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Report of the Study Group on combining gear parameters into effort and capacity metrics (SGEM)

11–15 August 2008

ICES Headquarters, Copenhagen

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International Council for the Exploration of the Sea
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Executive summary

The Study Group on combining gear parameters into effort and capacity metrics [SGEM] was poorly attended (only the Co-Chairs were able to attend). This constrained the extent of the work that could be done. However, the Terms of Reference were addressed as follows:

a) review work carried out on measuring relative/effective effort by gear type;

The Co-Chairs concluded that most previous work had treated gear type and to some extent, effort, in very general terms. Most previous work restricted consideration of gear to a few generic categories, e.g. otter and beam trawls. SGEM considered that effort should be based on actual effective effort i.e. swept-area, and that this should consider the characteristics of the gear and its deployment and be as detailed in time and space as possible.

b) determine the relationship between vessel construction (tonnage, power, length etc.) and the size or quantity of fishing gear deployed;

An example was presented from Scottish work. This revealed that the size of gear in the Scottish otter trawl fleets was largely unrelated to the power of the vessel towing the gear. Whereas this is probably not true for all fisheries or even this fishery historically, it does reveal that it must be emphasized not to make assumptions about the gear/vessel size relationship. Detailed information on gear deployed is only available in restricted cases, these should be catalogued and analyses carried out where possible.

c) from métiers, which have been identified using formal analytical tools and expert knowledge determine the relationship between key gear parameters and catch;

The Co-Chairs identified a number of candidate fisheries/métiers for further consideration. Four demersal otter trawl fisheries in the Northern North Sea (IVa) and Celtic Sea targeting mixed *Nephrops*/finfish and demersal fish; two pelagic otter trawl fisheries for mackerel in the North Sea and western waters and the gillnet fishery for hake in Western Waters (ICES Divisions VI and VII). A list of key physical and operational parameters have been identified.

d) using the measurements/indicators developed, in conjunction with relevant Assessment Working Groups, apply these to pilot fisheries where different gears are used to target the same species mix e.g. WGNSDS, WGNSSK, WGSSDS, WGHMM.

The Co-Chairs proposed that a number of case studies be examined. These include otter trawl demersal and pelagic fisheries in Scotland and Ireland. Other valuable case studies would include shrimp trawls in Iceland, as well as a beam trawl example. Other gears that would be worth investigating would be gillnets, longlines and seines. In some cases these would suitable for use as pilot studies as defined in ToR d).

1 Terms of reference

The **Study Group on combining gear parameters into effort and capacity metrics** [SGEM] (Co-Chairs: Dave Reid,* UK and Norman Graham,* Ireland) will be established and will meet at ICES Headquarters, Copenhagen, Denmark from 11–15 August 2008 to:

a) review work carried out on measuring relative/effective effort by gear type;

b) determine the relationship between vessel construction (tonnage, power, length etc.) and the size or quantity of fishing gear deployed;

c) from métiers, which have been identified using formal analytical tools and expert knowledge determine the relationship between key gear parameters and catch;

d) using the measurements/indicators developed, in conjunction with relevant Assessment Working Groups, apply these to pilot fisheries where different gears are used to target the same species mix e.g. WGNSDS, WGNSSK, WGSSDS, WGHMM.

SGEM will report by 10 September 2008 for the attention of the Fisheries Technology Committee and the findings of the Study Group will be reported in an *ICES Cooperative Research Report.*

2 Introduction

The Study Group met at ICES HQ, Copenhagen, Denmark from the 11–13 August 2008. Attendance at the meeting was very poor, with only the two co-chairs present. This restricted the scope of possible work, however, it was still possible to address the ToR in outline, and for the chairs to attend one day of the WKHIST meeting to exchange views and to identify mutually valuable work. The outcomes of the meeting and the suggestions for future work are detailed below.

3 Review work carried out on measuring relative/effective effort by gear type (ToR "a")

There have been considerable amounts of work carried out in recent years attempting to link effort and capacity to catches, effort and cpue/lpue. This includes projects such as "F and Effort", "TECTAC" and "Café". In most cases this has included some attempt to differentiate by gear type, but this has usually focused on the gear type in terms of fishing method e.g. Otter trawl, beam trawl, dredge etc. Even for these categories there has not always been a distinction between, say, single, twin and pair otter trawling.

The choice of metric for effort has also been difficult. In general the default has been to use some variant of days at sea, or days absent, by vessel. This is mainly because the most readily available effort data in national fisheries databases is in this form. The EU logbook contains a field for hours fished, but this is often ignored or may be filled in inaccurately.

