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Report of the

Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas

Vigo, Spain
12–14 February 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 TERMS OF REFERENCE AND PARTICIPATION

The **Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas** [SGSTG] (Chair: Francisco Velasco, Spain) will be established and will meet in Vigo, Spain from 12–14 February 2003 to:

a) conduct a review of the current uses and needs for IBTS data to determine potential uses and users of the data from the surveys in terms of stock assessment, species distribution and marine ecosystem applications e.g., biodiversity;
b) conduct a review of the current survey trawl gears to recommend standardisation of current methodology,
c) consider other candidate gears that would be suitable for use in all areas after suitable modification;
d) propose a minimum number of candidate net and ground gear configurations;
e) supervise modification and field trials of candidate trawl gears;
f) determine standardized trawling procedures after appropriate trawl gear has been chosen, in relation to the procedures used in the North Sea;
g) define the required scope of continuing intercalibration work required to maintain continuity in time series, including the North Sea time series;
h) recommend appropriate survey design for multi-vessel/gear permutations such as stratification, overlap, and the combining of data to provide indices of abundance and biodiversity and any other appropriate indicators of stock and regional scales.

SGSTG will report by 28 February 2002 for the attention of the Fishing Technology, Living Resources and Resource Management Committees and ACFM and ACE. It will also make its report available to WGFTFB.

The meeting was attended by:

Matthew R Dunn	UK
Siegfried Ehrich	Germany
Diana González	Spain
Robert Kynoch	UK
Rick Officer	Ireland
Xavier Paz	Spain (Part-time)
Kevin Peach	UK
Francisco Sánchez	Spain
Dave Stokes	Ireland
François Theret	France
Francisco Velasco (Chair)	Spain

2 INTRODUCTION

In its 2002 report (ICES 2002a), the International Bottom Trawl Working Group (IBTSWG) acknowledged the need for a new standard gear in the IBTS Eastern Atlantic Area[1]. This need is based on a number of factors:

- There is no widely used common gear outside of the North Sea. Gear currently used within the IBTS coordinated area includes; GOV (in various configurations), scaled down GOV, Standard Baca 44/60, Porcupine Baca, Norwegian Campelen trawl, rockhopper and PHHT.
- The standard (North Sea) GOV is expensive and is not very robust. It is also known to be poor at catching some species, particularly flat fish (SESITS, 1999; See below Section 5.2.3: Ehrich, Working Document 5).
- The GOV has been definitively rejected as suitable for Spanish and Portuguese coasts, and also is known to have limited value in many rough areas of the western shelf.

The IBTSWG believes that any standard gear should ideally be robust, cheap (to maintain as well as purchase), capable of deployment on rougher/harder sea beds than the GOV, and non-selective for as many species as possible. Given the growing interest in ecosystem aspects, the gear should ideally also be suitable for sampling benthic species.

[1] In 2002, "IBTSWG considered that the current quarterly classification of Southern and Western Division surveys creates temporal distinctions between surveys that are artificial." (ICES, 2002a) Eastern Atlantic Area was proposed as a more adequate definition for the area and so it is used in this report.

To address this issue a new Study Group on Survey Trawl Gear for the IBTS Eastern Atlantic Area (SGSTG) was established in 2003. Although the IBTSWG has addressed the need for standardization in trawl gear and fishing practices, little progress has been made because of a lack of expertise in trawl design and performance on the variety of bottom types comprising the area. This Study Group is intended to combine the expertise of the primary users of IBTS data from the Resource Management and Living Resources Committees, the trawl gear designers and the practitioners of trawl surveys from IBTSWG to develop a gear type and a set of standard fishing practices allowing the Eastern Atlantic Area of the IBTS to integrate data over a single, continuous survey area.

The idea of developing a standard gear *de novo*, due to the need of design, field trials and intercalibration, would be unlikely to produce a usable gear in less than five years. Given the current time series and the introduction of at least two new research vessels (Ireland and UK-England & Wales) in the western area in the near future, this time scale is not conducive to a complete revision and replacement of current gears. The delay in identification of potential new gears is problematic in that it means the development and modification of new surveys in the Western Division will be proceeding without a standard gear. Therefore it was considered that, rather than develop a new gear in less than one year, the Group would focus its review on the survey trawl gears currently used in the IBTS Eastern Atlantic Area, or in other areas. The Group will identify a few suitable candidates that can fulfil the sampling requirements in all the surveyed area, including target species and ground types as main concerns and supervise modification and field trials of these candidate trawl gears. Looking to the future, the Group also discussed the general criteria to design a Standard Gear *de novo* for the IBTS North Eastern Atlantic area.

3 REVIEW OF IBTS EASTERN ATLANTIC AREA DATA USES AND NEEDS

Estimates of abundance indices for assessment purposes are one of the most important objectives of IBTS surveys. However, geographical distribution of the species and marine ecosystem applications are becoming more important and their requirements are growing steadily together with its complexity.

Table 3.1 summarizes the use of IBTS Eastern Atlantic abundance indices in ICES Assessment Working Groups. Gadoid abundance indices stand out as the most used from northern surveys (UKSco, UK-WC and UK-NI), whilst from southern and western surveys (IRWC, EVHOE and SP) flatfish and angler abundance indices are also used in several stocks assessments. These geographical differences arise from the variability in ground types and target species, and thus a geographical approach will be applied to reduce this variability and identify homogenous areas with common sampling requirements.

Table 3.1. Use of the IBTS Eastern Atlantic surveys in ICES Assessment Working Groups (ICES 2003a, 2003b, 2003c, and 2003d). Recruit. indicates whether the survey receives weight in the XSA for the pre-recruit and recruiting age classes.

Survey	Common name	WG	Stock	Model	Recruit.	Tuning 2001		Tuning 2002	
						years	ages	years	ages
UK-ScoGFS	Haddock	WGNSDS	VIa	XSA,TSA	No	85–00	1–7	85–01	1–7
	Cod	WGNSDS	VIa	XSA,TSA	No	85–00	1–6	85–01	1–6
	Whiting	WGNSDS	VIa	TSA	No	85–00	1–7	85–01	1–7
UK-WCGFS	Cod	WGSSDS	VIIe-k	XSA	Yes	92–00	1–2	92–01	1–2
	Whiting	WGSSDS	VIIe-k	XSA	No	93–00	2–6	92–01	2–4
	Haddock	WGSSDS	VIIb-k	XSA	Yes	93–00	1–1	98-01	1–3[(2)]
								93–97	1–1[(2)]
	Hake	WGHMM [1]	North	XSA	No	88–00	1–2	88–01	1–2
	Megrim	WGHMM [1]	VIIb-k VIIIa-b	XSA	Yes			93–01	2–3
UK-NIGFSoct	Whiting	WGNSDS	VIIa	XSA		92–00	0–4	92–01	0–5
	Cod	WGNSDS	VIIa	XSA	Yes	92–00	0–2	92–01	0–2
	Haddock	WGNSDS	VIIa	XSA		95–00	0–3	95–01	0–3
UK-NIGFSmar	Whiting	WGNSDS	VIIa	XSA		92–00	1–5	92–01	1–5
	Cod	WGNSDS	VIIa	XSA	Yes	92–00	1–4	92–01	1–4
	Haddock	WGNSDS	VIIa	XSA		95–00	1–4	95–01	1–4
UK-NI_MIK	Cod	WGNSDS	VIIa	XSA	Yes			94–01	0–0
	Haddock	WGNSDS	VIIa	XSA		95–00	0–0	94–01	0–0
IR-WCGFS	Whiting	WGSSDS	VIIe-k	XSA	No	93–00	1–1		
	Haddock	WGSSDS	VIIb-k	XSA	Yes	93–00	0–1	93–01	1–1
	Plaice	WGSSDS	VIIb-c	XSA		93–00	1–4	93–01	1–4
	Plaice	WGSSDS	VIIh-k	XSA	No	93–00	2–5	93–01	2–5
	Sole	WGSSDS	VIIb-c	XSA		96–00	2–3	95–01	0–8
	Sole	WGSSDS	VIIh-k	XSA	No	93–00	2–4	93–01	2–6
IR-ISCSGFS	Haddock	WGNSDS	VIIa	XSA				97–01	0–3
FR-EVHOE	Whiting	WGSSDS	VIIe-k	XSA	Yes	97–00	0–4	97–01	0–4
	Cod	WGSSDS	VIIe-k	XSA	No			97–01	1–3
	Hake	WGHMM [1]	North	XSA	Yes	97–00	0–5	97–01	0–5
	Angler (piscatorius)	WGHMM [1]	VIIb-k VIIIa-b	XSA	Yes	97–00	0–7	97–01	0–7

