Guidelines for writing an ICES survey protocol

SCICOM Ecosystem Surveys Science and Technology (SSGESST)
and Workshop of SSGESST expert groups chairs (WKESST)

January 2014

Contents

1 Primary objective of the series of ICES survey protocols (SISP)

This document defines the required content of a SISP protocol, and contains key references that define the ICES survey approach. These guidelines should be used by authors when developing and further augmenting the SISPs, and also by reviewers when evaluating the manuals. In general, the SISP should meet the following objective:

The SISP document should be a manual whereby a person, with some expertise and experience in conducting surveys, but none in these particular surveys, could find all of the information required to competently conduct one of the surveys.

An important aspect is the balance between detail and accessibility. As a rule of thumb, any process that cannot be redone (e.g. sampling) must be prescriptive, but description of an analysis that can be redone can be less prescriptive. For the parts that require a substantial amount of detail, it is recommended to use annexes or citations to other key ICES and 3rd party documents, in particular if the procedures are common across surveys. This recommendation is typically the case for trawling gear manuals, sampling manuals, etc., and the last chapter defines key documents that could be used for this purpose.

The manuals should be updated whenever a significant change makes an update necessary (typically after the working group meeting). The protocol will then be reviewed (if changes are substantial), given a new version number, and published by ICES.

2 Suggested SISP outline

2.1 Background (approximately 2 pages + a map of the area and a figure of the overview of the time-series information)

The background section should set the scene for the survey, and provide an overview of the objective, areas, species covered, etc. More specifically, the chapter should contain:

- The objective of this particular survey (to management, science and advice).
- The spatial coverage (area) and temporal resolution (time of year; frequency; time of day for survey operation)
- Give some general information about the key species targeted with the survey; in particular the spatial distribution and typical age structure (long lived, short lived, etc.) or migration patterns of the species.
- List all survey gears and instruments.
- Include a brief summary of the existing time-series (first survey year, e.g. 1994–2012), including some brief information about significant changes in the survey methods over time, (e.g. gear changes or vessel changes) that affect the consistency of the time-series (create an annex or cite the list of survey reports for details).
- List of countries/institutes involved.

2.2 Comprehensive set of objectives

Whereas the background chapter specifies the overarching objectives, this section specifies the details. This section should include a list of all objectives, with periodization.

Identify the specific data products that result from the survey. Examples of data products that should be described in detail are:

- Biomass/abundance/index information
- Age structure
- Biodiversity indices
- Information on trophic interactions, e.g. from stomach sampling
- etc.

2.3 Survey sampling design

The survey sampling design specifies survey strategy and how the stations or transects are laid out. The survey, if conducted using standard methods, should refer to textbook methods. If survey-specific methods are used, the manual should state clearly when and why this approach has been taken so as to guide a person with general survey knowledge when performing the survey. Below is a list of required items:

- Survey area (e.g. ICES areas) covered.
- Definition of the primary sampling unit (PSU); relevant information on spatial and temporal resolution to be defined by survey expert (group).

- Survey design strategy (random, stratified random, fixed, systematic, adaptive, other). Describe what kind of (statistical) stratification scheme is used (if applicable).
- Sampling locations (How non-fishable areas are addressed for random designs or how locations are selected for fixed designs).
- Target numbers of samples to be collected or miles of transects to be covered.
- Temporal aspects:
  - The time frame of the survey (time period)
  - Frequency (annual, biannual etc.)
  - Consideration of diel variations (day-night sampling)
- Define fall-back options in case sampling is limited due to bad weather, technical problems, etc.

2.4 Observation methodology

Whereas the survey sampling design deals with the location and type of transects/stations, the observation methodology deals with how the actual sampling is carried out on a transect or at a station. In general, any techniques that are used for gear monitoring should be clearly stated, and, ideally, acceptable values of gear characteristics for the observation to be valid should be given.

Listed below are examples of the level of detail necessary for an effective protocol. The list is not comprehensive.