The most appropriate measure of fishing effort is probably the area swept by the gear that is actually used. For example, one hour's fishing with a 10m wide net could not be considered as the same as with a 20m wide net. It would also probably be useful to have that information combined with speed at which the net is towed, and the dura-

tion of the tow. Arguably larger fish may escape a net towed slowly; equally, longer tows may tire the larger fish. So while towing the same net at 2 knots for 2 hours might cover the same swept-area as in one hour at 4 knots the catch performance may be quite different.

An additional problem in analysing effort is the spatial component. Data have generally only been available at the ICES stats rectangle resolution. With the addition of VMS and, potentially, e-logbooks, it should be possible to analyse fishing effort at a much higher spatial resolution. VMS can be used to determine where and when fishing takes place and to some extent the speed of the vessel while towing. The obvious advantage of this would be that at present using days at sea as a proxy for effort, we would find it difficult to differentiate between a day that included one 1 hour tow, from a day that included 20 hours of towing.

4 Determine the relationship between vessel construction (tonnage, power, length etc.) and the size or quantity of fishing gear deployed (ToR "b")

Detailed information on vessel construction is available from national fleet registry databases, however, detailed information on the construction of the nets deployed by these vessels is generally not available. Such information is usually only available in a restricted number of cases where individual vessels have been studied in detail. In Scotland, detailed studies have been carried out on some vessels in both the whitefish (>120mm mesh) and Nephrops (>80mm mesh) demersal fleets (Kynoch 2005, Kynoch and Penny 2006).

Details for the fishing gear were obtained for 39 vessels (11 single rig and 9 twin rig whitefish boats and 19 twin rig Nephrops boats). The type of data collected included details of the doors, towing wires and groundgear as well as for the net itself. The latter included size of the fishing circle, and lengths of the headline, groundgear and fishing line. Figure 4.1 shows the relationship between the length of the headline and the power rating of the vessel. Headline length can be used as a proxy for the wing spread at least in single trawls (Kynoch and Penny 2006).

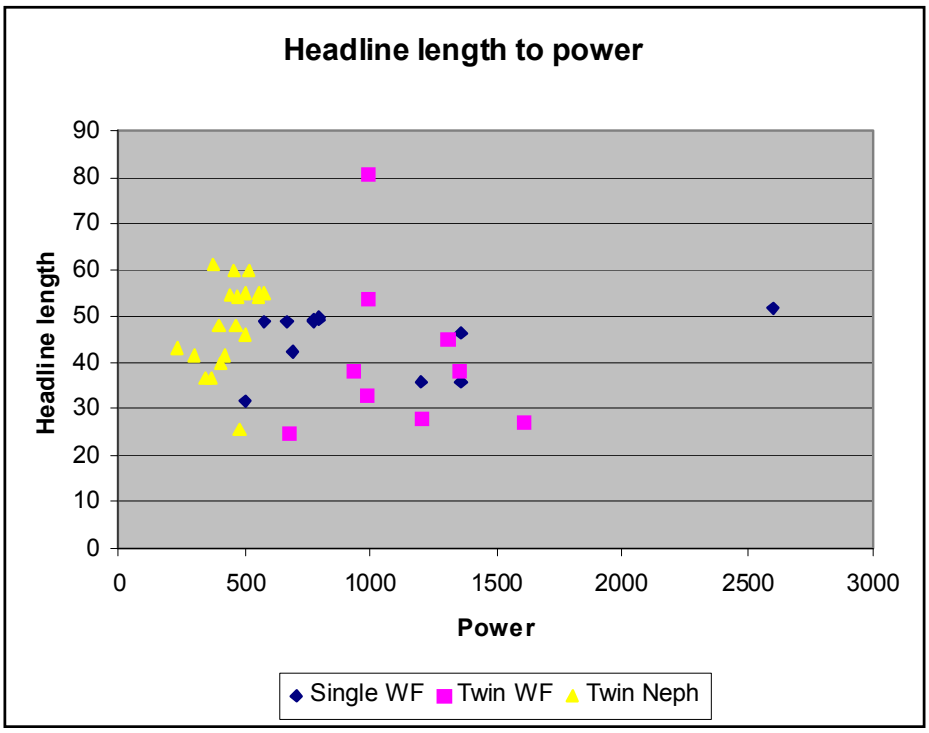

Figure 4.1. Relationship between the length of the headline and the power rating of 39 Scottish otter trawl vessel. The vessels are separated into single rig whitefish boats and twin rig whitefish and Nephrops vessels.

The figure clearly shows that although there is considerable variation in the headline length, it is not obviously related to the power of the vessel. Headline varied from 25 to 60m, with one twin rig vessel had an 80m headline. The most powerful single rig vessel (2600kW) had a 50m headline as did four other single rig vessels of between 500 and 800kW.

Gear performance data were obtained for a small number of the vessels in this study. This data included: door and wing spread, headline height, bridle angle and loads, as well as speed through the water and over the ground.

