TOWARDS COORDINATED ACOUSTIC SURVEYS IN NORTH WEST AFRICA:

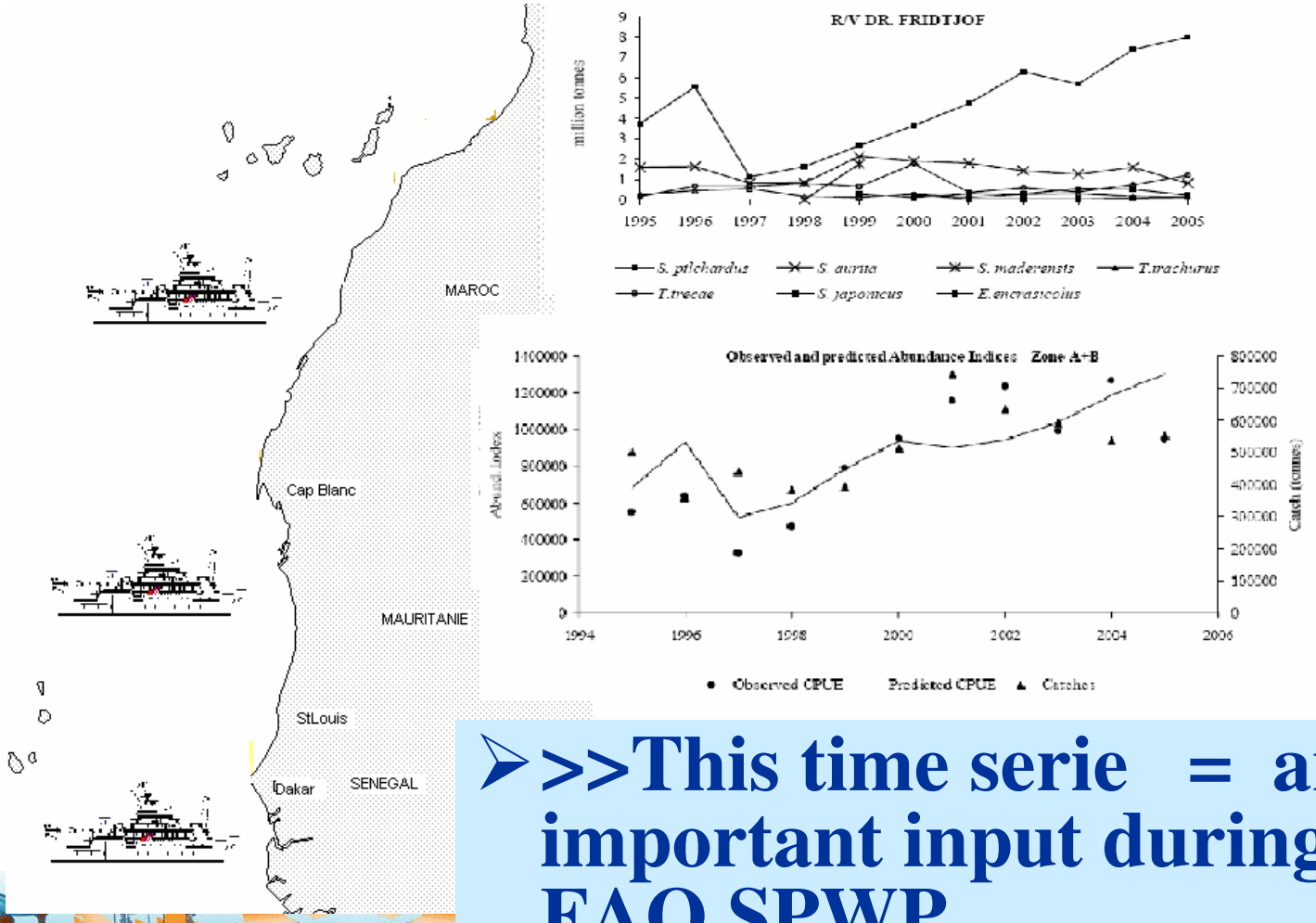
Results of Parallel surveys and Intercalibrations

Sarré A. CRODT
El Ayoubi S, Charouki N.,. Chbani M., INRH,
Ebaye. O. M , Taleb M.A.O. IMROP
Mbye E., Jallow J. FISH-Dmt
Krakstad J-O, Alvheim O. IMR

CONTEXT

- *Since 1995, the coastal pelagic fish off North-West Africa are subject to regular evaluation by the Norwegian research vessel Dr. Fridtjof Nansen through regional acoustic surveys covering the area from southern Senegal to Cape Cantin in Morocco*
- *This activity is undertaken within the framework of a programme of co-operation between the countries, FAO and the " Nansen Programme ".*
- *Year 2000 : acquisition of national research vessels with acoustic equipment in the Senegal, Mauritania and Morocco.*
- *Planning Group 2004 : Dr. Fridtjof Nansen is expected to leave the region*
- *Recommendation : The national vessels have to take over the responsibility for the acoustic surveys carried out by the R/V Dr. Fridtjof Nansen*

From Dr F.Nansen : A time serie of wide range of data since 1995



➢ >>This time serie = an important input during FAO SPWP

Local research vessels to continue now this time serie from Dr F.Nansen…

N/O Al Amir

N/O Al Awam

N/O Itaf Deme

➢ ***By Coordinated acoustic surveys***

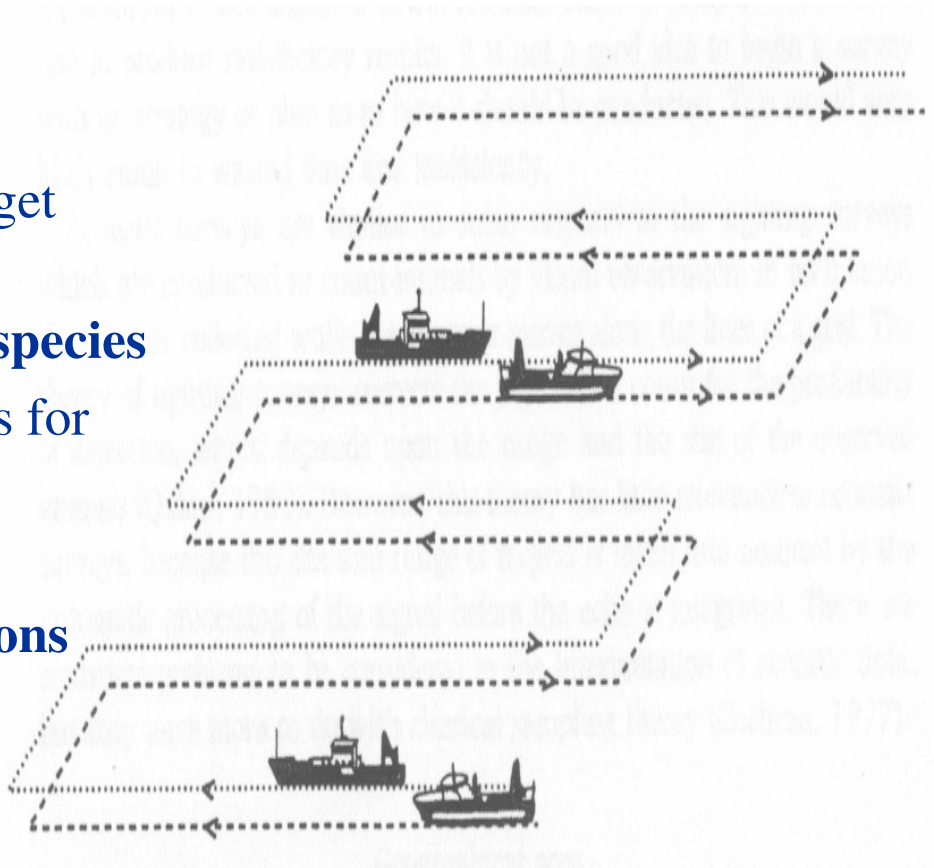
Parallel surveys and intercalibration exercises since 2004

- Oct 2004 Parallel survey and intercalibrations /all vessels
- Oct 2005 Parallel survey and intercalibrations /all vessels
- March 2006: Coordinated survey /intercalibration Itaf Deme / Al Awam
- Nov 2006 : Parallel survey and intercalibrations Al Amir / F.Nansen
- Oct 2007 : Coordinated surveys /intercalibrations / only local vessels

METHODS

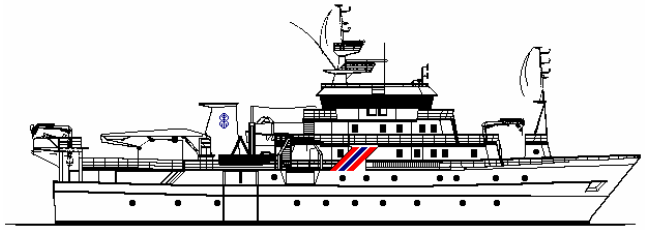
During these intercalibrations and parallel surveys :

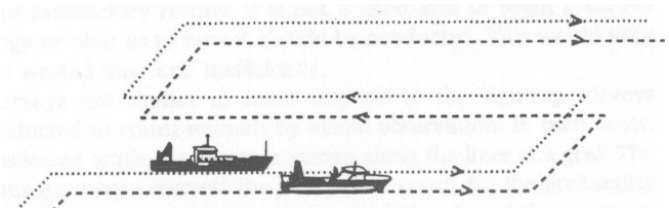
- All vessels produced:
  - Survey maps of cruise tracks
  - Map of fish distribution of target species.
  - **Biomass estimates of target species**
  - Length frequency distributions for target species
  - Catches during the survey
  - **Sa values from intercalibraions**



RESULTS FROM SENEGAL

2004 parallel survey:





»- Target species: Sardinella, horse mackerels and chub mackerel

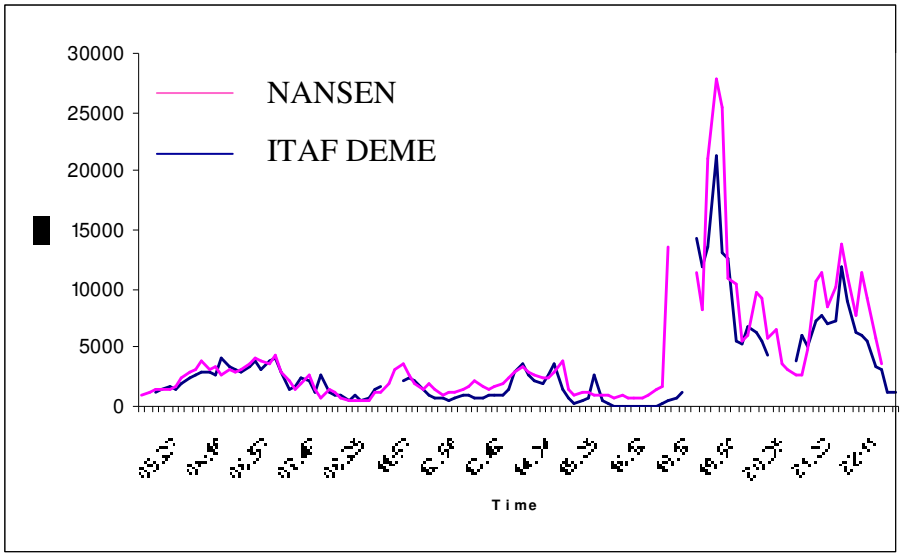
2004 *Biomass estimates in thousand tonnes* :

