areas” (HERGEN). A 36 month project (2001-2004) with a budget of £1,087,000 (£51,800 to FRS) and 7 partner institutes across Europe. Project looked at population structure in herring in and around the North Sea using modern genetic techniques.

PI on NERC funded project “Under Sea Ice and Pelagic Surveys” (USIPS). An 18 month project (1999-2001) with 3 partner institutes. Project used an Autonomous Underwater Vehicle to investigate the behaviour of herring ahead of a research vessel, to examine the distribution of Antarctic krill under Southern Ocean sea-ice and to make measurements of sea-ice thickness.

DISSEMINATION AND ADVISORY WORK

Conferences and international meetings

Co-convenor of the theme session on “Alternative Approaches to Management – Science, Managers and Industry Co-working” at the 2012 World Fisheries Congress.

Co-convenor of a symposium on “New Developments in Fisheries Acoustics: Applications in Bottom Trawl Surveys and Multi-frequency Species Identification” at the ICES Annual Science Conference (ASC) 2004.

Oral presentations at numerous international conferences, including two keynote talks on species identification methods in fisheries acoustics at FSAM meeting in Czech Republic (2010) and SEAFACETS meeting in Bergen 2008. Numerous presentations at ICES ASC, the American Fisheries Society annual meeting, and the Geostatistics for Environmental Applications conferences.

Advisory work

Member of 2010 FAO expert group looking at indicators for the Ecosystem Approach to Fisheries.

Currently member of several expert groups of the International Council for the Exploration of the Sea (ICES): WGCSE & WGNSSK (Demersal stock assessment working groups); WGIPS (Working Group for International Pelagic Surveys); & WGFASST (Working Group on Fisheries Acoustics Science and Technology).

Former chair of ICES PGHERS (2001-2003); Co-Chair of ICES WKAGME (2009); Former co-Chair, ICES Workshop on Survey Design and Analysis (2004-2005).

EC STECF Review of scientific advice on Stocks of relevance to the CFP (SGRST) (2003-2004).

TRAINING AND QUALIFICATIONS

Training

Scottish Executive Effective Manager Programme; Group Leader training programme; Financial Management Workshop; Geostatistics workshop; Simrad Fisheries Acoustics courses.

Qualifications

Full driving licence; RYA VHF Operators Licence; RYA Coastal navigation; BSAC club instructor course.

PUBLICATIONS

Refereed papers

- Fernandes, P.G. and Cook, R.M. (in prep.). Reversal of fish stock decline in the North East Atlantic.
- Scoulding, B., Chu, D., Ona, E. and Fernandes, P.G. (in prep.). Target strengths of two abundant mesopelagic fish species.
- Mcintyre, F.D., Collie, N., Stewart, M., Scala, L., & **Fernandes, P.G** (accepted, in press). Estimates of anglerfish abundance in closed areas using a visual survey technique. *Journal of Fish biology*.
- Guillard, J., **Fernandes, P.**, Laloe, T. & Brehmer, P. (2011). Three-dimensional internal spatial structure of young-of-the-year pelagic freshwater fish provides evidence for the identification of fish school species. *Limnology and oceanography-Methods*, 9: 322-328.
- Holmes, S.J., Bailey, N., Campbell, N., Catarino, R., Barratt, K., Gibb, A. & **Fernandes, P.G.** (2011). Using fishery-dependent data to inform the development and operation of a co-management initiative to reduce cod mortality and cut discards. *ICES Journal of Marine Science* **68**: 1679-1688.
- Fernandes, P.G.**, Coull, K., Davis, C., Clark, P., Catarino, R., Bailey, N., Fryer, R. & Pout, A. (2011). Observations of discards in the Scottish mixed demersal trawl fishery. *ICES Journal of Marine Science* **68**: 1734-1742.
- Zwolinski, J., **Fernandes, P.G.**, Marquez, V. and Stratoudakis, Y. (2009) Estimating fish abundance from acoustic surveys: calculating variance due to acoustic backscatter and length distribution error *Canadian Journal of Fisheries and Aquatic Sciences* **66**, 2081-2095.
- Fässler, S. M. M., Brierley, A. S., and **Fernandes, P. G.** (2009). A Bayesian approach to estimating target strength. *ICES Journal of Marine Science*, 66: 1197-1204.
- Fernandes, P. G.** (2009). Classification trees for species identification of fish-school echotraces. *ICES Journal of Marine Science*, **66**: 1073-1080.