A priori, one would have assumed that a larger more powerful vessel would have tended to tow a larger net. This is clearly not the case for this particular fleet. Kynoch and Penny (2006) concluded that the larger vessels were able to use less of their engine power to tow the net, and this allowed them to fish in worse weather, and over worse seabeds than the lower powered vessels. As a consequence, it may be that the more powerful vessels may be able to spend more of their time at sea actually fishing, so a day at sea might involve more time towing than the lower powered vessels. This will require checking. It might also be supposed that the higher powered boats would also be able to tow faster, however there was little evidence of this, and in any case otter trawls would also tend to lose bottom contact if towed too fast.

One immediate implication, at least for these fleets, is that control of kW days would not necessarily be an appropriate way of controlling effort. As there is no obvious link between power and gear size, then there is no reason to conclude that more powerful vessels mean greater effective effort. Using kW days would tend to penalise the more powerful boats although they may not have any greater effective effort. One possible unintended consequence of such penalisation might be that the more powerful vessels would then compensate by switching to larger nets.

As a way forward in understanding the links between vessels and gears, it is suggested that an inventory of similar vessel and gear performance data should be assembled and where possible this should be used to examine the relationship between the vessel and the size of gear it might tow. Further information should be available form both directed studies and from selectivity studies carried out on commercial vessels. In both cases these should be able to provide some net performance data. Gear construction data (e.g. headline and fishing line length etc.) may also be available from net manufacturers.

5 From métiers, which have been identified using formal analytical tools and expert knowledge determine the relationship between key gear parameters and catch (ToR "c")

SGEM 2008 proposes seven candidate fisheries/métiers for further examination to quantify the relationship between physical attributes of both the vessel (ToR b) and gear as well as operational characteristics of the gears once deployed. The candidate fisheries are:

- Scottish North Sea (IVa) demersal otter trawling for mixed whitefish
- Irish Celtic Sea (VIIj,g) demersal otter trawling for mixed whitefish
- Scottish North Sea (IVa) demersal otter trawling for mixed *Nephrops* and whitefish
- Irish Celtic Sea (VIIj,g) demersal otter trawling for mixed *Nephrops* and whitefish
- Scottish pelagic trawling for mackerel
- Irish pelagic trawling for mackerel
- French gillnet fishery for hake

A candidate list of physical and operational parameters are identified in table 1 which will be used in conjunction with landings (or catch) data to determine which have a significant effect on catch rates through GAM or PCA modelling techniques.

DEMERSAL TRAWLING	PHYSICAL GEAR CHARACTERISTIC	FISHING CIRCLE DESCRIPTOR
		Sweep length
		Fishing line length
		Ground gear length
		Ground gear type
		Cod-end construction
		Single/multiple/pair
	Operational Characteristics	Swept area/volume
		Door/wing-end spread
		Towing speed
		Distance Covered
		Bridle angle
	Physical Vessel Characteristics	Power
		Length
		Tonnage
		Storage Capacity
Demersal Gill Nets	Physical Gear Characteristic	Mesh size
		Hanging ratio
		Headline length
		Fishing line length
		Panel depth
		Twine construction
	Operational Characteristics	Soak time No.of Fleets
	Physical Vessel Characteristics	Power
		Length
		Tonnage
		Storage Capacity

DEMERSAL TRAWLING	PHYSICAL GEAR CHARACTERISTIC	FISHING CIRCLE DESCRIPTOR
Demersal Longlines	Physical Gear Characteristic	Longline length
		Hook spacing
		Hook shape
		Hook size
	Operational Characteristics	Soak time
	Physical Vessel Characteristics	Power
		Length
		Tonnage
		Storage Capacity
Pelagic trawling	Physical Gear Characteristic	Fishing circle descriptor
		Sweep length
		Fishing line length
		Single/pair
	Operational Characteristics	Swept area/volume
		Door/wing-end spread
		Towing speed
		Distance Covered
		Bridle angle
	Physical Vessel Characteristics	Power
		Length
		Tonnage
		Storage Capacity

6 Using the measurements/indicators developed, in conjunction with relevant Assessment Working Groups, apply these to pilot fisheries where different gears are used to target the same species mix e.g. WGNSDS, WGNSSK, WGSSDS, WGHMM

The primary focus of SGEM (2008) was to identify candidate fisheries and to determine the data types necessary for model development. It is intended to work intersessionally to obtain relevant data that may help describe the relationship between gear metrics, catch and/or LPUE. As such, it is premature to undertake collaboration with assessment working groups until such data mining and preliminary analysis are conducted. It is intended that when available, the provisional results be presented at future ICES expert group meetings e.g. AMAWGC, benchmark and data compilation workshops.