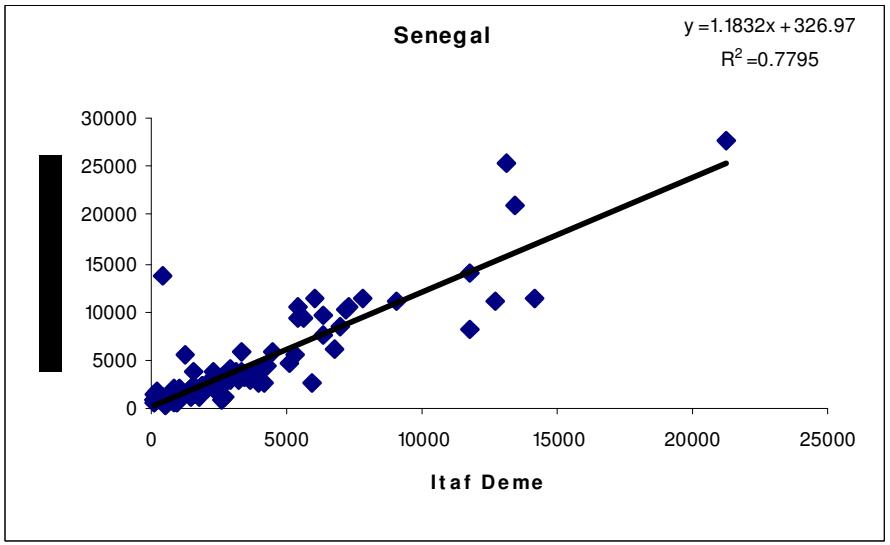
Species	*R/V. Itaf Deme*				Ratio; ID/FN Senegal only	*R/V. Dr. Fridtjof Nansen*				
	Casa-mance	Central	North	Total		Casa-mance	Gambia	Gambia – C.Vert	C.Vert – St Louis	Total
Sardinella maderensis	185	80	6.2	271.2	0.61	249	107	154	39	548
S. aurita	140	92.2	23	255.2	1.02	117	21	108	25	270
Horse mackerels	51.7	128	6.88	186.58	3.97	0	29	33	15	76
Mackerel	3	21.7	3.7	28.4	-	0	0	0	0	0
Other pelagics	150.8	139.5	46.4	336.7	2.15	57.6	55.8	78.9	20	212.3
Total	530.5	461.4	86.18	1078	1.21	423.6	212.8	373.9	99	1106

Note: The data for Gambia is excluded in the proportion. Gambia / C.vert (NANSEN) refer to the Center;

C.Vert - St Louis refers to the North. Scomber is included in other pelagics

2004 first intercalibration

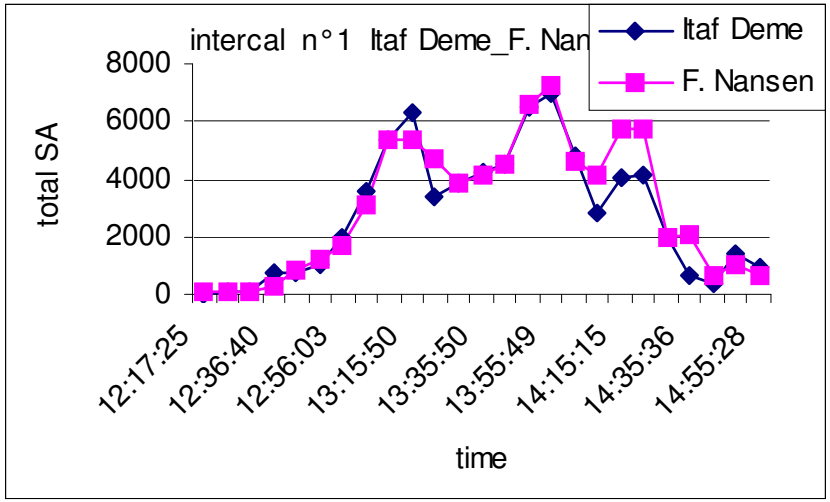


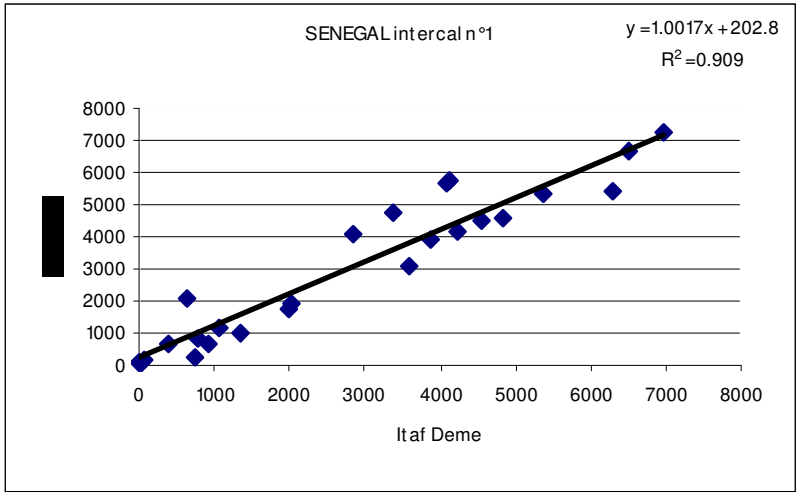


Ship	Itaf Deme	Dr. F Nansen	Diffe-rence	%
Total s_A sum	338323	450101	111778	24,83
Average	3192	4129	937	**22,6**

According to linear regression ,
the relation between the two vessels were
R/V "Dr. Fridtjof Nansen"= 1.1832 Itaf Deme +327
Correlation coefficient **R= 0.88**

2004 second intercalibration





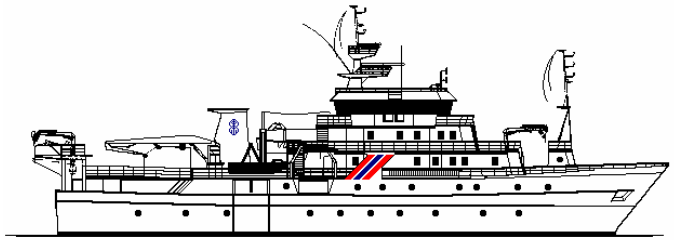
	itaf deme	F Nansen	Diffe-rence	%
sum	70773	75965	5192	6,83
average	2830,9	3038,6	207,68	**6,83**

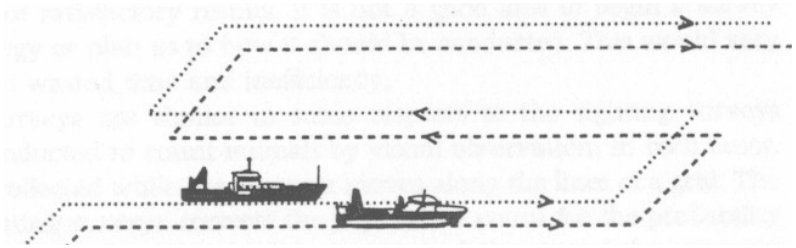
According to linear regression ,
the relation between the two vessels were

R/V "Dr. Fridtjof Nansen"= 1.0017 Itaf Deme +202.8

Correlation coefficient R= 0.95

2005 parallel survey:

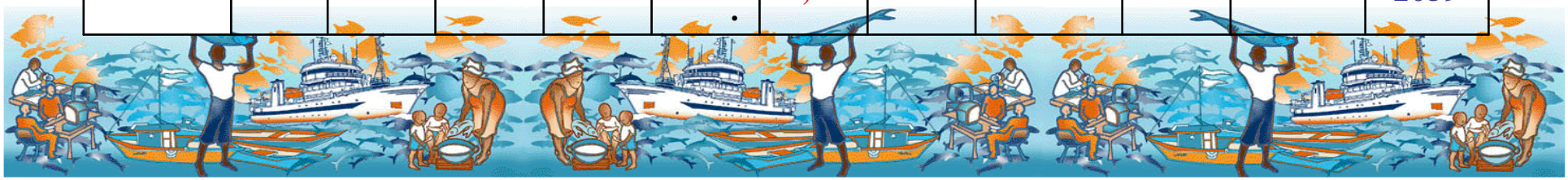




»-Target species: Sardinella, horse mackerels and chub mackerel

2005 *Biomass estimates in thousand tonnes* :

Species	*R/V. Itaf Deme*					Ratio; ID/FN	*R/V. Dr. Fridtjof Nansen*				
	Casa-mance	Gambia	Gambia - C.Vert	C.Vert – St Louis	Total		Casa-Mance	Gambia	Gambia – C.Vert	C.Vert-StLouis	Total
Sardinella maderensis	396	127	99	0.13	622.2	1,14	201	188	148	8	545
S. aurita	2	8	87	0.7	97.8	0,35	19	73	191	-	283
Horse mackerels	2	125	35	42	204.8	1,77	3.	4	12	97	116
Chub Mackerel	-	-	0.2	-	0.2	-	-	-	-	-	-
Other pelagics	76	107	69	17	269.8	2,35	59	19	26	11	115
Total	476.	368.2	289.7	60.65	1194.	1,13	279	284	377	116	1059



2005 intercalibrations

First analyse :Saly 2006, Senegal

Some problems which made the first analyse difficult :

- The vessels had all been using different minimum Sv threshold when scrutinizing and exporting data. These varied from –70 db to –79db. (*Seuil min d'integration du plancton)*

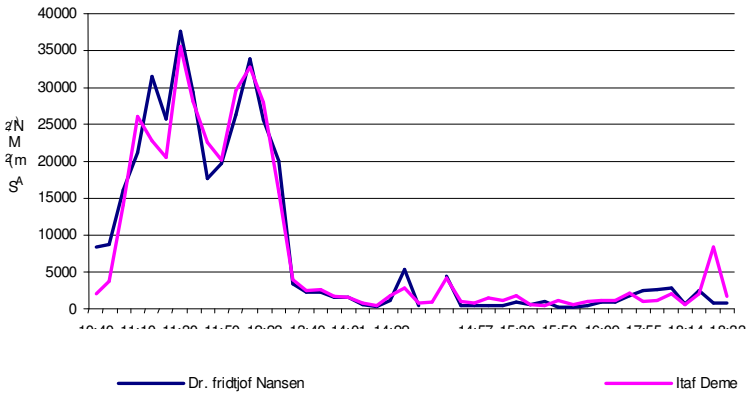
- Morocco had used the same –Sv threshold as Dr. Fridtjof Nansen, -79 db. However the export function in the BI60 software v 2.1.0 had a bug and it was decided to upgrade the software to v2.1.1 for all analyses of acoustic data in the region.

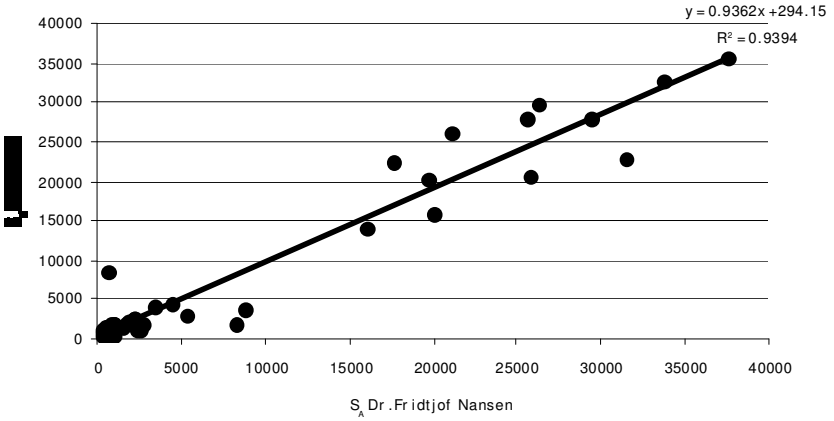
- Because of these problems >> need to re-scrutinise intercalibrations for a second analyse

2005 first intercalibration in Senegal

Analyses with BI500 and different Sv threshold:

Nansen -79DB *itaf Deme -72DB*





Ship	R.V. Itaf Deme	R.V. Dr. Fridtjof Nansen	Difference	%
Total s_A	358027	367339	9312	2,53
Average	7783.2	8163,1	379,9	**4,65**
Standard dev.	10732.9	11184.9		