2.4.1 Protocol for sampling gear and instrumentation

- How to set up the gear or instruments:
  - Gear and rigging, validation of gear characteristics
  - Echosounder settings: Pulse lengths, ping rates, frequencies, etc.
  - Video surveys: Camera settings; lighting; camera field-of-view setting, calibration and validation; distance from seabed; how to estimate vessel and sledge distance over ground
  - Ichthyoplankton surveys: Which net or sampling device to use
  - Calibration of sensors (CTD, etc.).
- How to operate the gear: haul duration, gear performance, sampling etc.:
  - Video surveys: Speed over ground, visibility, ground contact, tow duration.
  - Ichthyoplankton surveys: mesh size; which part of the water column to sample; how to monitor gear performance; how to measure flow
  - Area swept.
- Acoustic and ichthyoplankton survey: Calibration procedures
- Acoustics: How backscatter is allocated to species
- Timing and frequency of sampling:
  - Acoustic (or video) surveys: Validation with pelagic hauls
  - Ichthyoplankton surveys: Sampling for information on fecundity

2.4.2 Protocol for collecting biological samples

- How to sample, subsample, and measure from the catches.
- How to monitor and evaluate the quality of a trawl haul.
- Acoustic and ichthyoplankton surveys: Requirement for additional biological sampling.
- How to monitor and evaluate the quality of the data.
- Video surveys: Protocols for reviewing and verifying footage (*Nephrops* UWTV surveys), including training procedures, validation against reference footage, independent and consensus counting.
- Video surveys: Quality control plots (e. g. are standard quality control plots produced for each station showing navigational and count data, for each survey are cross validation plots produced for each counter, and are density estimates plotted by minute and counter).
- Video surveys: How to record sea-pens and other benthic mega-fauna during *Nephrops* UWTV surveys.
- Ichthyoplankton surveys: How to analyse and/or preserve samples on board; how to identify ichthyoplankton; how to stage eggs/larvae; requirements for adult sampling.

2.5 Caveats

This section should contain information on known limitations of the data obtained, including known bias and catchability issues.

2.6 Analysis

Include detailed guidelines on how to analyse the data (or refer to a software package). This information should be described in relation to the chosen survey design and chosen observation method.

This part of the SISP should also address what survey diagnostics need to be done. Diagnostics may include checking stratification assumptions, the coefficient of variance (CV) or other variance estimates, data screening and plausibility checks of various parameters, and possibly filtering methods (treatment of outliers). For multi-vessel surveys, it should be specified what should be done per vessel and what should be done when assembling the data.

2.7 Reporting of results

This section should outline what should be in the survey report. The section should define key figures required in the report, e.g. the number of trawl stations, area covered, etc.

The section should clearly define to which and when data products are to be submitted to the ICES Data Centre, including any required metadata and field definitions

It should specify how deviations from the survey protocols (coverage/weather related problems, technical problems, potential biases, etc.) should be reported in the survey report. The section could also define how major survey challenges (dead zone problems, survey coverage, etc.) are reported to ensure that the survey reports can be used as a guide for future improvements.

The survey group is expected to provide bias considerations and CV estimates. (*This may in some cases best be included in the survey summary sheet, see below*).

2.7.1 Survey summary sheet

A survey summary sheet should be provided for each survey. The following may serve as an example:

2.7.1.1 Survey summary

Nation:	COUNTRY	Vessel:	SHIP
Survey:	SURVEY NAME	Dates:	Starting date-end date
Personnel:			

Survey description:	Main aims of the survey
Gear details:	
Calibration overview	A short description of equipment calibration and a comparison with the results from previous calibration.
Notes from survey:	Number of hauls carried out, number of nautical miles, deviations from sampling programme/SISP manual, other issues potentially influencing the survey results.
Target species catch rates:	Time-series mean Mean for survey year Species 1 Species 2
Number of fish species recorded and notes on any rare species or unusual catches:	
Number of epifauna species recorded:	
Index revisions:	

Stations fished

ICES Divisions	Strata	Gear	Tows planned	Valid	Additional	Invalid	% stations fished

Number of biological samples (maturity and age material)

Species	Number	Species	Number

Survey map(s) displaying sampling stations, transects, and if relevant.