7 Historical information and support for WKHIST

The 2008 meeting of SGEM was programmed to coincide with the meeting of WKHIST, with the aim of identifying any cross cutting issues. To this end members of SGEM attended a day of the WKHIST meeting. The main issue that emerged was that for much of the historical data being examined by WKHIST is based on some form of cpue or LPUE information. As detailed above, the effort component of these calculations would be enhanced by information on the gears used for these fisheries and the vessel characteristics. For example, the absence of a link in recent years between vessel power and gear size in the Scottish otter trawl fisheries is of relevance in interpreting LPUE information. Equally, an analysis of historical gear and vessel data would demonstrate whether this was a recent pattern in this fishery and whether this was also true historically. Investigation of this and similar questions would be valuable for both the interpretation of historical LPUE information and for understanding the current links between vessels and their gear. It is recommended that SGEM and WKHIST (or it's successors) be maintained.

8 Request from WGFTB to SGEM

In addition to the candidate fisheries identified for further investigation, SGEM notes the request from WGFTFB (2008) relating to *Pandalus* shrimp trawls.

"WGFTFB recommends the issue of shrimp trawl efficiency be addressed to SGEM as a case study for consideration using the Icelandic or other suitable datasets and also considering whether wingend spread can be used as an effort management parameter for this fishery"

Due to lack of data, SGEM (2008) was unable to consider this request and notes that in order to conduct an analysis, which aims to address the relationship between wing-end spread and efficiency, requires active participation and the submission of data from relevant sources. SGEM recommends that data on shrimp trawl construction, wing-end spread and catch rates be made available prior to the next meeting of SGEM for consideration.

9 References

Kynoch, R. J. 2005. Engineering performance of gears used by the Scottish fleet targeting Nephrops in ICES subarea IV. Fisheries Research Services Internal Report No 06/05.

Kynoch, R. J., and Penny, I. 2006. Engineering performance of gears used by the Scottish fleet targeting whitefish species in ICES subarea IV. Fisheries Research Services Internal Report No 22/06.

Annex 1: List of participants

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Annex 2: SGEM terms of reference for the next meeting

The **Study Group on combining gear parameters into effort and capacity metrics** [SGEM] (Co-Chairs: Dave Reid, UK and Norman Graham, Ireland) will meet at ICES Headquarters, Copenhagen, Denmark, from 11–15 August 2009 to:

a) review work carried out on measuring relative/effective effort by gear type in the and where possible determine the relationship between vessel construction (tonnage, power, length etc.) and the size or quantity of fishing gear deployed; Scottish North Sea (IVa) demersal otter trawling for mixed whitefish. The review will focus on the following fisheries:

- Irish Celtic Sea (VIIj,g) demersal otter trawling for mixed whitefish
- Scottish North Sea (IVa) demersal otter trawling for mixed *Nephrops* and whitefish
- Irish Celtic Sea (VIIj,g) demersal otter trawling for mixed *Nephrops* and whitefish
- Scottish pelagic trawling for mackerel
- Irish pelagic trawling for mackerel
- French gillnet fishery for hake

b) investigate the linkage between wingend spread, the use of single and multiple rigs on the efficiency of trawls used for targeting *Pandalus* shrimp.

SGEM will report by 10 September 2009 for the attention of SciCom and the findings of the Study Group will be reported in an *ICES Cooperative Research Report.*

Supporting Information

Priority:	The current activities of this Group will lead ICES into issues related to the ecosystem affects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Scientific justification and relation to action plan:	Action Plan No: 2.3, 3.2,3.4,3.16,4.13,4.15,5.3, 5.8 Term of Reference a) Fishing effort is the product of an individual vessels capacity to catch fish and its activity (FAO, 1999). For management purposes, capacity is generally quantified using some form of vessel characteristic that relates to its physical size and/or power. These capacity metrics are often combined with effort restrictions such as maximum days at sea, to control or limit fishing mortality. However, many studies have demonstrated that the link between capacity, effort and fishing mortality is imprecise. This may be more precisely quantified if fishing capacity indicators also included metrics relating to the size or amount of gear deployed. In order to consider the relationship between vessel construction, gear type, activity and ultimately catch, the SGEM, will explore the relationships between these and will consider the feasibility of using gear characteristics as indicators of fishing capacity. SGEM will focus on several case studies including both data rich and data poor fisheries, including both single and multispecies/multi-gear fisheries.
Resource requirements:	The research programmes, which provide the main input to this group, are already underway, and resources are already committed. The additional resource required to undertake additional activities in the

	framework of this group is negligible.
Participants:	The Study Group is likely to attract 15–20 participants from a range of appropriate scientific and technical disciplines including gear technologists, commercial gear manufacturers, mathematical and statistical modellers.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	There is a very close working relationship with all the groups of the Fisheries Technology Committee. It is also very relevant to the Assessment Working Groups and Working Group on Ecosystem Effects of Fisheries.
Linkages to other organizations:	The work of this group is closely aligned with similar work in FAO and the EU Regional Advisory Councils.