Survey	Common name	WG	Stock	Model	Recruit.	Tuning 2001 years ages	Tuning 2002 years ages
	Angler (budegassa)	WGHMM [1]	VIIb-k VIIIa-b	XSA	Yes	97–00 2–13	97–01 2–13
	Megrim	WGHMM [1]	VIIb-k VIIIa-b	XSA	Yes	97–00 2–9	97–01 1–9
FR-RESSGASCS	Hake	WGHMM [1]	North	XSA	Yes	87–00 0–5	87–01 0–5
	Sole	WGSSDS	VIIIa-b	XSA	No	87–00 1–6	87–01 1–6
SP- GFS	Hake	WGHMM [1]	VIIIc- IXa	XSA	Yes	83–00 0–5	83–01 0–5
	Megrim	WGHMM [1]	VIIIc- IXa	XSA	Yes	90–00 1–6	90–01 1–6
	Four Spot Megrim	WGHMM [1]	VIIIc- IXa	XSA	Yes	88–00 1–6	88–01 1–6
	Horse mackerel	WGMHSA		XSA		85–00 0–11	85–01 0–11
P- GFS- July	Hake	WGHMM [1]	VIIIc- IXa	XSA	Yes	89–00 1–5	89–01 1–5
	Horse mackerel	WGMHSA		XSA		89–00 0–11	85–01 0–11
P- GFS- October	Hake	WGHMM [1]	VIIIc- IXa	XSA	Yes	85–00 0–5	85–01 0–5
	Horse mackerel	WGMHSA		XSA		85–00 0–11	85–01 0–11

(1) WGSSDS (Working Group on the Assessment of Southern Shelf Demersal Stocks) was replaced by WGHMM (Working Group on the Assessment of Southern Stocks of Hake, Monk and Megrim) for these species since 2002.

(2): split in last assessment.

3.1 Geographical distribution of target species and ground types

The variability in target species and ground types within the IBTS Eastern Atlantic Area has been one of the main reasons for the existence of the different sampling gears used in this area. To reduce this variability, the group has tried to define homogeneous areas regarding target species and ground types within the European Atlantic shelf (Figure 3.1.1).

Table 3.1.1 summarises target species, ground types and existing IBTS surveys in the different areas identified in Figure 3.1.1. Main target species are those targeted by the surveys in response to stock priorities. The second column in this table includes those species that are not considered currently as main target species because they a) are important commercial species, but not currently assessed b) are valuable by-catch species in the area or c) IBTS indices are not used in assessment because the gear is not providing representative samples and consistent indices. According to their behaviour in the water column, the species included in Table 3.1.1 can be classified as:

- Pelagic species: mackerel, herring, horse mackerel (recruits) and sprat.
- Demersal species: cod, haddock, whiting, hake, blue whiting, pollack, saithe, ling, horse mackerel (adults), elasmobranches (catfish), cephalopods (squid) and sea breams.
- Benthic species: *Nephrops*, megrims (2), anglers (2), plaice, sole, lemon sole, wedge sole, elasmobranches (rays and skates), rose & red shrimps and cephalopods (octopuses and cuttlefish).

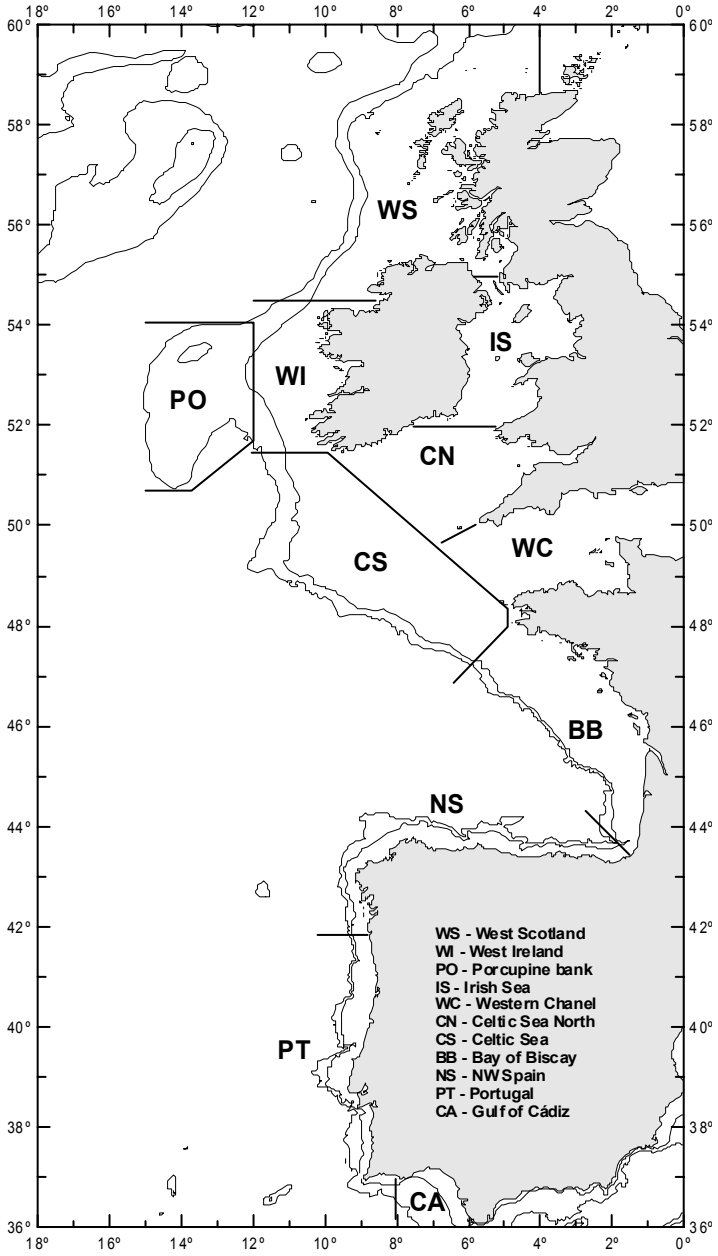

Figure 3.1.1. Homogeneous surveyed areas in the Atlantic European shelf taking into consideration target species and ground types.