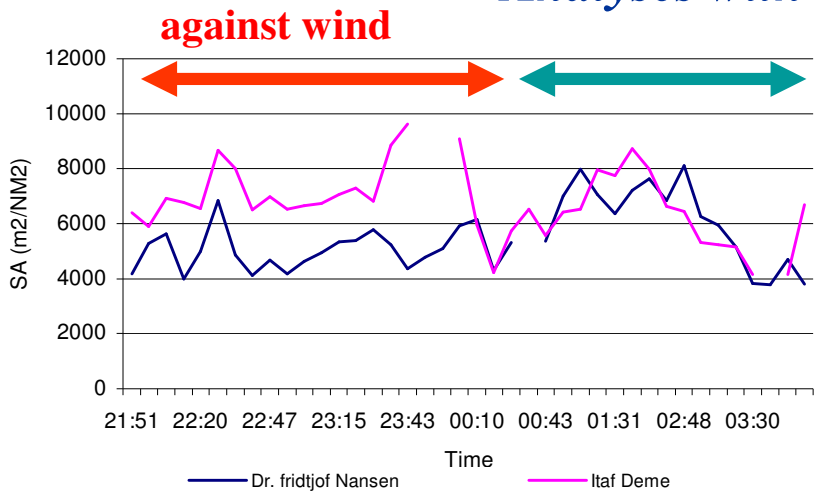
According to linear regression ,
the relation between the two vessels were

Itaf Deme = 0.9362 Dr. Fridtjof Nansen +294.15

Correlation coefficient R= 0.94

2005 second intercalibration in Senegal

Analyses with different Sv threshold:

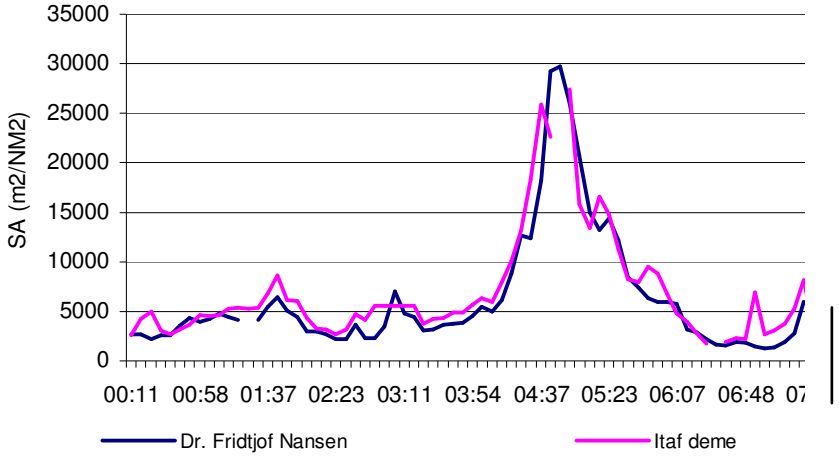


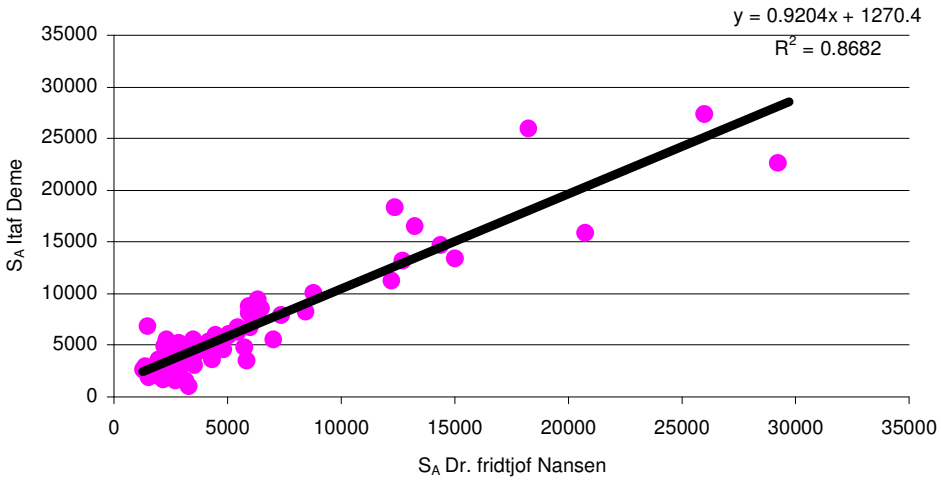
Ship	R.V. Itaf Deme	R.V. Dr F Nansen	Difference	%
Total s_A	24847	213099	35378	**16,60**
Average	6715.	5464	1251	**22,90**
Standard dev.	1320.	1191.		

- The wind came from the north and although not very strong it made sea conditions more difficult throughout the first part of the night
- when going against sea and wind : FN>ID
  after turning inshore. : FN≈ID
- This intercalibration illustrates importance the weather factor, the quality of the intercalibration is sharply reduced with bad weather.
- This factor affect Itaf Deme most because of the smaller size of the vessel

2005 third intercalibration in Senegal

Analyses with different Sv threshold:





Ship	R.V. Itaf Deme	R.V. Dr. Fridtjof Nansen	Diffe-rence	%
Total s_A	475600	444400	31200	**7,02**
Average	6605	6087	517	**8,51**
Standard dev.	5346.	6079		

According to linear regression ,
the relation between the two vessels were
R/V "Dr. Fridtjof Nansen"= 0.9204 Itaf Deme +1270.4

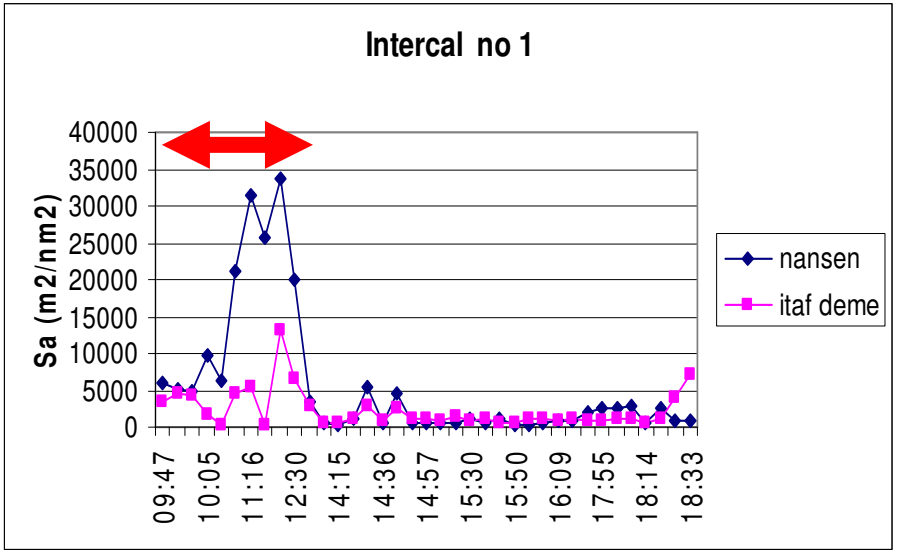
Correlation coefficient R**= 0.87**

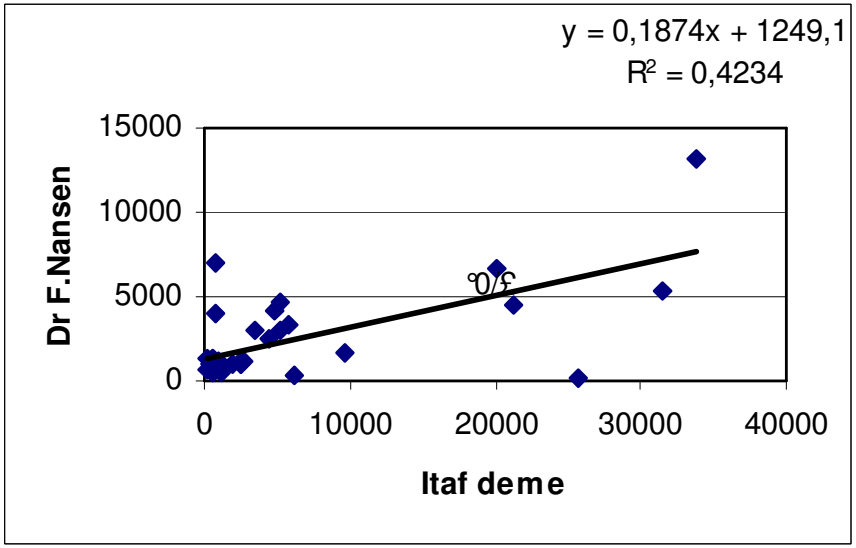
Conclusion with -72db Sv threshold intercalibrations and BI500:

- **The two vessels recorded the same acoustic densities and the 1st and 3rd intercalibration experiment seems successful**

2005 first intercalibration in Senegal

Analyses with BI60 and -79 db threshold :

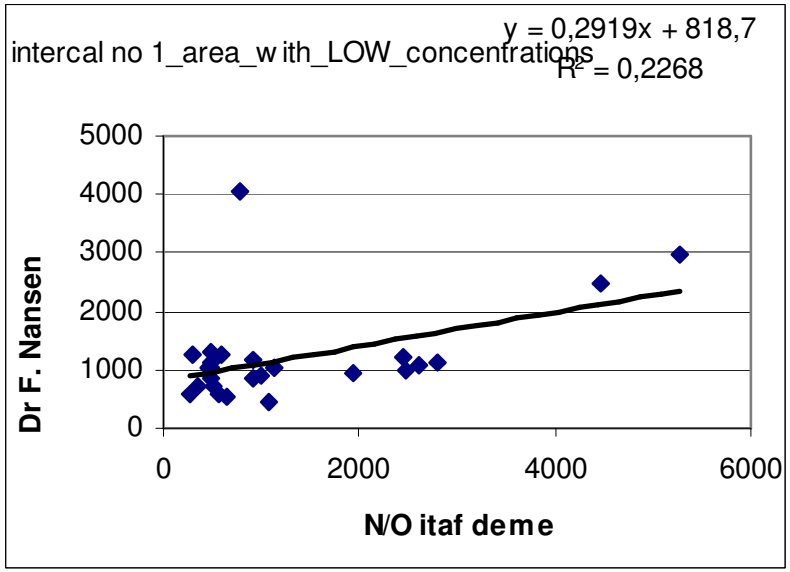


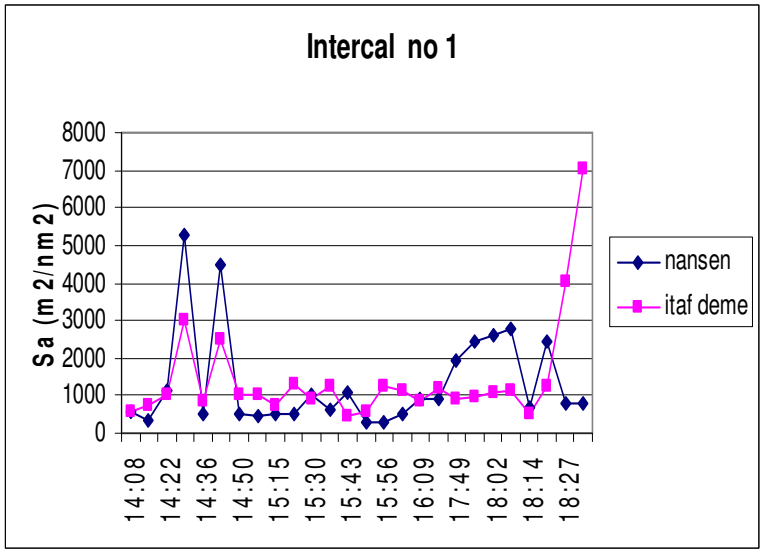


	Itaf Deme	Nansen	Diffe-rence	%
sum	84044	201829	117784	58,36
avera ge	2271,4	5454	3183	**58,36**