3 Annexes

The manuals should preferably cite annexes and publications, and only include details when it is different from the standard practise. The set of annexes should, ideally, define the standard ICES approach and promote standardization across surveys. "Missing" key documents should be developed and published as SISP supporting documents.

3.1 Suggested key documents

3.1.1 Acoustic surveys

MacLennan, D. N., Fernandes, P. G., and J. Dalen. 2002. A consistent approach to definitions and symbols in fisheries acoustics. ICES J. Mar. Sci., 59: 365–369.

Foote, K. G., H. P. Knudsen, G. Vestnes, D. N. MacLennan, and E. J. Simmonds. 1987. Calibration of acoustic instruments for fish density estimation: A practical guide. ICES Cooperative Research Report, No 44. 69 pp.

3.1.2 Survey design

Literature

Conquest, L., Burr, R., Donnelly R., Chavarria J., and Gallucci, V. 1996. Sampling methods for stock assessment for small-scale fisheries in developing countries. *In:* Stock assessment: quantitative methods and applications for small-scale fisheries. Ed. by Gallucci, V. F., S.B. Saila, D.J. Gustafson, B.J. Rothschild, 1996. CRC Press, Boca Raton, USA.

Cochran, W. G. 1977. Sampling Techniques (third edition). John Wiley and Sons, New York, 428 pp.

Cressie, N. A. C. 1993. Statistics for Spatial Data. Revised Edition. Wiley, New York, 928 pp.

Lehtonen, R., and Pahkinen, E. 2004. Practical Methods for Design and Analysis of Complex Surveys, 2nd ed. Wiley & Sons, New York. 349 pp.

ICES. 2004. Report of the workshop on Survey Design and Data Analysis (WKSAD), 21–25 June 2004, Aberdeen, UK. Fisheries Technology Committee. ICES CM 2004/B:07, Ref. D,G.

ICES. 2005. Report of the Workshop on Survey Design and Data Analysis (WKSAD), 9–13 May 2005, Sète, France. ICES CM 2005/B:07. 170 pp.

Rivoirard J., Simmonds J., Foote K. G., Fernandes P., Bez, N. 2000. Geostatistics for Estimating Fish Abundance. Blackwell Science, Oxford, 206pp.

Papers

Harbitz, A., and M. Pennington. 2004. Comparison of shortest sailing distance though random and regular sampling points. ICES Journal of Marine Science, 61:140–147.

Harbitz, A., E. Ona and M. Pennington. 2009. Use of an adaptive acoustic-survey design to estimate the abundance of highly-skewed fish populations. ICES Journal of Marine Science, 66: 1349–1354.

Helle, K., and M. Pennington. 2004. Survey design considerations for estimating the length composition of the commercial catch of some deep-water species in the Northeast Atlantic. Fisheries Research, 70:55–60.

Folmer, O., and M. Pennington. 2000. A statistical evaluation of the design and precision of the shrimp trawl survey off West Greenland. Fisheries Research, 49:165–178.

McGarvey, R., and M. Pennington. 2001. Designing and evaluating length–frequency surveys for trap fisheries with application to the southern rock lobster. Canadian Journal of Fisheries and Aquatic Sciences, 58:254–261.

Pennington, M. 1996. Estimating the mean and variance from highly skewed marine survey data. Fishery Bulletin, 94: 498–505.

Pennington, M., and Vølstad, J. H. 1991. Optimum size of sampling unit for estimating the density of marine populations. Biometrics, 47: 717–723.

Pennington, M., and J. H. Vølstad. 1994. Assessing the effect of intra-haul correlation and variable density on estimates of population characteristics from marine surveys. Biometrics, 50:725–732.