- Wuillez, M.; Rivoirard, J., and **Fernandes, P.G.** (2009). Evaluating the uncertainty of abundance estimates from acoustic surveys using geostatistical conditional simulations. *ICES Journal of Marine Science* **66**: 1377-1383.
- Fässler, S. M. M., **Fernandes, P. G.**, Semple, S. I. K., and **Brierley, A. S.** (2009). Depth-dependent swimbladder compression in herring *Clupea harengus* observed using magnetic resonance imaging. *Journal of Fish Biology*, **74**: 296-303.
- Fässler, S.M.M. Gorska, N., Ona, E. and **Fernandes, P.G.** (2008). Differences in swimbladder volume between Baltic and Norwegian spring-spawning herring: Consequences for mean target strength. *Fisheries Research*, **92** (2-3), 314-321.
- Korneliussen, R. J., Diner, N., Ona, E., Berger, L., and **Fernandes, P. G.** (2008). Proposals for the collection of multifrequency acoustic data. *ICES Journal of Marine Science*, **65**: 982–994.
- Reid, D.G., Allen, V.J., Bova, D.J., Jones, E.G., Kynoch, R.J., Peach, K.J., **Fernandes, P.G.** and Turrell, W.R. (2007). Anglerfish catchability for swept-area abundance estimates in a new survey trawl. *ICES Journal of Marine Science* **64**: 1503-1511.
- Zwolinski, J., Morais, A., Marques, V., Stratoudakis, Y. and **Fernandes, P.G.** (2007). Diel variation in the vertical behaviour of sardine (*Sardina pilchardus*) off Portugal. *ICES Journal of Marine Science* **64**: 963–972.
- Fässler, S.M.M., Santos, R., García-Núñez, N. and **Fernandes, P.G.** (2007). Multifrequency backscattering properties of herring (*Clupea harengus*) and Norway pout (*Trisopterus esmarkii*). *Canadian Journal of Fisheries and Aquatic Sciences* **64**(2): 362-374.
- Mair, A.M., **Fernandes, P.G.**, LeBourges-Dhaussy, A., and Brierley, A.S. (2005). An investigation into the zooplankton composition of a prominent 38 kHz scattering layer in the North Sea. *Journal of Plankton Research* **27** (6):1-11.
- Gimona, A. and **Fernandes, P.** (2004). A stochastic approach to modelling spatial uncertainty in the distribution of pre-spawning North Sea Herring while accounting for environmental variables. In T. Nishida, P. J. Kailola and C. E. Hollingworth (eds). *GIS/Spatial Analyses in Fishery and Aquatic Sciences*. Saitama, Japan, pp 215-222.
- Fernandes, P.G.**, Stevenson, P., Brierley, A.S., Armstrong, F. and Simmonds, E.J. (2003). Autonomous Underwater Vehicles: future platforms for fisheries acoustics. *ICES Journal of Marine Science* **60**: 684-691.
- Gimona, A. and **Fernandes, P.G.** (2003). A conditional simulation of acoustic survey data: advantages and potential pitfalls. *Journal of Aquatic Living Resources* **16**(3): 123-129.
- Brierley, A. S., **Fernandes, P. G.**, Brandon, M. A., Armstrong, F., Bone, D. G., Griffiths, G., McPhail, S. D., Millard, N. W., Pebody, M., Perrett, J., Squires, M. and Stevenson, P. (2002). An investigation of avoidance by Antarctic krill of RRS James Clark Ross using the Autosub-2 autonomous underwater vehicle. *Fisheries Research* **60**: 569-576.
- Brierley, A. S., **Fernandes, P. G.**, Brandon, M. A., Armstrong, F., Millard, N. W., McPhail, S. D., Stevenson, P., Pebody, M., Perrett, J., Squires, M., Bone, D. G. and Griffiths, G. (2002). Antarctic krill under sea ice: elevated abundance in a narrow band just south of ice edge. *Science* **295**: 1890-1892.
- MacLennan, D.N., **Fernandes, P.G.** and Dalen, J. (2002). A consistent approach to definitions and symbols in fisheries acoustics. *ICES Journal of Marine Science* **59**: 365-369.
- Fernandes, P. G.**, Gerlotto, F., Holliday, D. V., Nakken, O. and Simmonds, E. J. (2002). Acoustic applications in fisheries science: the ICES contribution. *ICES Journal of Marine Science* **215**: 483-492.
- Brierley and **Fernandes, P.G.** (2001). Diving depths of Northern Gannets: Acoustic observations of *Sula bassana* from an autonomous underwater vehicle. *The Auk* **118**(2): 529-534.
- Fernandes, P. G.**, Brierley, A. S., Simmonds, E. J., Millard, N. W., McPhail, S. D., Armstrong, F., Stevenson, P. and Squires, M. (2000). Fish do not avoid survey vessels. *Nature* **404**: 35-36. + addendum *Nature* **407**:152.