>>Around 6db difference between the two vessels

If we exclude areas with high concentrations



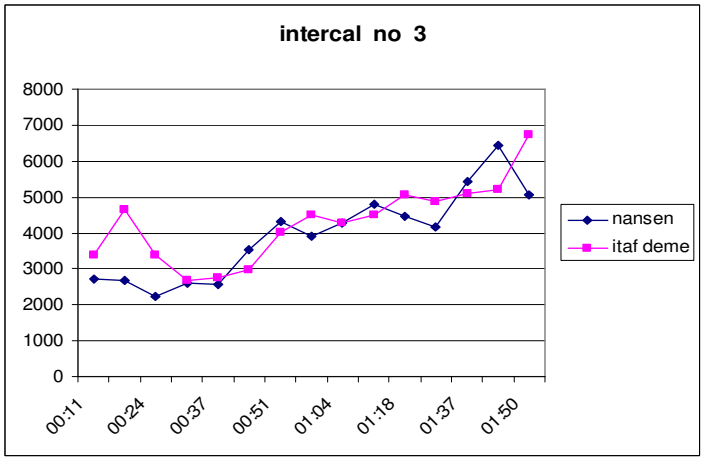


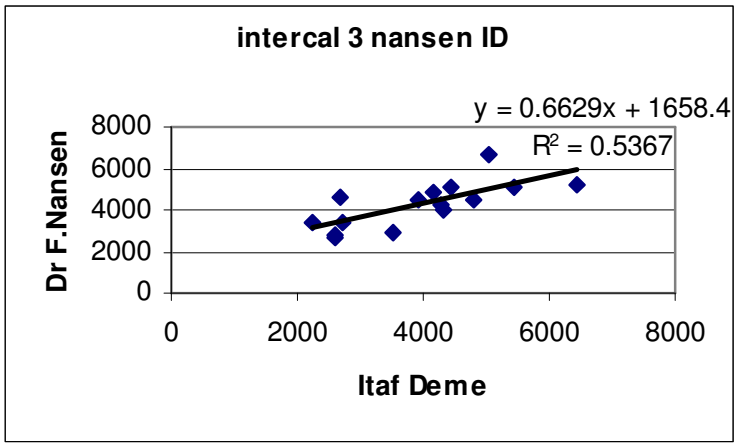
	Itaf Deme	Nansen	Diffe-rence	%
somme	34249	37242	2993	**8,04**
moyenne	1317	1432	115	8,04

>>the recordings for both vessels are in the same level
even if the correlation factor is poor

2005 third intercalibration in Senegal

Analyses with different Sv threshold:





Ship	R.V. Itaf Deme	R.V. Dr. Fridtjof Nansen	Diffe-rence	%
Total s_A	64120	59196	4924	**8,3**
Average	4275	3946	328	8,3

>>similar Sa values (relative difference in SA of 8.3
But it concerns only the beginning of the

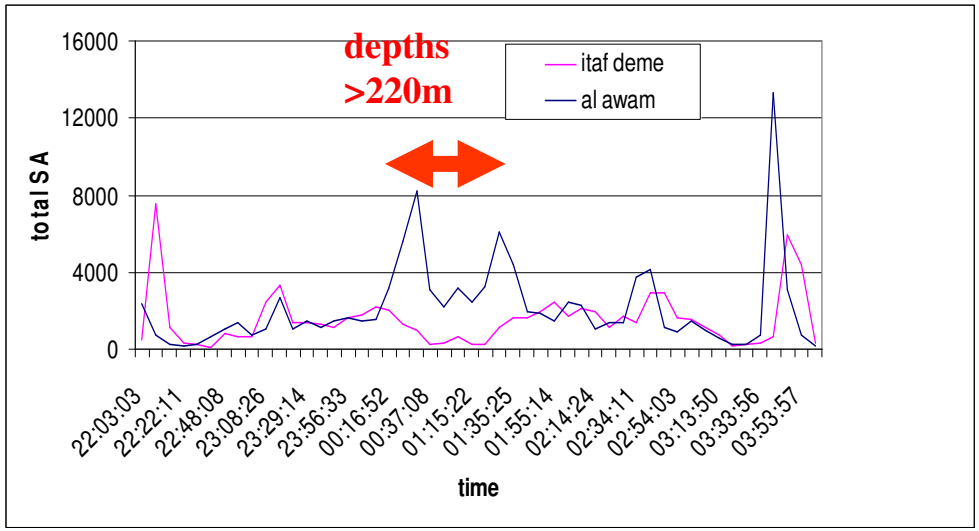
intercalibration where low concentrations were met

Conclusion with -79 db threshold analyses and with use of BI60

much higher Sa values from Dr. Fridtjof Nansen in presence of big concentrations

Intercalibrations between ITAF DEME and AL AWAM

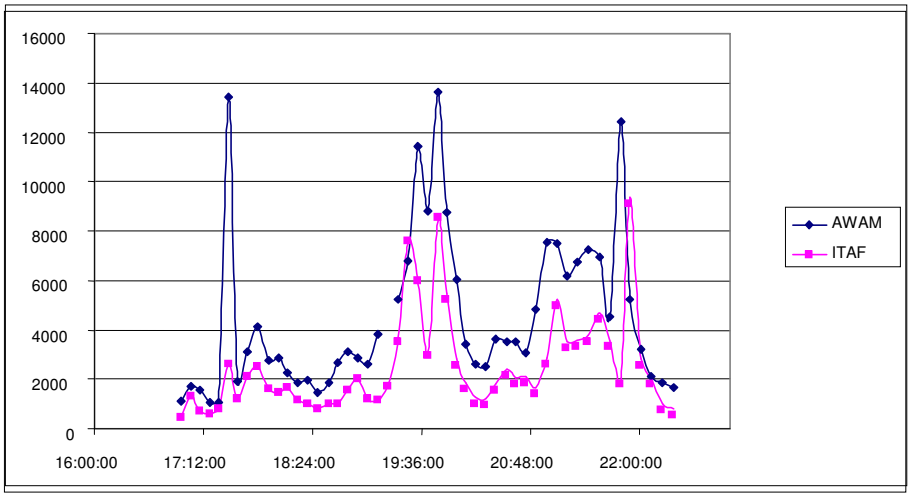
First intercalibration between R/V "Itaf Deme" and R/V "Al Awam" 06.03.2006

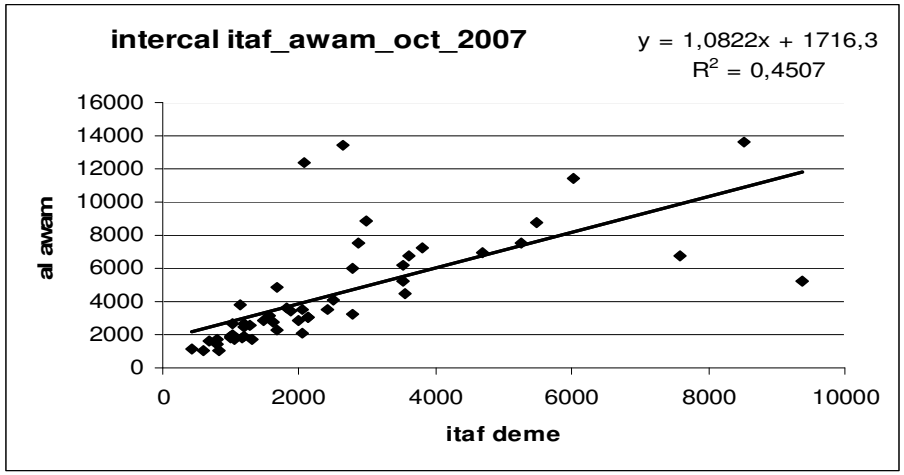


Ship	Itaf Deme	Al Awam	Diffe-rence	%
Total s_A sum	76332	107783	31451	**29,18**
Average	1527	2156	629	**29,17**

- a bad correlation between the two vessels in deep waters ↔ (from time 00:23 to 00:42 corresponding to depth >220m).
- Because Itaf Deme's integrator was set to operate only from 0 to 220m deep.

Second intercalibration between R/V "Itaf Deme" and R/V "Al Awam" 10.11.2007





Ship	Itaf Deme	Al Awam	Diffe-rence	%
Total s_A sum	127388	221830	94441	42,57
Average	2497	4436	1938	**43,7**

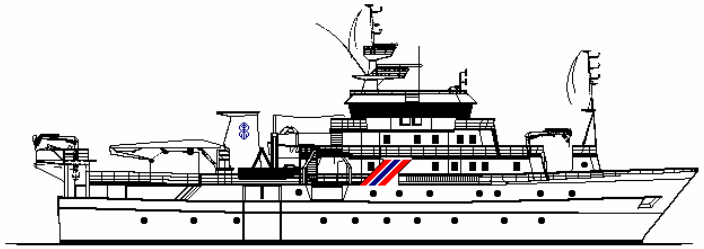
According to linear regression ,
the relation between the two vessels were

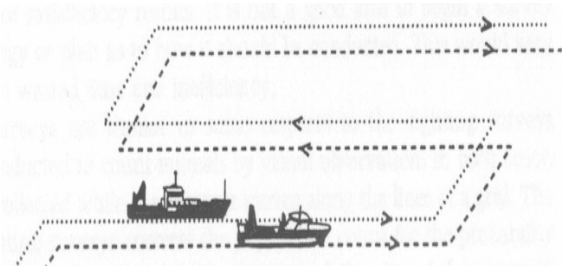
"Al Awam" = 1,0822 " itaf Deme" + 1716,3

Correlation coefficient R= 0.67

RESULTS FROM MAURITANIA

2004 parallel survey:





»- Target species: sardinella, anchovy, sardine, mackerel and horse mackerels,

2004 *Biomass estimates in thousand tonnes* :

	R/V. AL. AWAM			Ratio AW/NAN	R/V. Dr. F.NANSEN		
Species	St. Louis – C. Timiris	C. Timiris – C. Blanc	TOTAL	%	St. Louis- C. Timiris	C. Timiris – C. Blanc	TOTAL
S. MAD	194.3	17.3	212	**0.16**	1244	91	1335
S. AUR	156.4	177.1	333	**1.56**	189	24	213
PILCH	48.8	67.4	93	**0.23**	20	384	404
C. RHON	87.1	3	90.1				
T. TRE	21	2.7	23.7	**0.29**	29.8	53	83
ANCH.	0	16.2	16.2		0	0	0
O / PEL			90	**0.60**	106	42	148
TOTAL			858	**0.39**	1588.8	594	2183

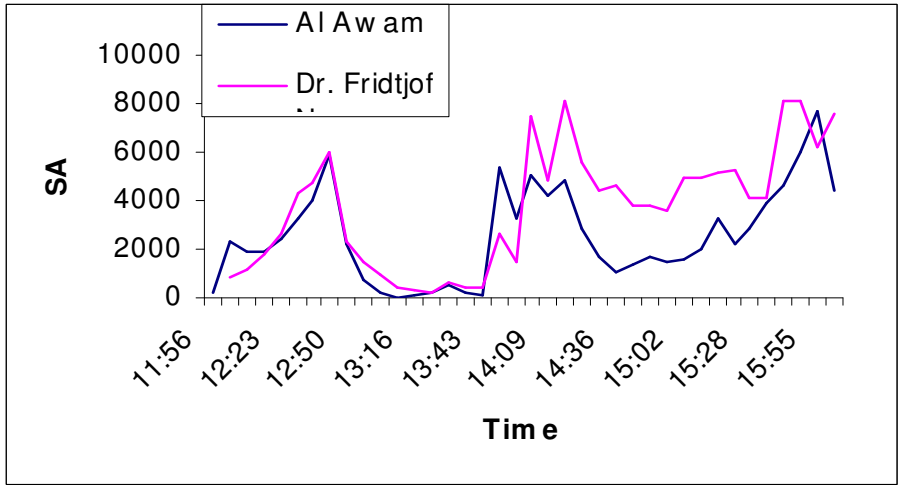
(Al Awam samples better the small individuals than Dr Fridtjof Nansen which is rather sampling big fishes)

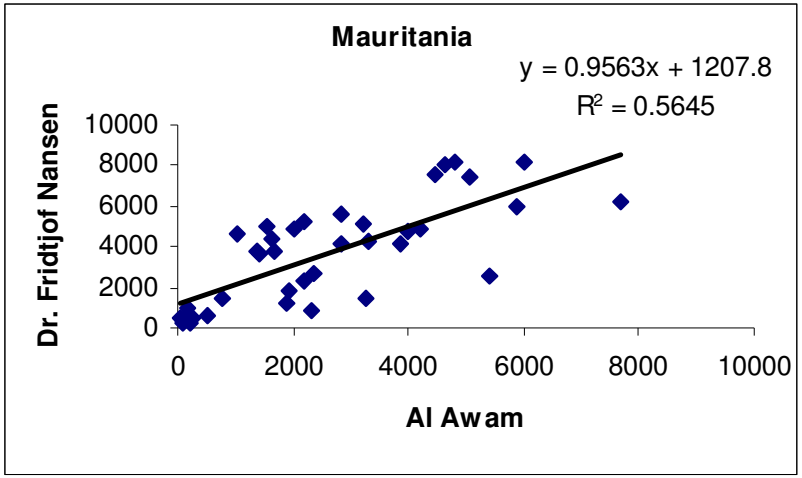
Differences in biomass estimation in Mauritania may be partly explained by the differences in catch composition