3.2 Ecosystem and biodiversity information

There is currently a growing interest in ecosystem information, and multispecies or ecosystem models are becoming more common in fisheries resource management. An ecosystem approach tries to identify and quantify the critical biological interactions between and within commercial target species, non-commercial species and top predators. From this approach, it is possible to estimate specific precautionary reference points and limit values for key species, which will be needed for the development of adaptive strategies in the ecosystem approach to fisheries management. Therefore a standard gear should ideally be suitable for sampling as much of the different macrofauna compartments as possible.

Table 3.1.1. Main and secondary target species by each survey area considered (see Figure 3.1.1 for area codes). IBTS surveys covering each area as well as a first estimation of percentage ground type within each area. Bold figures in ground type indicate the interest of surveys in covering that ground type, though not necessarily being covered by the survey presently.

Area	**Main target species**	**Other species of interest**	**IBTS Surveys** (Quarters)	**% ground type**			
				1	2	3	4
WS	Cod, haddock, whiting, mackerel	Anglers, megrim, plaice, saithe, pollack, *Nephrops*, elasmobranches, pelagic species	SCOGFS (1&4) NIRGFS (1&4), IRGFS (4)	**20**	**50**	**24**	6
WI	Cod, haddock, whiting, plaice, sole	Anglers, megrims, hake, *Nephrops*, saithe, pelagic species	IRGFS (4)	**80**	**20**		
PO	Hake, megrims, anglers, *Nephrops*	Witch, Deep water species, elasmobranches	SPGFP (4)	**30**	**45**	**15**	10
IS	Cod, haddock, whiting, plaice, sole	*Nephrops*, elasmobranches, pelagic species	SCOGFS (1&4) NIRGFS (1&4) IRGFS (4) CEFAS (4)	**70**	**20**	**10**	
WC	Cod, haddock, whiting, plaice, sole, mackerel	Anglers, herring, lemon sole, cephalopods, elasmobranches, pelagic species	CEFAS (1&4) EVHOE (4)	**10**	**20**	**50**	20
CN	Cod, haddock, whiting, hake, megrim, plaice, sole, anglers	*Nephrops*, turbot, Pollack, ling, elasmobranches, lemon sole, pelagic species	CEFAS (1), IRGFS (4) EVHOE (4)	**10**	**30**	**50**	10
CS	Cod, haddock, whiting, hake, megrims, anglers, sole	*Nephrops*, Pollack, elasmobranches, ling, lemon sole, pelagic species	CEFAS (1&4) IRGFS (4) EVHOE (4)	**60**	**30**	**10**	
BB	Hake, megrims, anglers, whiting, horse mackerel, blue whiting, sole	*Nephrops*, elasmobranches	EVHOE (4) RESGASC (2&4)	**70**	**20**	**10**	
NS	Hake, megrims, anglers, *Nephrops*, horse mackerel, blue whiting	Mackerel	SPGFN (4)	**70**	**10**		20
PT	Hake, horse mackerel, blue whiting, rose & red shrimps, mackerel, Spanish mackerel	Megrim, anglers, *Nephrops*	PGFS (3&4)	**20**	**40**	**20**	**20**
CA	Hake, horse mackerel, rose & red shrimps, *Nephrops*, Wedge sole	Mackerel, sea breams, cephalopods	PGFS (3&4) SPGFS (2&4)	**80**	**10**		10

Ground type codes: **1**: Sandy, muddy: trawlable with wire synthetic coat. **2**: Gravel, bed rocky: trawlable with wire with double coat. **3**: Moderate rocky: trawlable with rubber discs or bobbins. **4**: Hard rocky: hostile trawling grounds trawlable with rockhopper gear.

Three different sampling tools are used to obtain information from the different macrofauna compartments on the Shelf: acoustic surveys for pelagic species, bottom trawl surveys for ground fish and demersal species and beam trawl surveys for small benthic fish and epibenthic macrofauna. The data collected from these three types of surveys should be as comprehensive as possible to feed the ecosystem based management models. A bottom trawl gear directed mainly to sample the pelagic and semipelagic components, or mainly to the benthic and the demersal components, it would not provide a representative sample of the whole system, and thus leave an important gap in the ecosystem based models.

Nevertheless, the Group considered that the main current objective of IBTS surveys is to estimate abundance indices of commercial species for their assessment. Therefore, whilst the sampling of benthic species should be addressed in designing the standard gear, it should not compromise this main objective, and it should not entail any impoverishment in the abundance indices.

Other approaches should also be considered to compensate for the sampling deficiencies of the gear, and to obtain the maximum benefit from the bottom trawl surveys. For example, it should be considered whether it is possible to employ other smaller scale sampling with different gear (mainly small beam trawls) using IBTS survey vessel time, or exploiting the samples collected by employing different studies, such as gut contents.

4 IDEAL FEATURES OF THE STANDARD GEAR

Basic Design: an uncomplicated gear design would be essential to enable ease of handling, deployment and repair on differing vessels. Rigging adjustment should also be as simple and steady as possible to avoid differing adjustments leading to differences in trawl performance.

Ground gear contact: looking at Table 3.1.1 a good contact of the ground rope with the ground is essential for most of the species considered, but critical for *Nephrops*, anglers and flatfish. Nevertheless, the ground gear must also be adaptable to different seabed conditions.

Vertical opening: it is essential for some target species that the vertical opening must be high enough to collect a representative sample.

Horizontal opening: it must be adequate to collect sufficient but not excessive samples, and compatible with the vertical opening for the stability of the net.

Mesh size: in the lower part of the sampling trawl, the mesh size must be small enough to catch *Nephrops* and flatfish. To maintain geometry and efficiency of the trawl it is recommended to use larger meshes in the upper wings and square. However, to maintain good water flow in the body of the trawl, the meshes in the top panels must reduce gradually to equal the meshes in the lower panel before the extension piece.

Robustness and durability: the material used in construction of the trawl must be chosen to ensure the strength and minimise the damage to the trawl. The design must incorporate guard meshes and tearing strips to minimise potential damage to the small mesh. There should be no slack netting in any panels of the trawl, especially in the lower wings and the belly.

Towing speed: the towing speed must be adapted to the behaviour of the different target species and remain constant for the duration of the survey tow. The trawl design must be compatible with the required towing (ground) speed and the actual speed through the water to maintain the geometry, stability and groundgear contact.

Herding effect: the herding effect of the rigging must remain constant at all times. The sweep angle and length must be chosen with reference to the behavioural characteristics of the target species.

Stability: geometry of the trawl gear must be maintained for different water depths, water flow on the trawl, sea state and seabed conditions to ensure a stable catchability of the sampling trawl.

Costs: the costs of gear construction and maintenance should also be balanced against all the previous considerations.

5 REVIEW OF THE GEARS CURRENTLY USED IN IBTS EASTERN ATLANTIC AREA

Gears currently used in IBTS Eastern Atlantic Area are summarised in Table 5.1. According to what has been agreed as the ideal candidate for standard gear, two different gears currently in use (Porcupine Baca and GOV) are then considered as potential candidates, and therefore treated in more detail.