Pennington, M., L.-M. Burmeister and V. Hjellvik. 2002. Assessing the precision of frequency distributions estimated from trawl-survey samples. Fishery Bulletin, 100:74–81.

Pennington, M., and K. Helle. 2011. Evaluation of the design and efficiency of the Norwegian self-sampling purse-seine reference fleet. ICES Journal of Marine Science, 68:1764–1768.

Smith, S. J. 1990. Use of statistical models for the estimation of abundance from groundfish trawl survey data. Canadian Journal of Fisheries and Aquatic Sciences, 47: 894–903.

3.1.3 Trawl sampling

Anon. 1989. Report of the Study Group in Net Drawing. Coun. Meet. int. Coun. Explor. Sea., C.M. 1989/B:44. 17 pp.

Engås, A. and Godø, O. R. 1989a. The effect of different sweep lengths on the length composition of bottom-sampling trawl catches. J. Cons. int. Explor. Mer, 45:263–268.

Engås, A. and Godø, O. R. 1989b. Escape of fish under the fishing line of a Norwegian sampling trawl and its influence on survey results. J. Cons. int. Explor. Mer, 45:269–276.

Ferro, R. S. T. 1983. Report by the Study Group on Twine Thickness Measurement. ICES CM 1983/B:26. 9 pp.

Godø, O. R., and Engås, A. 1989. Swept area variation with depth and its influence on abundance indices of groundfish from trawl surveys. Journal of Northwest Atlantic Fishery Science, 9: 133–139.

Godø, O. R. 1994. Factors affecting the reliability of groundfish abundance estimates from bottom trawl surveys. *In:* Marine fish behaviour in capture and abundance estimation. Ed. by A. Fernö and S. Olsen. pp. 166–199. Fishing News Books.

ICES. 2005. Protocol for the Use of an Objective Mesh Gauge for Scientific Purposes. ICES Cooperative Research Report No. 279. 8 pp.

ICES. 2009. Report of the Study Group on Survey Trawl Standardisation (SGSTS). *In:* ICES Council Meeting documents [ICES Council Meeting Documents. Copenhagen]. (Eds, p. [np], Vol. ICES CM 2009/FTC:09.

Kotwicki, S., Martin, M. H., and Laman, E. A. 2011. Improving area swept estimates from bottom trawl surveys. Fisheries Research, 110: 198–206.

Reid, D. G., Annala, J., Rosen, S., Pol, M. V., Cadrin, S. X., and Walsh, S. J. 2007. Current status of mobile and static sampling gears used in resource surveys. ICES Journal of Marine Science: Journal du Conseil, 64(8), 1607–1609.

Walsh, S. J. 1991. Diel variation in availability and vulnerability of fish to a survey trawl. Journal of Applied Ichthyology, 7:147–159.

Weinberg, K. L., and Kotwicki, S. 2008. Factors influencing net spread and sea floor contact of a survey bottom trawl. Fisheries Research, 93: 265–279.

3.2 Data storage at ICES

Links to data formats used at ICES (http://www.ices.dk/marine-data/Pages/default.aspx):

- Vocabularies used throughout the ICS Databases: http://vocab.ices.dk/
- Reporting formats and checks by survey as currently used in DATRAS: http://info.ices.dk/datacentre/datsu/selrep.asp
- Eggs and larvae data at ICES Data Centre: http://www.ices.dk/marine-data/data-portals/Pages/Eggs-and-larvae.aspx
- Environmental data (including marine litter from late 2013 onwards): http://info.ices.dk/env/submitting_data.asp#Exchange
- Oceanographic data (including vertical CTD profiles taken during surveys): http://ocean.ices.dk/Submission/Default.aspx
- Data guidelines: http://www.ices.dk/marine-data/guidelines-and-policy/Pages/ICES-data-type-guidelines.aspx

Additional information on Metadata (ISO 19319) as used by ICES: http://geo.ices.dk/geonetwork/srv/en/main.home?search=ices_datasets