- Al Awam samples better the small individuals than Dr Fridtjof Nansen

- Big individuals of horse mackerel are underestimated by Al Awam because its maximum fishing depth is 100 m

2004 first intercalibration with DrF.Nansen





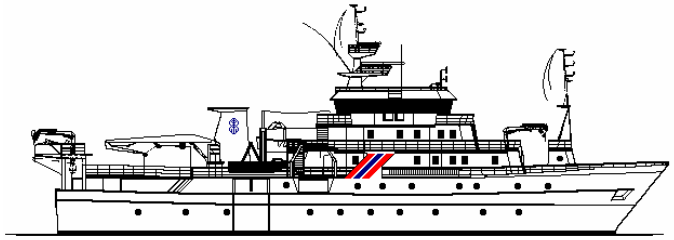
Ship	Al Awam	Dr. Fridtjof Nansen	Difference %
Total s_A sum	97369	137610	29.3
Average	2562	3719	**31.0**

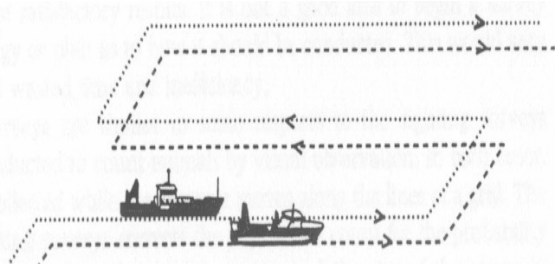
According to linear regression ,
the relation between the two vessels were

”F.Nansen” = 0,956 ” Al Awam” + 1207

Correlation coefficient **R= 0.75**

2005 parallel survey:



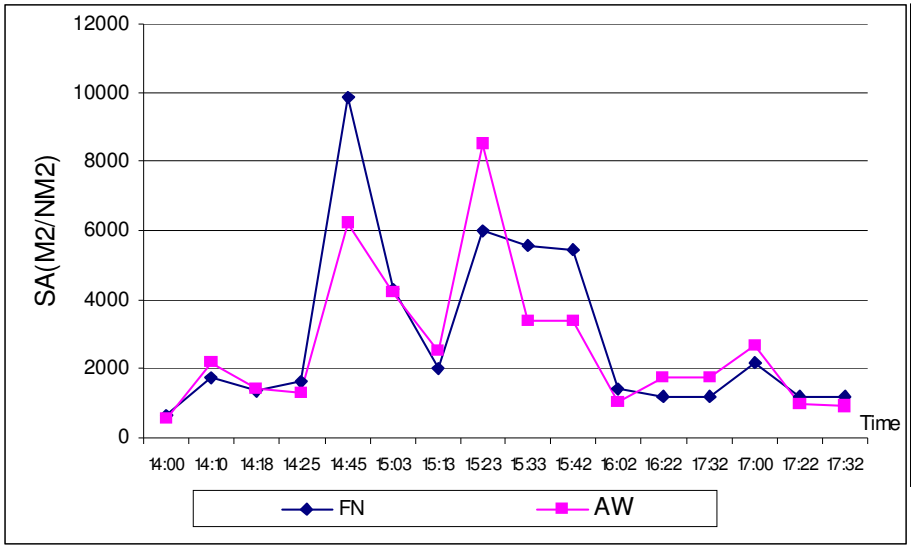


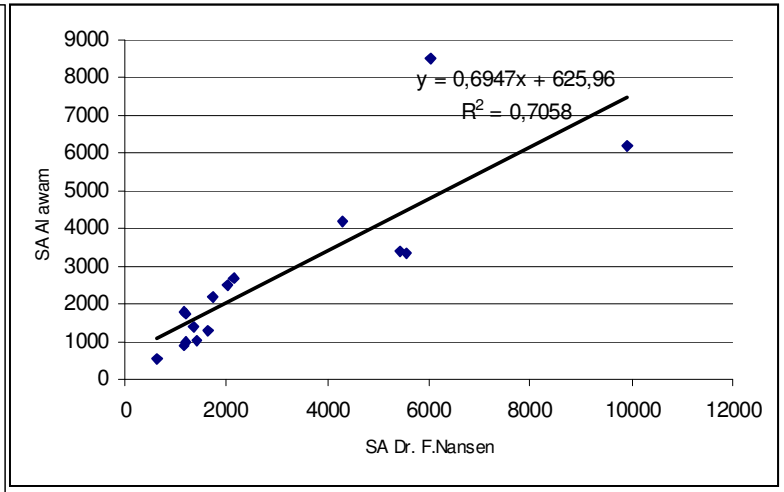
» -Target species: sardinella, anchovy, sardine, mackerel and horse mackerels,

2005 *Biomass estimates in thousand tonnes* :

	R/V. Al Awam			Ratio AW/NAN	R/V. Dr. Fridtjof Nansen		
Species	St. Louis – C. Timiris	C. Timiris – C. Blanc	TOTAL	%	St. Louis- C. Timiris	C. Timiris – C. Blanc	TOTAL
Sardinella maderensis	52	202	253	**0.48**	302	225	527
Sardinella aurita	16	57	74	**1.00**	6	68	74
Sardina pilchardus	395	97	492	**0.23**	1075	1103	2178
Engraulis encrasicolus		45	45	**0.46**	0	98	98
Trachurus trecae	76	103	179	**0.90**	106	92	198
Autres Pelag	48	202	250	**3.85**	62	3	65
	587	706	1293	**0.41**	1551	1589	3140

2005 intercalibration





ship	Al-awam	Dr.F. Nansen	Difference	%
Total S_A sum	42659	46989	4330	9,21
Average	2666	2936	270	**9,20**

According to linear regression ,
the relation between the two vessels were

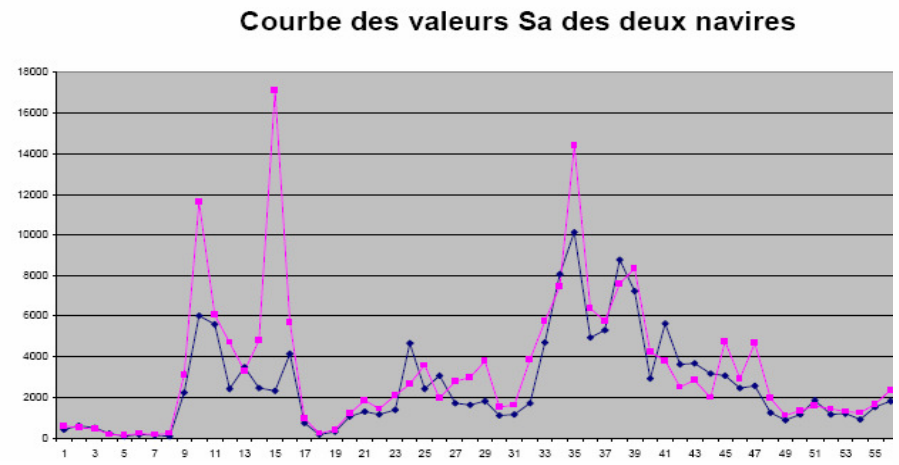
Al awam = 0.6947 Dr. Fridtjof Nansen +625.96

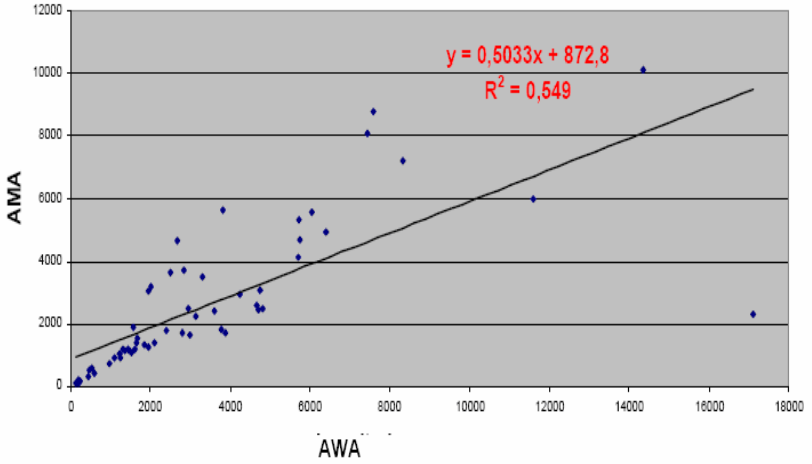
Correlation coefficient R= 0.84

>>improvement from 2004 to 2005
from 30 % to 9% difference

Intercalibrations between AL AWAM and AL AMIR

Intercalibration with N/O Al Amir in November 2007:





AL AWAM

AL AMIR

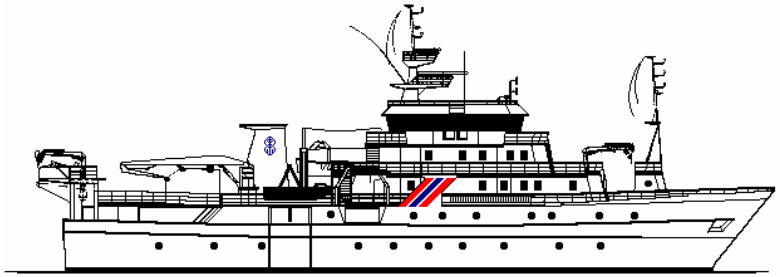
According to linear regression ,
the relation between the two vessels were

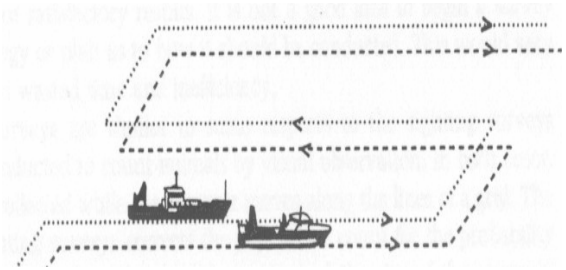
”Amir” = 0.5 ”Al Awam” + 873

Correlation coefficient R= 0.74

RESULTS FROM MOROCCO

2004 parallel survey:



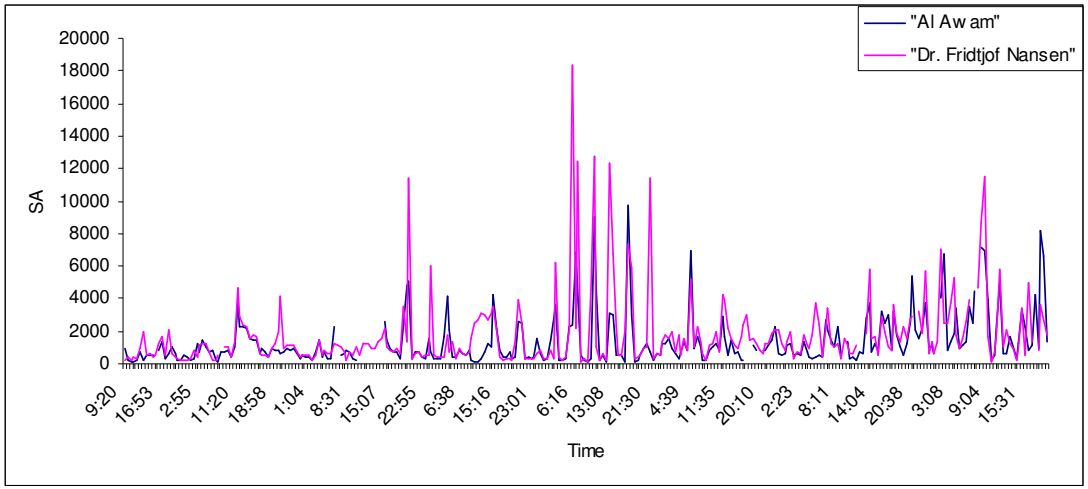


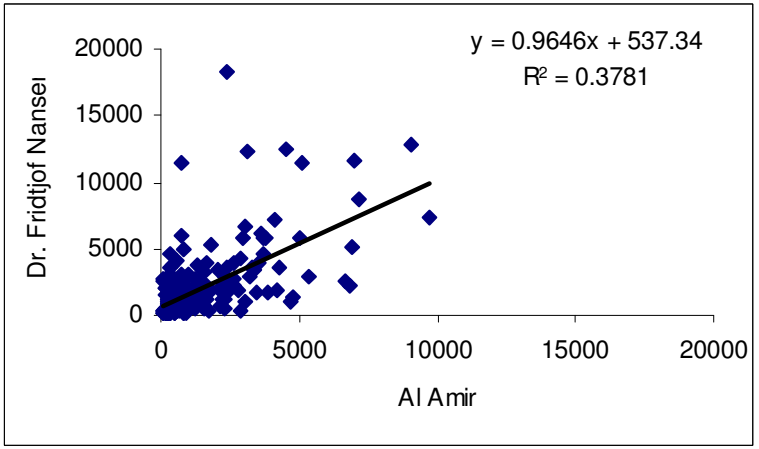
» - Target species: sardine, anchovy, mackerel and horse mackerel