Table 5.1. Sampling materials used in the IBTS groundfish surveys (N/A: not applicable; N/R: Not Recorded)

Country/Institute **Sampling Material**	Ireland MI	UK/ Scotland MLA	UK/North Ireland DARD	UK/ England CEFAS	France IFREMER	Spain IEO	Spain /Porcupine IEO	Portugal IPIMAR
Research vessel	*Celtic Voyager*	*Scotia*	*Lough Foyle*	*Cirolana*	*Thalassa*	*Cornide de Saavedra*	*Vizconde de Eza*	*Noruega*
Type	Stern Trawler							
GRT	340	2619	547	1731	3022	1133	1400	496
KW	N/R	3000	880	N/R	2200	1650	1800	1100
Overall length (m)	32	68.6	43.5	74	72.7	67	53	47.5
Gear Type	GOV 28.9/37.1	GOV 36/47	Rock Hopper	PHHT	GOV 36/47	BACA 44/60	BACA 40/52	NCT
Depth range (m)	15–200	20–200	20–120	40–600	30–400	30–700	180–800	30–750
Trawling speed (knots)	3.5	4	3	4	4	3	3.5	3.5
Doors weight (kg)	500	1100	N/A	1440	1350	650	850	650
Doors surface (m^2)	3.99	4.5	N/A	4.5	4.5	3.58	4.2	3.75
Sweep length (m)	60	60	12.5	18.28	50 100	200	250	No
Diameter of Lower Bridle (mm)	20	20	18	20	22	N/A	18	16
Diameter of Upper Bridle (mm)	12	14	20	16	12	N/A	18	14
Diameter of Middle Bridle (mm)	12	14	N/A	N/A	12	N/A	N/A	14
Exocet Kite	Yes	Yes	No	No	No	No	No	No
Floats in Headline	18	20	N/R	20	18	25	12	80
Floats in Winglines	32	20 + 20	N/R	32 + 32	24 +24	15 + 15	50	80
Mean vertical opening (m)	5.2	4.6	3	4.4	4 4.1	2.0	3.5	4.8
Mean doors spread (m)	48	82	37	81.7	76.9 112.7	107.1	120.4	44.3
Mean horizontal opening (m)	N/R	19.6	N/R	N/R	18.7 20.5	18.9	20	15.6
Sweeps Angle (º)	N/R	18	N/R	N/R	16.9	12.7	11.5	N/A
Groundrope	Rubber disks	Bobbins	Rubber disks	Rubber bobbins + Rubber disks + Chain	Rubber disks and Chains Rubber and metal disks	Synthetic wrapped wire core	Synthetic wrapped wire core double coat	Bobbins

5.1 Porcupine Baca

The Porcupine Baca 40/52 (Figure 5.1.1) was developed for the Porcupine Bank Survey in 2001, in collaboration with gear technologists and fishermen as a high headline modification of the Baca trawl routinely used in bottom trawl surveys off the Atlantic Spanish coast. It is a gear designed to capture species that usually live on the bottom or near it, but by increasing vertical opening its efficiency to capture pelagic and semi-pelagic species is improved.

The net dimensions are a 39.46 m footrope and 51.96 m headline (Figure 5.1.1). The groundrope is designed to ensure a close ground contact, to prevent fish escaping beneath the net, and weighs 350 kg in air, is wrapped with a double synthetic coat of nylon to strengthen it and increase its diameter (98 mm) to reduce hook-ups, and it is also ballasted with 50 kg of chains. Mean vertical opening of the net is around 3.5 m, horizontal opening 17–21 m, and door spread 120 m, achieving a sweep angle of 11.5º. Mesh size is 90 mm throughout, made of Polyethylene, and fitted with a 20 mm internal liner in the codend. The sweeps are 250 m long with 55 mm diameter. Doors are oval 850 kg and with a 4.2 m^2 surface area, and in the Porcupine survey the gear is deployed with a 18 mm diameter warp.

The performance of Porcupine Baca in the Porcupine surveys (2001 and 2002, Velasco and Sánchez, Working Document 4) suggests that it is more efficient for benthic and demersal species than the other gears used in the IBTS

western and southern areas except the Spanish Standard Baca, which shows a similar efficiency for these species. However, the Porcupine Baca was more efficient than Spanish standard Baca for sampling pelagic or semipelagic species. The efficiency for these species compared to the GOV has not been tested, but given its smaller vertical opening, it is likely that the GOV is more efficient for pelagic species. In terms of the length composition of the catches, the area covered by the Porcupine survey is not a recruitment area, but from the results on haddock in that area, and from those of other roundfish in trials performed on the Spanish coast, it can be inferred that 10–12 cm is the lower limit of the length distribution that is properly sampled with this gear.

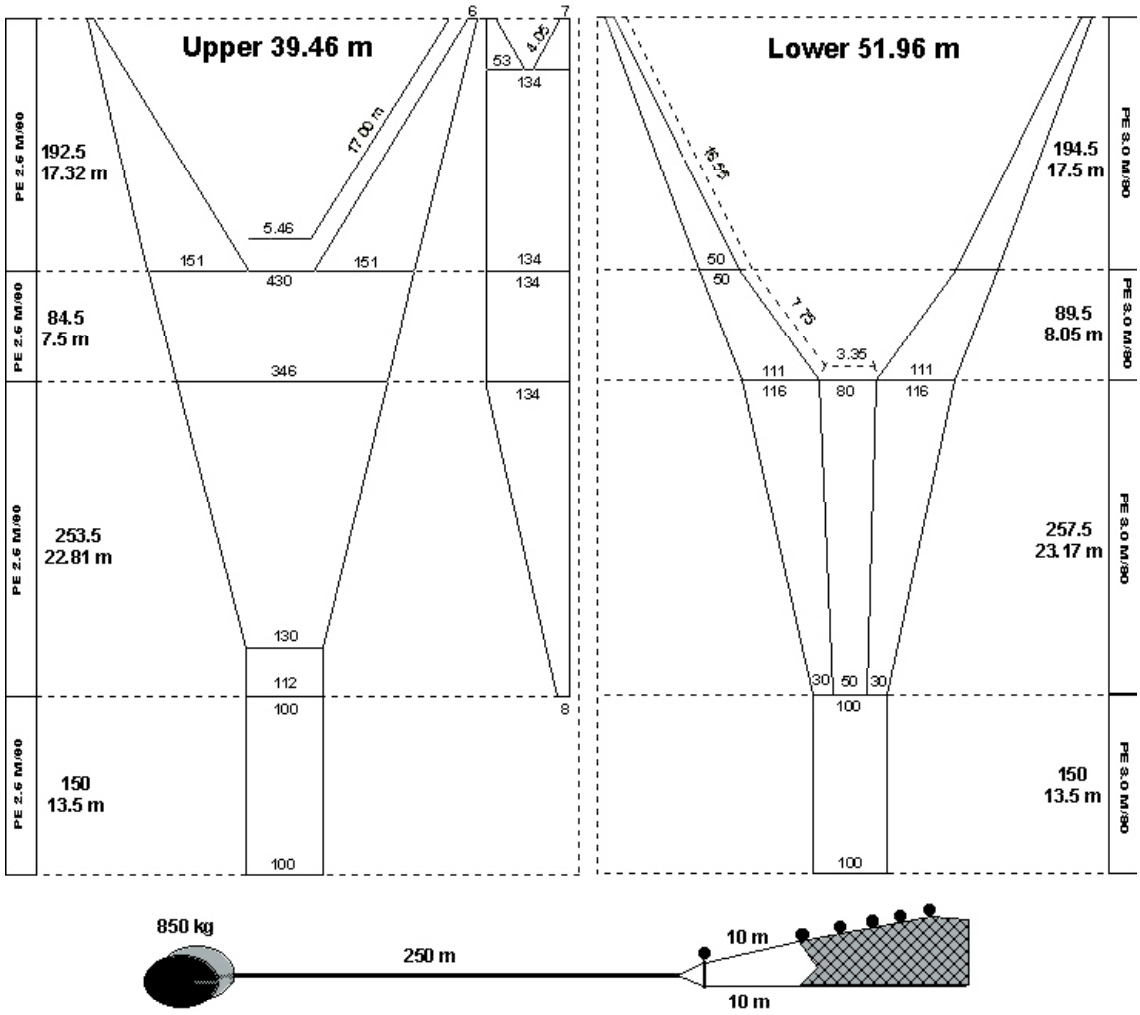

Figure 5.1.1. Design of Porcupine Baca 40/52 as used in Porcupine Survey.