Fernandes, P. G. and Rivoirard, J. (1999). A geostatistical analysis of the spatial distribution and abundance of cod, haddock and whiting in North Scotland. *Quantitative Geology and Geostatistics* **10**: 201-212.

Fernandes, P. G. and Simmonds, E. J. (1997). Variographic refinement of North Sea herring acoustic survey data. *Quantitative geology and geostatistics* **9**: 451-462.

Books

Rivoirard, J., Simmonds, E. J., Foote, K. F., **Fernandes, P. G.** and Bez, N. (2000). Geostatistics for estimating fish abundance. Oxford, Blackwell Science Ltd. 206 pp.

ICES papers

N. Bailey, C. Needle, S. Holmes, **P. Fernandes**, N. Campbell, B. O'Neill, A. Gibb, and G. Chalmers (2010). The Scottish Conservation Credits Scheme—an example of implementing a result-based approach to fishery management. ICES CM2010/P:16

Fernandes, P.G., Armstrong, F., Burns, F., Copland, P., Davis, C., Graham, N., Harlay, X., O'Cuaig, M., Penny, I., Pout, A.C. and Clarke, E.D. (2007). Progress in estimating the absolute abundance of anglerfish on the European northern shelf from a trawl survey. ICES CM2007/K:12, 14 pp.

Wuillez, M., Rivoirard, J. and **Fernandes, P.** (2006). Evaluating the uncertainty of abundance estimates from acoustic surveys using geostatistical conditional simulations. ICES CM 2006/I:15, 26 pp.

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Zwolinski, J. **Fernandes, P.G.** and Stratoudakis, Y (2005). Uncertainty in acoustic estimation of abundance in an unstable multi-species environment. ICES CM 2005/U:24, 22 pp.

Embling, C.B., **Fernandes, P.G.**, Hammond, P.S., Armstrong, E., Gordon, J. (2005). Investigations into the relationship between pelagic fish and dolphin distributions off the west coast of Scotland. ICES CM 2005/R:08, 15 pp.

ICES (2005). Report of the Workshop on Survey Design and Analysis. ICES CM 2005/B:07. 170 pp.

Fernandes, P.G. and Stewart, M. (2004). Determining the quality of a multifrequency acoustic identification algorithm. ICES CM 2004/R:11. pp.

Gajate, J., Ponce, R., Peña, M., Iglesias, M., **Fernandes, P.G.** and Alvarez, F. (2004). The SIMFAMI database: a library on ground truthed acoustic survey data. ICES CM 2004/R:27. pp.

Holmes, S.J., Campbell, N., Aires, C., Fernandes, P.G., Catarino, R., Bailey, N. and Barratt, K. (2009). Using VMS and Fishery Data in a Real Time Closure Scheme as a Contribution to Reducing Cod Mortality and Discards. ICES CM 2009/M:13. 27 pp.

Korneliussen, R.J., Diner, N., Ona, E. and **Fernandes, P.** (2004). Recommendations for the collection of multi-frequency acoustic data. ICES CM 2004/R:36. 15 pp.

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Mosteiro, A., **Fernandes, P.G.**, Armstrong, F. and Greenstreet, S. (2004). A dual frequency algorithm for the identification of Sandeel school echotraces. ICES CM 2004/R:12. pp.