2004 *Biomass estimates in thousand tonnes* :

	Al Amir		Total	%	F. Nansen		Total
	C.Juby- C.Ghir	*C.Ghir-C.Cantin*			*C.Juby- C.Ghir*	*C.Ghir-C.Cantin*	
Pilchard.	408	218	626	0.75	627	210	837
Anchovy.	40	26	66	2	30	2	32
Scomber.	174	112	286	0.85	242	96	338
H. Mackerel	64	21	85	42.5	0	2	2
Total	686	377	**1063**	0.87	899	310	**1209**

2004 first intercalibration





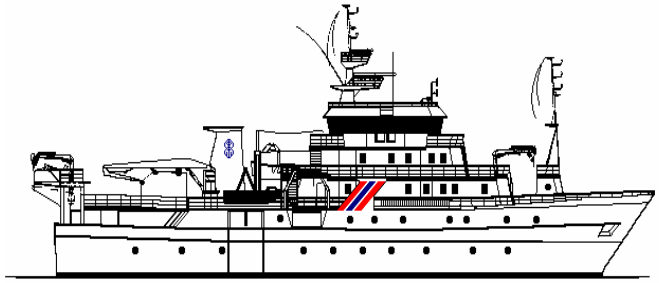
Ship	Al Amir	Dr. F Nansen	**Diffe_ rence %**
Total s_A sum	384203	510480	**24,73**
Average	1377	1773	**22,3**

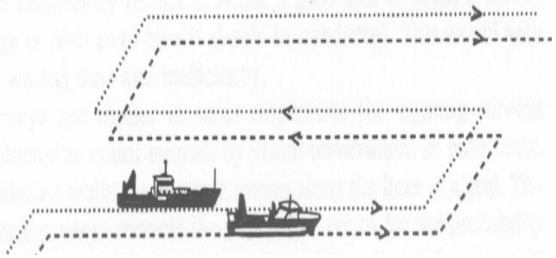
According to linear regression ,
the relation between the two vessels were

”F. Nansen” = 0, 9646 ”Al Amir” + 537,34

Correlation coefficient R= 0.61

2005 parallel survey:



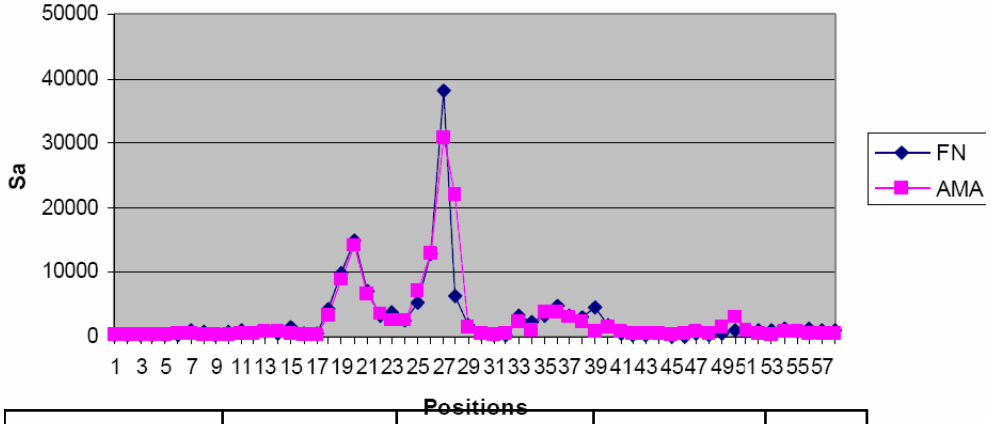


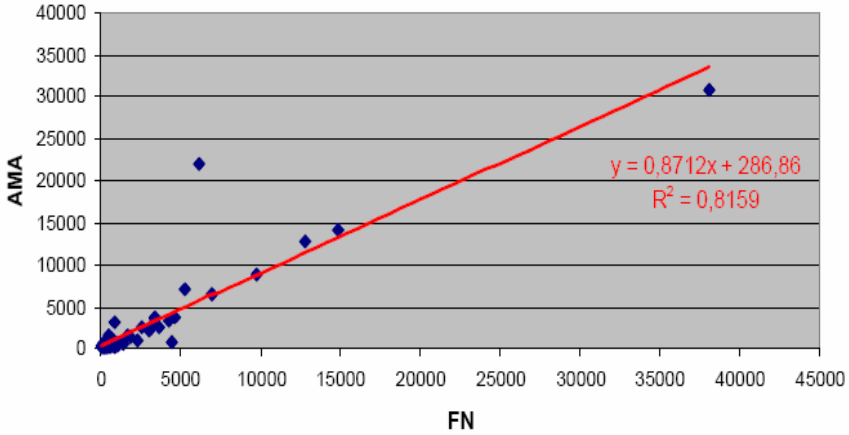
»-Target species: sardine, anchovy, mackerel and horse mackerel

2005 *Biomass estimates in thousand tonnes* :

	R/V. Al Amir	Ratio AM/NAN	R/V. Dr. Fridtjof Nansen
Species	**Cape Blanc to Cape Bojador**	%	**Cape Blanc to Cape Bojador**
Pilchard.	4628	**0,79**	5830
Anchovy.	33	**3,30**	10
Chub mackerel	189	**0,79**	240
horse mackerel	370	**0,33**	1125
Sardinella	409	**0.68**	600
Total	**5629**	**0,72**	**7805**

2005 first intercalibration





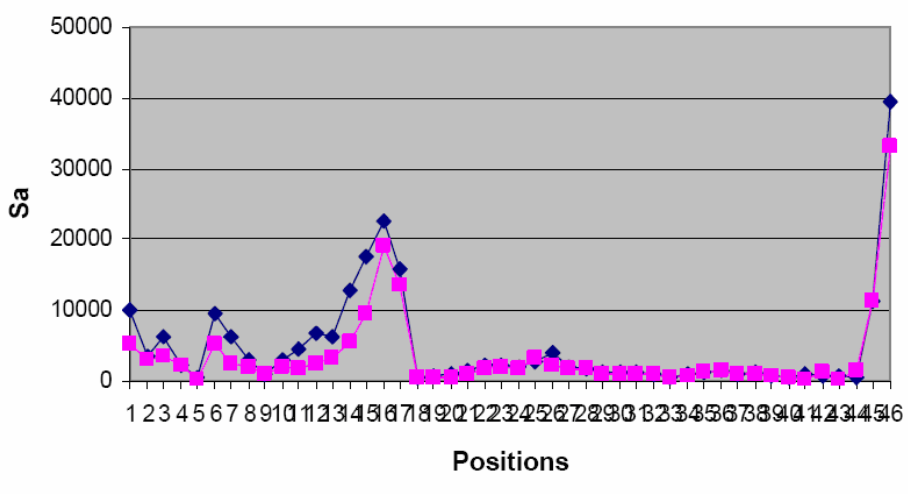
ship	Al-Amir	Dr.F.Nansen	Difference	%
Total S_A sum	154734	158517	3783	**2,9**
Average	2667	2733	65	**2,9**

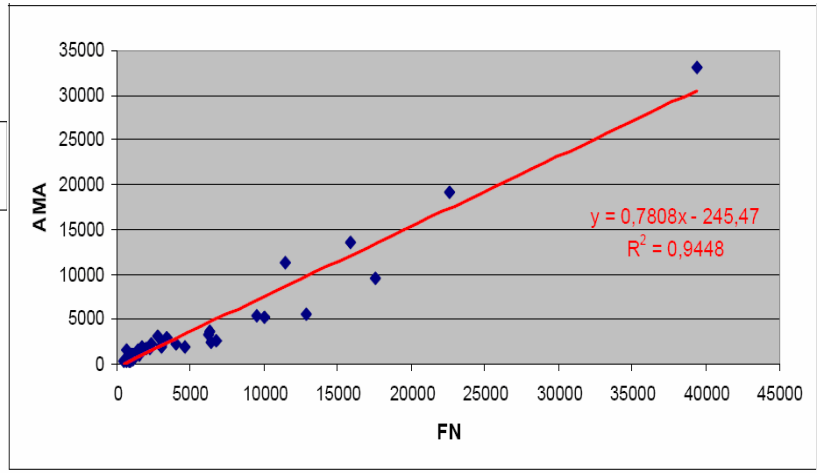
According to linear regression ,
the relation between the two vessels were

”Amir” = 0.8712 ”F.Nansen” + 286,86

Correlation coefficient R= 0.9

2005 second intercalibration





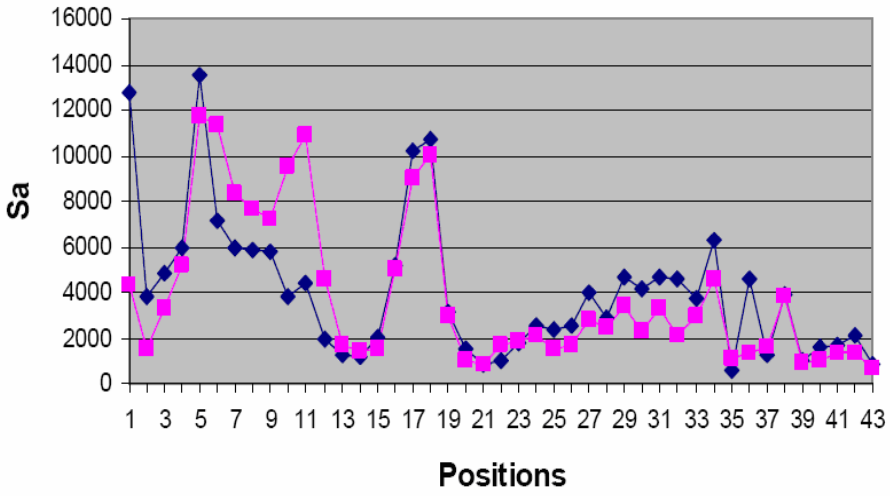
ship	Al-Amir	Dr.F .Nansen	Difference	%
Total S_A sum	159539	218792	59252	**27,08**
Average	3468	4756	1288	**27,08**

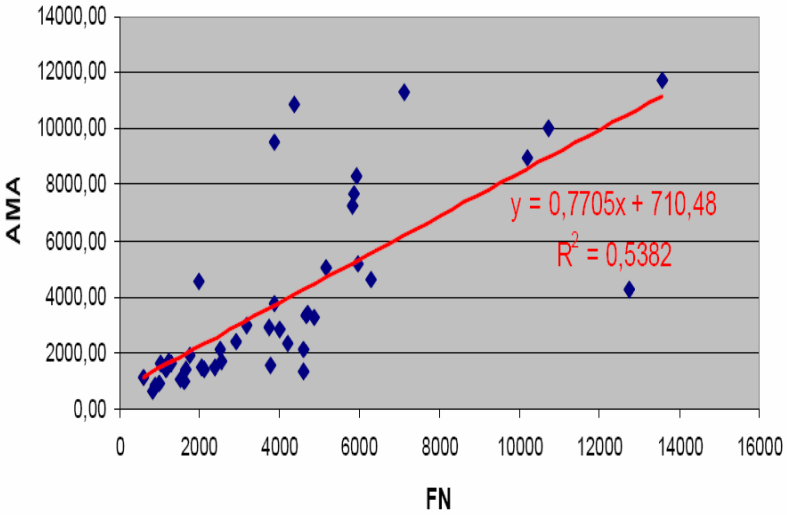
According to linear regression ,
the relation between the two vessels were