In November 2002, trials of the Porcupine Baca were performed by CEFAS RV *Cirolana* in the western English Channel and Irish Sea. At fishing positions in the western English Channel, the trawl suffered severe damage, particularly to the lower wings and belly, with the net separated from the ground rope in 2 tows. The seabed in this area was hard (rock and shell), although clear from large rocks and pinnacles.

The gear rigging used was not the standard for the Porcupine Baca, as the doors were a different size (polyvalent doors, 1440 kg, 4.5 m^2 surface area), the sweep length was shorter (50 m), and the groundrope and headrope were longer (lengthened by 1 m to facilitate attachment to the lower bridle). In order to move towards the recommended rigging, the sweeps were then lengthened to 150 m. With this rigging, the Baca was fished at stations in the Irish Sea, sustaining light or no damage except during one station in the North Channel. The seabed in the North Channel is hard and rocky, whereas the other stations fished were soft (sand and mud). However, to avoid any further damage and loss of time, the Baca was replaced with the PHHT when R/V *Cirolana* moved to stations on harder grounds in the southern Irish Sea and English Channel. Therefore, whilst these trials cannot be considered fully conclusive, they suggest that the Porcupine Baca needs to be strengthened or modified before it can be fished on hard grounds.

5.2 GOV

5.2.1 Review of current GOV methodology

There are three different configurations of GOV deployed in the Eastern Atlantic Area; Ireland, France and Scotland. Differences in gear parameters are listed in Table 5.1. Figures of these gears can be found in ICES (2002b).

The configuration used by Ireland is a scaled down version of the GOV, to compensate for the smaller vessel size and lower horsepower. The standard 36 m headline is reduced to 28.9 m and likewise the ground rope from 47m to 37.1m. The door surface area is also reduced from the standard 4.5 m² to 3.99 m² with a weight of 500 kg. Using a sweep length of 60m in all depths, rubber disc ground gear (A) and a trawling speed of 3.5 knots, a mean net geometry of 5.2 m headline height and a 48 m door spread is achieved. As yet the horizontal net opening has not been recorded.

The configuration used by Scotland is the GOV (36/47), using a sweep length of 60 m in all depths and a 530 mm double rubber wheel bobbins ground gear (C) with an Exocet kite and 1100 kg doors. Trawling at a speed of 4 knots, a mean net geometry of 4.6 m headline height, 82 m door spread and a horizontal opening of 19.6 m is achieved.

The configuration used by France is the GOV (36/47) with a depth dependent sweep length of 50 or 100 m to attain a constant sweep angle of 16.9º, a standard ground gear (A) of 20cm rubber discs in the bosom and quarter sections, 10 cm in the wing sections. The gear is fished without an Exocet kite but with extra buoyancy and smaller diameter upper bridles to compensate for this change. The gear is spread with 1350 kg doors and towed at a speed of 4 knots. In depths of less than 70 m a mean net geometry of 4 m headline height, a 76.9 m door spread and a horizontal opening of 18.7 m is achieved. Using the 100 m sweeps at depths in excess of 70 m a mean net geometry of 4.1 m headline height, a 112.7 m door spread and a horizontal opening of 20.5 m is achieved.

This summary highlights the current variability in the GOV used for IBTS surveys, and the necessity to standardise the methodology within one gear type as proposed in the next section.

5.2.2 Standardization of the GOV

With the imminent delivery of two new Research Vessels, the requirement for continued co-ordinated surveys of the Eastern Atlantic Area to maintain time series and service working groups is a necessity. The opportunity exists, however, to review current GOV usage and adopt a standard procedure across surveys. The review should:

1) Address issues of quality control with regard to the guidelines described in the IBTS manual.
2) Address standardisation of sweep length usage to reduce sweep angle variability.
3) Address headline height and shape variability (Exocet kite)

5.2.3 Trials in the North Sea determining catch efficiency

In 1995 catch efficiency of the GOV (36/47) equipped with the standard rubber disc ground gear (Type A) was investigated by Dahm and Wienbeck (1996). Using a method developed by Engås and Godø (1986), small flat trawls (bag nets) were fitted beneath the ground rope and behind the roller gear to retain that part of the catch which had escaped under the fishing line of the GOV.

Figure 5.2.3.1 shows the proportion of the GOV catch in relation to the total catch as recorded in the bag nets and in the GOV. As expected, the pelagic species and the gadoids (except cod) were contained with more than 90% efficiency in the main codend. The low proportion of cod is comparable with those of flatfishes such as dab and lemon sole. In particular, cod smaller than 35cm had a strong tendency to escape under the fishing line Ehrich (1991).

The GOV displays low catch efficiency in relation to the small fish species living very close to the bottom, for example dragonets. It is concluded that such species are only present randomly in the GOV catches.

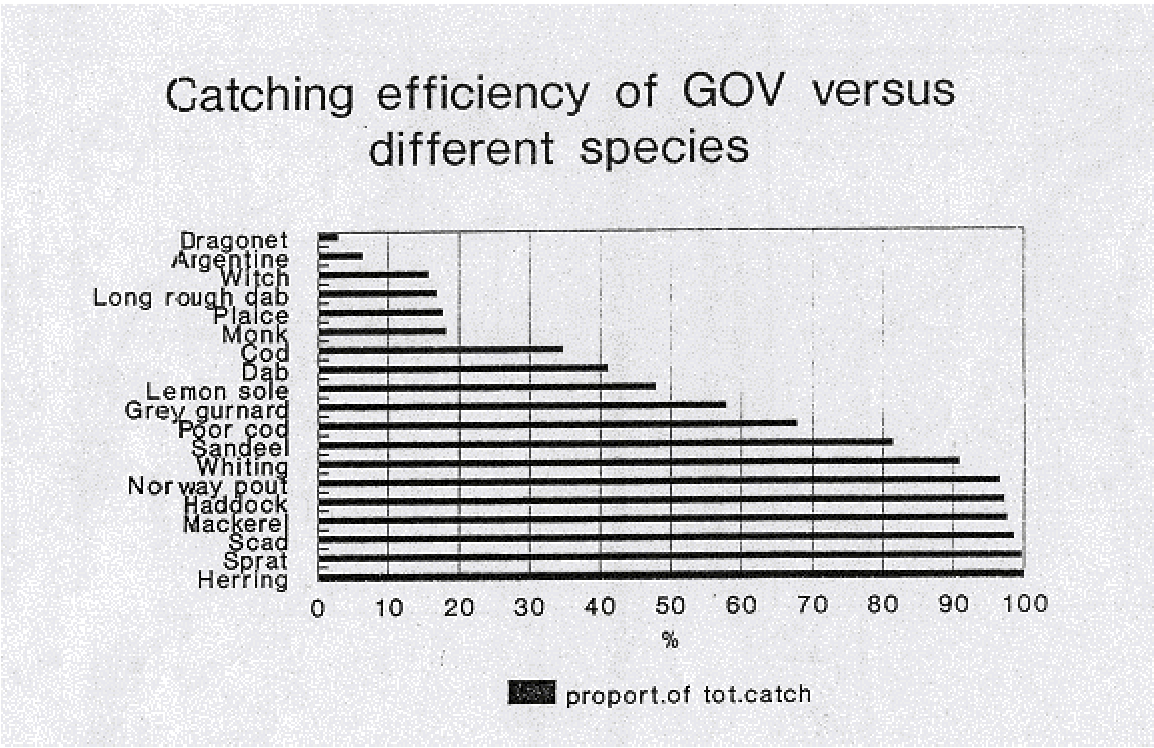

Figure 5.2.3.1. Results of the bag-nets experiment (Dahm and Wienbeck, 1996). GOV catch (%) in relation to total catch.