Santos, R., García-Núñez, N., Fässler, S. and **Fernandes, P.G.** (2004). The multifrequency scattering properties of herring (*Clupea harengus*) and Norway pout (*Trisopterus esmarkii*). ICES CM 2004/R:15. pp.

ICES (2004). Report of the Workshop on Survey Design and Analysis. ICES CM 2004/B:07 261 pp.

- Simmonds, E.J., Zimmermann, C., Jansen, S., Götze, E., Torstensen, E., Staehr, K.-J., Couperus, A.S. and **Fernandes, P.G.** (2003). ICES coordinated acoustic survey of ICES Divisions IIIa, IVa, IVb and VIa (North) 2002 Results and long term trends. *ICES CM 2003/Q:20*. 23 pp.
- ICES (2003). Report of the planning group for herring surveys. *ICES CM 2003/G:03* 176 pp.
- Fernandes, P.G.**, Stevenson, P. and Brierley, A.S., (2002). AUVs as research vessels: the pros and cons. *ICES CM2002/J:02*, 11 pp.
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- Fernandes, P. G.**, MacDonald, L., Aukland, R., Reid, D., Simmonds, E. J. and Shanks, A. (2001). Changes in the availability of herring to the North Sea acoustic survey; the impact of diurnal migration. *ICES CM 2001/Q:08* 24 pp.
- ICES (2001). Report of the planning group for herring surveys. *ICES CM 2001/G:02* 148 pp.
- Simmonds, J., Rivoirard, J. and **Fernandes, P.** (2000). Vessel, gear and day/night effects in the estimation of herring abundance and distribution from the IBTS surveys in the North Sea. *ICES CM 2000/K:32*, 16 pp.
- Fernandes, P.G.** and Brierley, A.S. (1999). Using an Autonomous Underwater Vehicle as a platform for mesoscale acoustic sampling in marine environments. *ICES CM 1999/M:01*. 16 pp.
- Fernandes, P.G.**, Gerlotto, F., Soria, M. & Simmonds, E. J. (1998). Into the next dimension: three-dimensional acoustic observations of fish school aggregations. *ICES C.M. 1998 /J:33*, 8 pp.
- Fernandes, P.G.** (1998). A spatial analysis of trawl variability in the 1995 North Sea herring acoustic survey. *ICES C.M. 1998 /J:6*, 7 pp.
- Reid, D. G., **Fernandes, P.G.**, Bethke, E., Couperus, A., Goetze, E., Hakansen, N., Pedersen, J., Staehr, K.-J., Simmonds, E. J., Toresen, R. & Torstensen, E. (1998). On visual scrutiny of echograms for acoustic stock estimation. *ICES C.M. 1998 /J:3* pp.
- Simmonds, E. J., Bailey, M., Toresen, R., Couperus, B., Pedersen, J., Reid, D. G., **Fernandes, P.G.** & Hammer, C. (1997). 1996 ICES coordinated acoustic survey of ICES Divisions IIIa, IVa, IVb, and VIa. *ICES C.M. 1997 /H:11*, 13 pp.
- Fernandes, P.G.** (1996). The application of the log backtransformation to determine dataset selection in North Sea herring acoustic surveys. *ICES CM 1996/D:13*, 14 pp.
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- Simmonds, E.J., Toresen, R., Corten, A., Pedersen, J., Reid, D.G., **Fernandes, P.G.** and Hammer, C. (1996). 1995 ICES coordinated acoustic survey of ICES Divisions IVa, IVb, VIa and VIIb. *ICES CM 1995/H:8*, 16 pp.
- Simmonds, E.J., Toresen, R., Corten, A., Pedersen, J., Reid, D.G. and **Fernandes, P.G.** (1995). 1994 ICES coordinated acoustic survey of ICES Divisions IVa, IVb, VIa and VIIb. *ICES CM 1995/H:15*, 13 pp.
- Yuan, Y., Borchers, D. L., Clarke, E. D., and Fernandes, P. G. (2009). Estimation of Monkfish Absolute Abundance from Trawl Surveys. *ICES CM 2009/N:10*.

Other articles

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