”Amir” = 0.7808 ”F.Nansen” + 245,47

Correlation coefficient R= 0.97

2005 third intercalibration





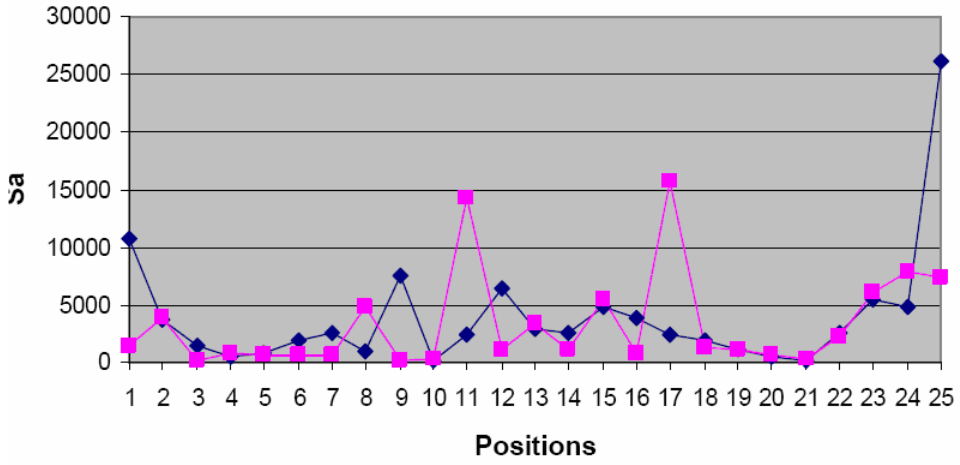
ship	Al-Amir	Dr.F. Nansen	Difference	%
Total S_A sum	165462	175102	9639,	5,51
Average	3847	4072	224,	**5,51**

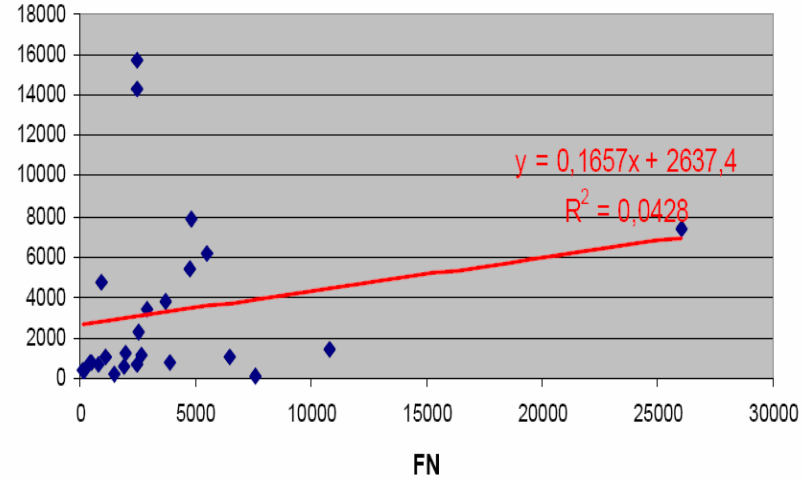
According to linear regression ,
the relation between the two vessels were

”Amir” = 0.7705 ”F.Nansen” + 710,48

Correlation coefficient R= 0.73

2005 fourth intercalibration





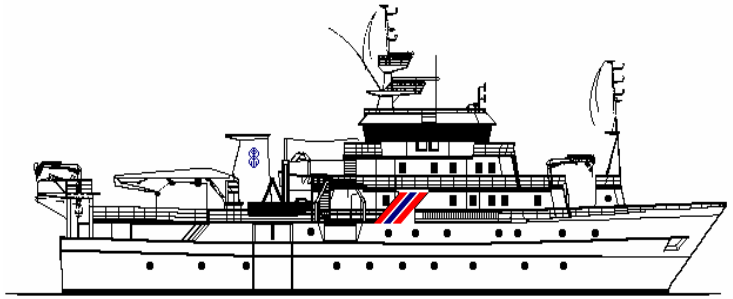
Ship	Al-Amir	Dr.F .Nansen	Diffe-rence	%
Total S_A sum	82255,5	98514	16258	16,50
Average	3290,22	3940	650	**16,50**

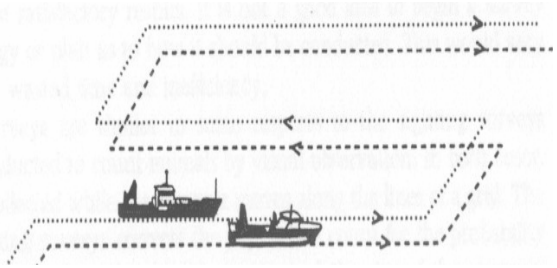
According to linear regression ,
the relation between the two vessels were

"Amir" = 0.1657 "F.Nansen" + 2637,4

Correlation coefficient **R=** 0.2

2006 parallel survey:





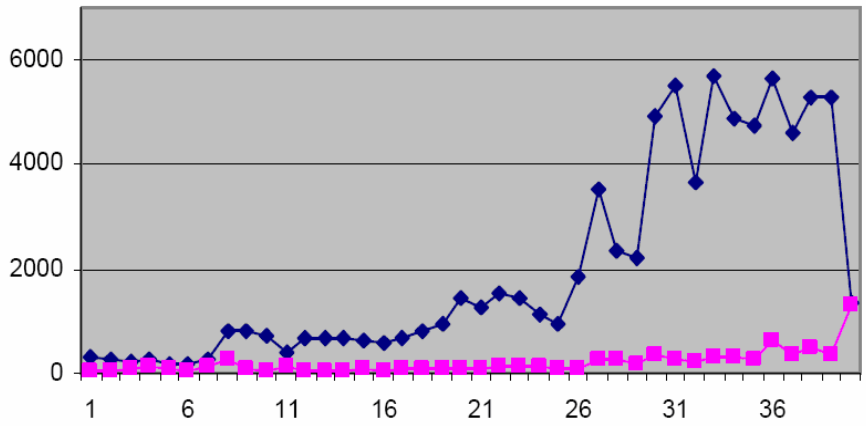
»-Target species: sardine, anchovy, mackerel and horse mackerel

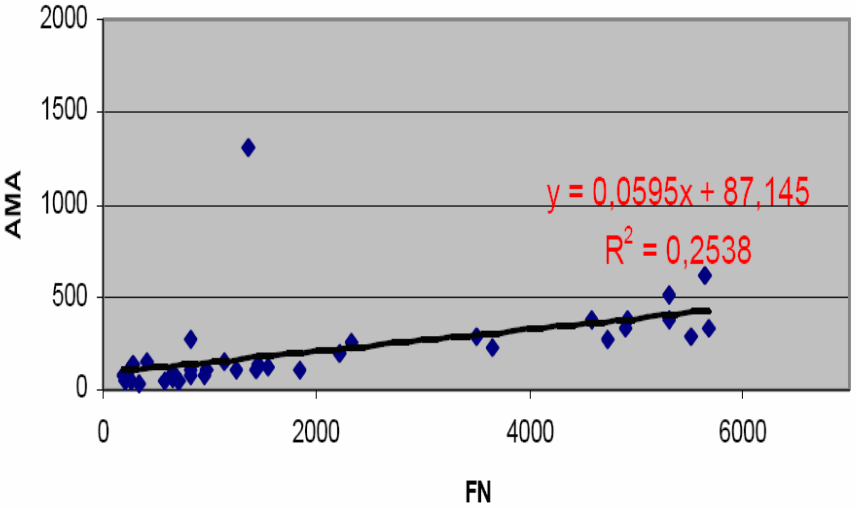
2006 *Biomass estimates in thousand tonnes* :

	sardine	Chub mackerel	anchovy	Horse mackerel	sardinella	
	Biom	Biom	Biom	Biom	Biom	total Biom
FN	3390	315	12	307	1245	5269
AMA	3019	475	17	333	1260	5104
FN/AMA	1.12	0.66	0.72	0.92	0.99	1,03

During 2006 intercalibrations, a stong wind made sea conditions difficult throughout the course line.

2006 first intercalibration





Ship	Al-Amir	Dr.F .Nansen	Diffe-rence	%
Total S_A sum	8214	79441	71226	89,66
Averag e	205	1986	1780	89,66

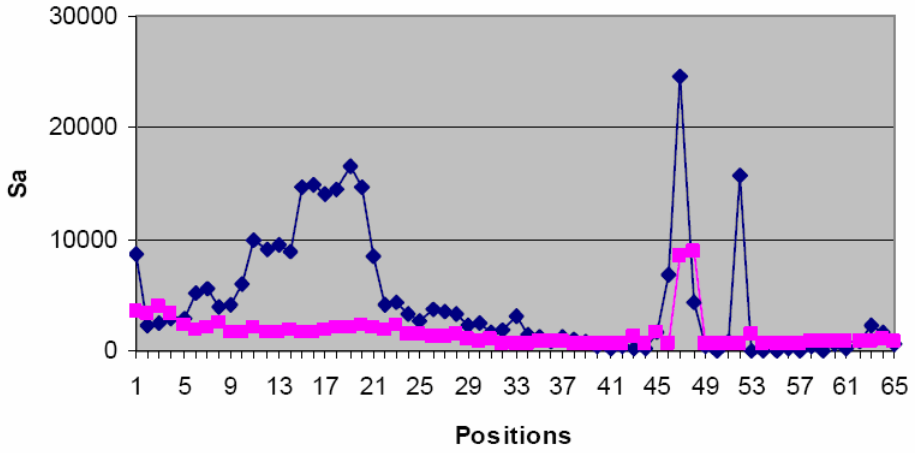
According to linear regression ,
the relation between the two vessels were

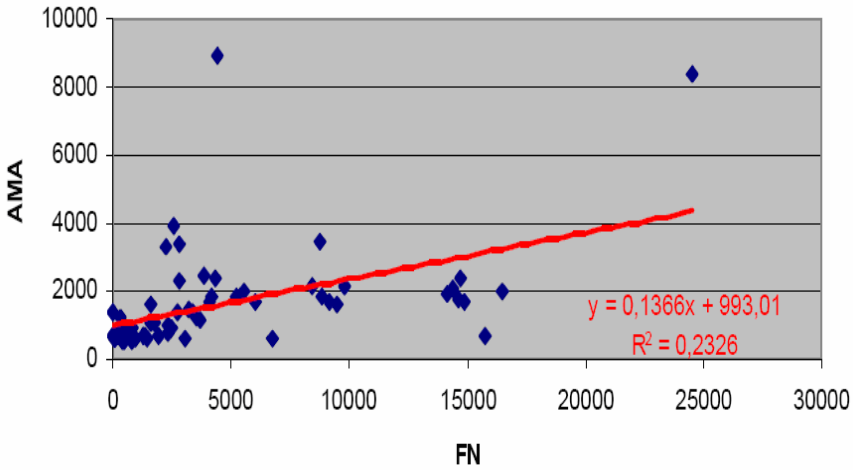
"Amir" = 0.0595 "F.Nansen" + 87,145

Correlation coefficient **R= 0.5**

➡ Around 20db difference

2006 second intercalibration





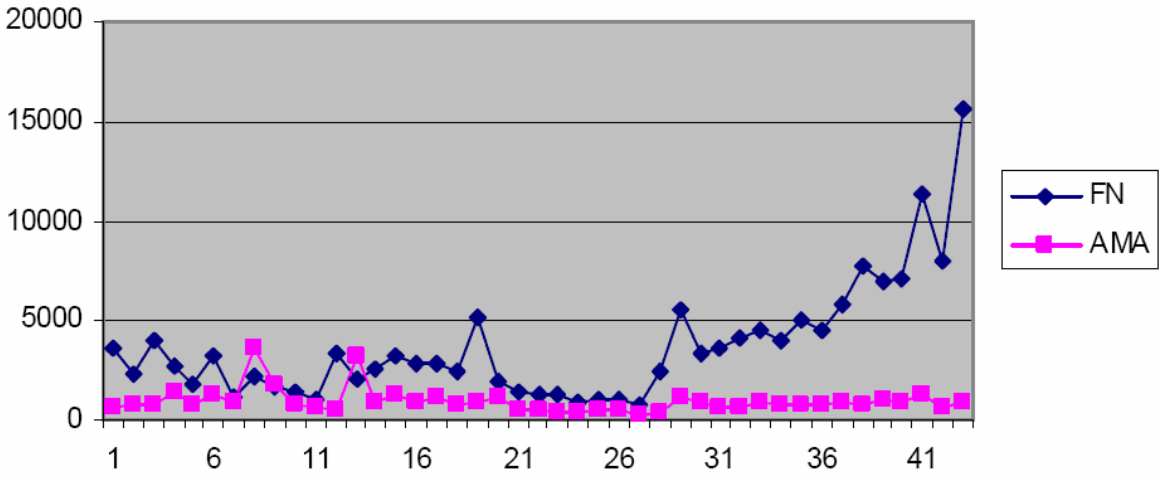
ship	Al-Amir	Dr.F .Nansen	Difference	%
Total S_A sum	159539	218792	59252	**27,08**
Average	3468	4756	1288	**27,08**