Related to the flatfishes, and to the small bottom dwelling species, the results given above are supported by further recent investigations (Ehrich, Working Document No. 5).

In the first week of January 2002, the FRV "Walther Herwig III" visited Box A in the German Bight to investigate the species distribution of fish and epibenthos using the GOV standard gear (27 hauls) and a 2m-beam trawl (9 hauls). In the same area and two weeks earlier, the smaller research vessel "Solea" carried out comparative fishing between a 7m-beam trawl and an otter trawl, as used in the German Small-Scale Bottom Trawl Survey. The standardized abundance indices are listed in Table 5.2.3.1.

For most of the bottom dwelling species of small size the 2m-beam trawl was the most effective gear. For solenette the abundance was nearly 20 times higher compared to the 7m-beam trawl. The GOV only caught solenette randomly. The same ranking also exists for scaldfish, dragonet, hooknose and dab, whereas for the bigger sized plaice the 7m-beam trawl was the most effective gear. As supposed for whiting the ranking was in the reverse order, and the abundance based on GOV was about 3 times higher than that of the beam trawls.

Table 5.2.3.1. Gear specific abundance indices, standardized to N per hectare.

species	abundance (N/ha)		
	2m-beam trawl	7m-beam trawl	GOV
LIMANDA LIMANDA; dab	577.7	464.1	261.6
PLEU. PLATESSA; plaice	34.9	98.1	1.4
BUGL. LUTEUM; solenette	1816.0	97.7	3.0
ARNOGL. LATERNA; scaldfish	251.6	38.5	0.3
CALLIONYMUS LYRA; dragonet	76.9	13.8	0.3
A. CATAPHRACTUS; hooknose	56.8	13.4	0.5
E. GURNARDUS; grey gurnard	0.0	3.0	0.0
MER. MERLANGUS; whiting	46.8	41.7	139.8

In general, each fishing gear gives representative catches for only a part of the whole fish assemblage in the area. The fishing trials presented here show that dab is underrepresented in the catch of the GOV, and that the small flatfishes and the other small bottom dwelling species like hooknose are caught by the GOV in an effectively random manner, and not representatively.

6 REVIEW OF OTHER SUITABLE CANDIDATE GEARS

6.1 GOC 73 Standard gear for Mediterranean trawl surveys

A working document (Ramos et al., Working Document 3) presented to the group showed the preliminary results of comparative fishing trials between the Standard Baca 44/60 and the GOC 73 trawl gears. This working document suggested that the GOC 73 trawl gear might also be a potential candidate for surveying groundfish within the IBTS surveys, at least in the Gulf of Cadiz area currently surveyed with the Standard Baca 44/60.

The GOC 73 trawl gear was designed by a French-Italian technologist team from IFREMER-IRPEM as a scientific sampling gear for bottom trawl surveys in the Mediterranean Sea. Currently it is the standard gear used in the surveys of 'MEDITS' EC Co-operative projects. The GOC 73 is a four-panel gear with 35.7 m headline length, a 7.4 m siderope and a 40 m groundrope length with coated wire and 55 kg of chains. The mesh size decreases from 140 mm in the wings and the anterior part of the net to 40 mm in the codend, and is fitted with a 20 mm internal liner in the codend. Vertical opening is ensured with 40 floats and 30 m upper and lower bridles. The gear is spread with 350 kg doors (2.6 m^2) and towed at a speed of 3 knots. Sweeps length depends on depth, 100 m in depths of less than 200 m and 200 m in deeper stations. Using this rigging a net geometry of 2.5 m headline height, between 96 and 116 m door spread and a horizontal opening between 17.2 and 18.1 m is achieved.

The results presented from the comparison experiment show that the GOC had a good contact between the groundrope and the bottom, rendering representative catches of flatfish and demersal species. The differences in selectivity for both gears regarding the species sampled were small, with a 70% coincidence and larger precision of GOC for pelagic and several demersal species. Nevertheless, the disadvantages of the GOC according to these results are a relatively low vertical opening (considering the desired specifications for a candidate gear for the whole area), instability when fishing on irregular grounds, and that the ground rope configuration would not be appropriate for rough grounds.

6.2 Flume tank trials

D. Stokes (MI, Ireland), B. Harley, M. Dunn and T. Boon (all CEFAS) consulted N. Ward and M. Montgomerie (both SFIA) at the Sea Fish Industry Authority (SFIA, UK) flume tank in Hull on 29–30th Jan 2003, to discuss survey trawl design and review alternative existing commercial trawls for trawl surveys on the west of coast of England, Wales and Ireland. Scale models of several trawl designs were demonstrated in the flume tank, two of which were presented as general purpose trawls with characteristics suitable for the survey objectives we identified.

1) **The Boris "goshawk" box trawl:** This was a compact trawl with a 17.3 m headline and 22.7 m fishing line, and fitted with 40 cm rockhopper gear. Fished with a 45.5 m wire top bridle and 45.5 m and 1.2 cm chain lower bridle, the headline height was measured as 3.1 m. All netting was clear of the ground, but the aft lower wings and the belly presented a level platform at their juncture with the groundgear. This design had double tapered (diamond shaped) side panels, the widest part of which was aligned with the front edge of the square, providing the extra fullness in the fishing circle. The design originated in the 1950s, and used to be available in fishing line sizes up to 48.5 m. Variants of this design, including versions without the side panels, are still in regular use along the English NE coast.
2) **The Stuart 360:** This was larger than the Boris goshawk with a 24.2 m headline and 30 m fishing line. The variant presented was rigged for relatively rough ground, with rockhopper groundgear and shortened flying lower wings (not attached to the ground gear). A 3-bridle arrangement was employed, with the upper (wire) attached to the headline, the middle (wire) attached to the fishing line, and the lower (chain) to the groundgear. The trawl had a relatively long tapering cut, with panels of progressively smaller mesh size (160–120–80 mm). The flotation used kept panels tight, with the lower wings rising near vertical from the seabed. The headline height was measured at 4.5–4.8 m. Some experimental adjustments were then carried out to show how the lower wings might be lowered towards the ground gear. When 40% of the buoyancy was removed and the upper bridle shortened by 0.3m, the wing dropped down allowing it to follow the groundrope, however the headline height dropped to 3.3 m.

The Boris Goshawk and Stuart 360 trawls each had features desirable for a survey trawl. For example, the good wing shape of the Boris Goshawk and the long tapering cut of the Stuart 360. However, neither trawl had all of the features identified by the SGSTG (see Section 4). Nevertheless, the tank demonstrations indicated that commercial manufacturers have the expertise to design a net with most or all of these features.

6.3 New survey Gear NOAH

A new survey gear, NOAH, is being studied in a one year EU project called Survey trawl, and will be finished in December 2003. The partners are IFREMER (Co-ordinator), IMR Bergen and NCMR Athens.

The trawls used to sample demersal fish are normally slightly modified commercial fish or shrimp trawls. Such trawls are designed to capture commercial species, and do not lend themselves well to representative sampling, mainly due to the herding effect of trawl doors, sweeps and bridles. The impact of herding is different on different species and size groups of the same species, and both inter- and intra-specific effects can be quite large.

The Survey trawl project intends to provide the strategic basis and initial design for a new survey trawl, which will represent a good compromise in terms of being non-herding and non-selective, and with stable and consistent operation. The final objective is to produce a new trawl with the characteristics of a beam trawl (no herding effect, stability), but with no beam.

To avoid the herding effect, three different trawl and associated rigging concepts will be studied. The netting part of the three trawls should be very similar for each concept, but the riggings will be very different. The three designs will be tested by means of numerical simulation, using Dynamit software, to verify whether the designs represent hydrodynamically viable options.

Particular attention will be paid to:

- The gear simplicity.
- The net openings and geometry variations versus the towing speed and depth.
- The gear geometry variation for different friction intensities on the ground.

The comparison of both standard survey trawls and the new trawl concept will be made on the basis of engineering performance. In that respect, a technical comparison between existing and developed gears will be aided through expert advice.

6.3.1 Preliminary results

Benoit Vincent (IFREMER, Working Document 2) has made some simulations on the GOV to test an example of a new concept for the SGSTG meeting. The rigging used was with four doors: two doors connected to the lower wing ends and two pelagic doors connected to the upper wing ends. This simple rigging is commonly used by fishermen in Mediterranean.

With the standard rigging the vertical opening decreases from 4,3m to 2,7m (horizontal opening increases from 16,8m to 20,2m) when depth increases from 50m to 500m.

Using the four door rigging, in the same depth range, the vertical opening decreases only from 4,4m to 4,3m (horizontal opening increases from 15,2m to 15,6m).

Some work remains to be done, but these preliminary results show that it is possible to produce a new trawl gear (specifically new rigging) which has potentially no herding effect and good stability of geometry at all times.

7 CANDIDATE NETS AND GROUND CONFIGURATIONS, FIELD TRIALS

Taking into consideration the variability of target species and ground types in the IBTS Eastern Atlantic Area, and the various gears currently used in this area, the group agreed that two gears, GOV and Porcupine Baca, should be considered as suitable candidates to be used as standard gear. Nevertheless, both gears have pros and cons if adopted in all the IBTS surveys in the Eastern Atlantic Area. The GOV has potential fragility and cost problems stated above, and it is not suitable for collecting adequate benthic target species. The Porcupine Baca has a vertical opening that *a priori* is not considered large enough to sample some pelagic target species, and preliminary trials in rough grounds have posed doubts on its suitability to work such areas. Therefore these gears will be modified (see below) to try overcoming these problems and trials will be performed during 2002.

The Group will consider the results of these trials in its next meeting. If no agreement is achieved to adopt a single general standard gear, it is expected that these two modified gears (easier to inter-calibrate, given its similar geometry,

than the present variety of gears) will cover all the sampling necessities in the area. An appropriate survey design for multi-vessel/gear permutations, a term of reference to be addressed in the next meeting, will then allow estimating indices of abundance and biodiversity and any other appropriate indicators of stock and regional scales.

7.1 Porcupine Baca

7.1.1 Proposed modifications

The modifications proposed to the Porcupine Baca trawl are generally intended not to alter the trawl geometry as specified in Section 5.1 or efficiency, but only to strengthen the trawl and reduce the costs of its construction and maintenance.

7.1.1.1 Mesh size

Current design: The Porcupine Baca uses 90 mm mesh throughout the net

Problem: The lack of graduated mesh size may mean that smaller fish are lost through the meshes particularly ahead of the cod end liner.

Proposed modification: Graduation of mesh size from 90 mm in the anterior two panels to 70 mm in the posterior panels. Further graduation was considered to unnecessarily complicate the maintenance and increase costs.

7.1.1.2 Groundrope

Current design: The Porcupine Baca ground rope weighs 350 kg and is wrapped with a double coat of nylon to strengthen it and to increase its diameter in order to avoid snagging. The groundrope is ballasted with an extra 50 kg of chain.

Problem: The double wrapped groundrope is relatively expensive to construct and difficult to repair when damaged. It also places the netting very close to the bottom increasing the likelihood of damage in rougher bottoms.

Proposed modification: It is proposed to separate the groundrope from the fishing line and not to use chain. To maintain the same overall diameter of the groundrope a rope fitted with 8.5 cm rubbers will be used. The rope will be ballasted at intervals with lead to achieve the same overall weight in the water as that of the original Porcupine Baca groundrope. It is suggested that the additional buoyancy of the rubbers should be compensated for by a 7 % change in overall weight. The groundrope will be fastened to the fishing line such that there is very little vertical gap between the groundrope and the fishing line.

Problem: The overall diameter of the groundrope and other elements terminating at the forward end of the wings is large. Some net manufacturers therefore found it difficult to constructing a neat end to the trawl at this point. Their solution was to extend the lengths of the groundrope and headline.

Proposed modification: Incorporation of rubbers in the groundrope and separation of the fishing line should make it unnecessary to extend the groundrope and headline beyond the originally specified lengths.

7.1.1.3 Wings

Current design: The wings extend a total distance of 25.55 m forward of the bosom, 17.5 m from the crown. Polyethylene twine is used throughout, 2.5 mm diameter in the upper and side panels, 3 mm in the lower panels.

Problem: The wings of the trawl are relatively prone to damage and tend to tear extensively when damaged.

Proposed modification: In the lower, most forward section of the side panels and in the most forward panels of the lower wings it is proposed to substitute the Polyethylene twine with a stiffer, high tenacity twine of the same diameter as in the original design. Suggested twine types include “Euronet”, “Brezline”, or “Compact” twines.

7.1.1.4 Belly

Current design: Polyethylene twine of 3 mm diameter is used throughout.

Problem: Damage in the belly tends to result in extensive tears.

Proposed modification: It is proposed to substitute the forward 10 meshes in the belly with a stiffer, high tenacity twine of the same diameter as in the original design. Suggested twine types include "Euronet", "Brezline", or "Compact" twines.

7.1.1.5 Trawl doors

Current design: 800 kg Oval Polyvalent doors are used.

Problem: These doors are smaller than those used by most Institutes. It would be beneficial if Institutes wishing to use the Porcupine Baca could do so without having to change to smaller doors at sea.

Proposed modification: No modification is proposed but appropriate door rigging settings that retain the desired trawl geometry should be obtained for doors other than 800 kg Oval Polyvalent doors.

7.1.1.6 Sweep length

Current design: 250 m sweeps are used.

Problem: Sweep length may not maintain the same trawl geometry when the net is used with doors other than the specified 800 kg Oval Polyvalent doors or in waters shallower than 200 m.

Proposed modification: If appropriate door rigging settings that retain the desired trawl geometry cannot be obtained for doors other than 800 kg Oval Polyvalent doors it is proposed to alter the sweep length.

7.1.2 Trials schedule

The modifications proposed to the Porcupine Baca trawl are intended to maintain the same trawl geometry and efficiency. From this point of view, modifications to the ground rope, sweeps length and mesh size will be tested as a first step. The trawl geometry will be tested in sea trials aboard the *Celtic Explorer* in March 2003 if a modified net is available at that time. After these tests, comparative hauls will be carried out between the modified Porcupine Baca (R/V *Celtic Explorer*) and the GOV (R/V *Cirolana*).