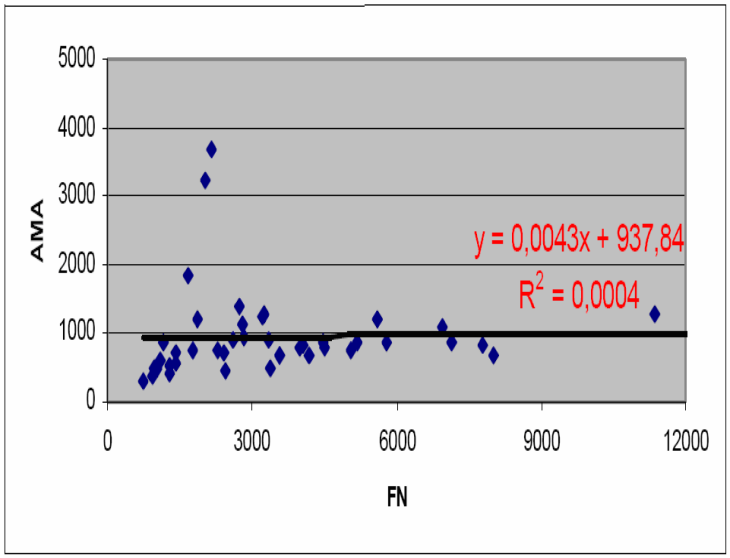
According to linear regression ,
the relation between the two vessels were

"Amir" = 0.1366 "F.Nansen" + 993,01

Correlation coefficient R= 0.97

2006 third intercalibration





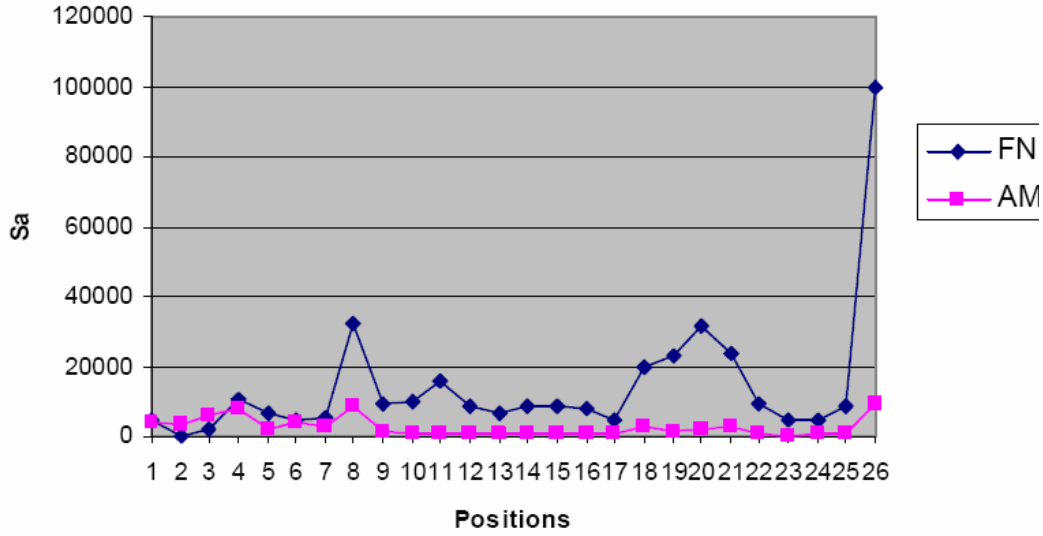
Ship	Al-Amir	Dr.F .Nansen	Diffe-rence	%
Total S_A sum	41007	158993	117985	**74,21**
Average	953	3697	2743	**74,2**

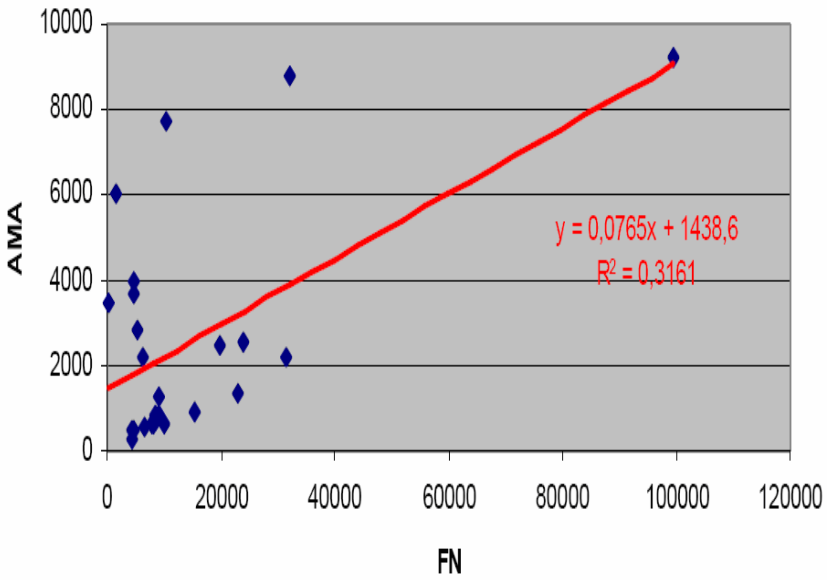
According to linear regression ,
the relation between the two vessels were

"Amir" = 0.0043 "F.Nansen" + 937,84

Correlation coefficient **R= 0.06**

2006 fourth intercalibration





Ship	Al-Amir	Dr.F.Nansen	Diffe-rence	%
Total S_A sum	65626	368700	303073	**82,2**
Average	2524	14180	11656	**82,2**

According to linear regression ,
the relation between the two vessels were

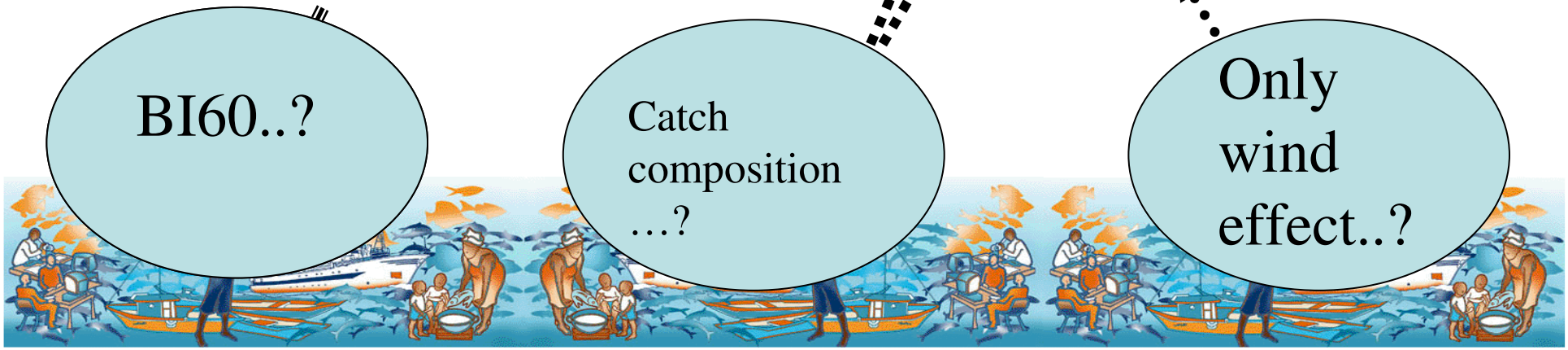
"Amir" = 0.0765 "F.Nansen" + 1438,6

Correlation coefficient R= 0.56

→ Near 14 db difference

Overview of Biomass estimates and results from intercalibrations

		N/0 Itaf Deme		N/O Al Awam		N/O Al Amir	
		Sa values Difference %	**Total Biomass** FN-ID %	**Sa values** Difference %	**Total Biomass** FN-AW %	**Sa values** Difference %	**Total Biomass** FN-AM %
2004		7 to 25%	-17%	30%	60%	25%	12%
2005	-72 db, BI500	2,5 à 8,5%	-11%	9%	59%	28%	3 à 27%
	-79db, BI60	8 à 58 %					
2006						27 à 89%	3%

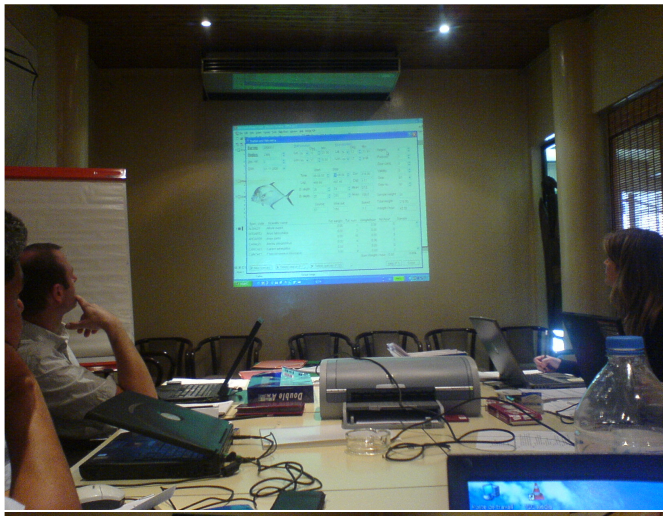


Conclusion / General recommendations:

>>A general conclusion may be difficult to find from all these exercices because of fluctuations registred from year to year for a same vessel.

>>But general obsevations may be done from these exerxises

- In all exercices F.Nansen had registered higher Sa values than local vessels, slightly in 2004 and much more in 2005 and 2006 except Al Awam which registered decreasing difference with F.Nansen.
- In all intrecalibrations between Al Awam and local vessels, Al Awam has registered higher Sa values than the local vessel concerned.
- Although Al Awam gives higher Sa values, the biomass estimates from this vessel are the lowest compared to F.Nansen.. This is because biomass estimation involves several components among which Sa values but also distribution areas, catch composition and decision process from operator during scrutinizing.
- Next steps before further intercalibrations should be :
  - » to identify more clearly all elements which have intoduced these fluctuations from year to year in order to recover 2004 conditions (Itaf Deme and Al Amir).
  - » Al Awam should focus mainly in improving better determination of elements composing biomass estimate, particularly increasing range of catch composition.
  - » If the goal remains to continue time serie of F.Nansen and given that this reference vessel will leave the region, local vessels have to identify a reference on which the three local vessels should strive to align their results
- The discussion is still continuing to have answers on these questions in order to finally have reliable coordinated acoustic surveys.



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