Another opportunity for testing the modified net, more focused on testing efficiency for flatfish and *Nephrops*, will be on the Spanish Porcupine survey in autumn 2003. At this time repeated tows over the same grounds with the original and modified nets may also provide data on relative efficiency.

If vessel time is available at the end of Porcupine survey, comparison experiments between the standard Baca trawl (R/V *Cornide de Saavedra*) and Porcupine Baca (R/V *Vizconde de Eza*) will be performed on the Spanish coast by the IEO.

A model of the Porcupine Baca trawl is being constructed by SFIA, and should be available from March 2003 for testing at the Hull flume tank.

7.2 GOV

Problems have been identified deploying and fishing the GOV (Bellail and Meillat, Working Document 1), which results in damage to the body of the trawl. The consequence of this is that confidence has been lost in this trawl design. With some minor modifications it may be possible to restore confidence in this gear and reduce lost fishing time. All modifications must be carried out with due consideration to existing trawl geometry, with a view to maintaining the time series index. The distribution in the water column of pelagic or semipelagic target species will be investigated in the literature, with a view to reviewing headline height parameters to standardise GOV deployment across nations and surveys. Any potential changes will be taken with due consideration to target species.

7.2.1 Model trials – Sea Fish Industry Authority Flume Tank, Hull

Experiments were made using the SFIA model of the GOV 36/47 (MarLab specification) at the Hull flume tank, in order to reduce loose netting and ground contact in the lower wings and belly. This situation was considerably improved by removing the kite and adding floats providing 140 kg of additional buoyancy, 40 kg on each forward wing end, 20 kg on each quarter, and 20 kg on the centre headline. The middle bridle and middle bridle extensions were removed and the upper and lower bridles were extended to 60m and 58m respectively. Finally, the upper bridles were extended by a further 0.3 m to shift the towing force more to the groundrope. With this configuration the lower wings were tight with well shaped diamond meshes, unlike the relatively slack meshes displayed in the original specification. The headline height with this specification was measured at 6.37 m. However, the SFIA model is 15^{th} scale made to a specification provided many years ago, and it was not clear how closely it matched the current IBTS specification. It was agreed that the SFIA model did not always behave in the flume tank in the same way as the 10^{th} scale model tested in the North Sea Centre in 1984, a view which is supported by camera footage of the real GOV in operation (R. Kynock and K. Peach). Mike Montgomerie and N. Ward (SFIA) indicated that the cut of the GOV suggested that it could be fished with none of the netting in contact with the seabed.

7.2.2 Proposed modifications

1) Replace kite with flotation.
2) Incorporate new twine technology – Replace low tenacity with high tenacity twine.
3) Strengthen the belly with tearing strips and/or belly lines.
4) Develop ground gear D (Rockhopper) experimental design (direct observations).
5) Investigate the effect of removing the middle bridle (Maintain geometry).
6) Alter flotation to compensate for instrumentation.

7.2.3 Trials schedule

CEFAS has planned to conduct some gear trials aboard RV *Cirolana* in the North Sea by the end of February 2003. The aim is to collect data to evaluate the observations made using model trawls in the SFIA flume tank. The gear deployed during the trials is planned to include a Porcupine Baca trawl, a standard GOV, and a GOV with modifications following the recommendations from the SFIA flume tank visit in January 2003 (Section 7.1.2). If initial trials to modify the GOV prove successful, then the performance of the GOV with different ground gears may also be tested.

Marlab (Aberdeen) is planning to conduct GOV gear trials in the North Sea during May and November 2003. The possibility will exist to test some of the proposed modifications e.g., flotation, removing the middle bridle, use of Rockhopper Groundgear. Net parameters and direct observation would be recorded on all trawls to assess implications of net configuration to gear geometry. All modifications will be undertaken with reference to results from the CEFAS trials during February 2003.

7.3 Trials methodology

Trials proposed in Sections 7.1.2 and 7.2.2 will follow if possible the standard methodology for IBTS surveys described in the Manual for The International Bottom Trawl Surveys in the Western And Southern Areas (ICES, 2002b), but applying the proposed modifications. However it is understood that to make the most of ship-time, trawl duration can be reduced while studying gear geometry. Nevertheless when comparative fishing experiences between two gears are performed, trawling duration will be the standard in the corresponding area/gear and consecutive hauls will be carried out in the same direction to avoid the possible effect of strong currents in the catches.

It is considered essential that as many as possible gear parameters are monitored and logged during the trials. Vertical opening, ground contact, wing and door spread and trawling speed with GPS are considered the minimum required information to assess the performance of the gear regarding its geometry.

8 FUNDING

A Working Document (Cardador and Chaves, Working Document 6) acknowledged the necessity and advantages of adopting a standard gear for the IBTS Eastern Atlantic Area, but stated some of the problems involved in such a decision. The cost of this decision in terms of trials, gear construction and acquisition, intercalibration with former gears, is large and needs to be planned and considered carefully to ensure the general adoption of the Standard Gear(s) by all the surveys involved in the IBTS Eastern Atlantic Area.

At present some countries face the replacement of their research vessels, and have assigned extra-funding for the associated trials and intercalibrations. This circumstance will favour carrying out trials of the modified gears previous to the decision on the final standard gear(s) and will provide information on the sampling performance of the candidate gears. Nevertheless further funding will be required to test their suitability for each survey and carry out the necessary intercalibrations to maintain continuity in time series. The possibility of applying for an Intercalibration project has to be addressed by Institutes carrying out surveys within the IBTS Eastern Atlantic area. Future calls of The Community Initiative Programme Interreg III B «Atlantic Area» should be considered as an appropriate frame for such a project, although other sources of budget should also be explored.

9 RECOMMENDATIONS

1) That a review of gear parameters being logged on surveys be made for inclusion in the IBTS manual to facilitate quality control in deployment of the gear. Such a review should include parameters such as sweep length, tide/current strength, placement and buoyancy compensation for net sensors. As a minimum requirement headline height, wing spread and door spread should be logged; the issue of groundgear contact during the haul should also be addressed.
2) A study should be conducted to examine the definition of a valid haul with regard to weather conditions, gear damage and environmental factors effecting trawl performance.
3) In the short term, surveys should concentrate on strengthening and small deployment modifications to their current gears (sweep length, bridles, buoyancy etc), without jeopardising their time series. These modifications should attempt to address the problems with the current gears identified by the SGSTG. Suitable modifications should be discussed at IBTS or SGSTG and adopted by all the surveys using the gear prior to its implementation.
4) Over the current survey year the suggested modifications to the Porcupine Baca ground gear and the GOV bridle and buoyancy arrangements be tested by the relevant countries, and results reported back to this SGSTG.
5) That the specific requirements of a standard gear(s) identified by the SGSTG be discussed with a number of commercial net manufacturers to get some tangible designs for a multi-purpose net. In the mid term these designs should form the basis for discussion, simulations should follow using flume tank trials, and Dynamit computer simulations and ad-hoc sea trials carried out where possible.
6) In the long term, where a gear(s) can be identified, that appropriate resources should be sought for comprehensive sea trials and intercalibration prior to the adoption of such a gear. After adoption, trials should determine for which part of the fish assemblage the proposed standard gear delivers representative catches.
7) Given that key decisions have to be taken in a short time its considered essential that information on trials and results of these should be exchanged between the SGSTG during the year.

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APPENDIX 1 – LIST OF CONTACT ADDRESSES

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Vigo, 12–14 February 2003

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