Fish population surveys in estuaries : a comparison between acoustic at moored stations and purse seine surveys

Luis Tito de Morais, Jean Guillard, Monique Simier, Ibrahim Sow, Jean Raffray, Jean Jacques Albaret

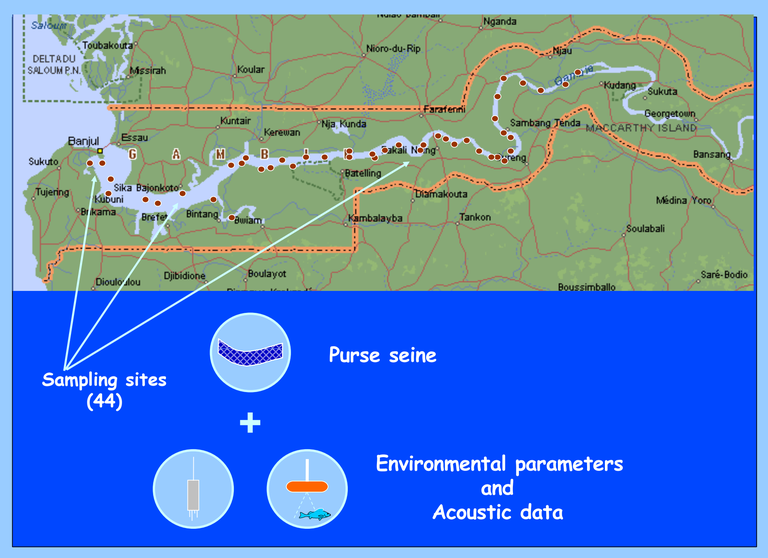
Fish population surveys in estuaries: a comparison between acoustic at moored stations and purse seine surveys

Luis Tito de Morais[a], Jean Guillard[b], Monique Simier[c], Ibrahima Sow[d], Jean Raffray[a], Jean-Jacques Albaret[a]
(a) IRD, UR RAP, BP1386, Dakar Sénégal ; (b) INRA, UMR CARRTEL, BP 511, 74203, Thonon, France
(c) IRD, UR RAP, CRH BP 171, 34203 Sète Cedex, France ; (d) ISRA,CRODT, BP 2241, Dakar Sénégal.
tito@ird.sn, guillard@thonon.inra.fr, simier@mpl.ird.fr, sowibou1947@yahoo.fr, raffray@ird.sn, albaret@ird.sn

Introduction

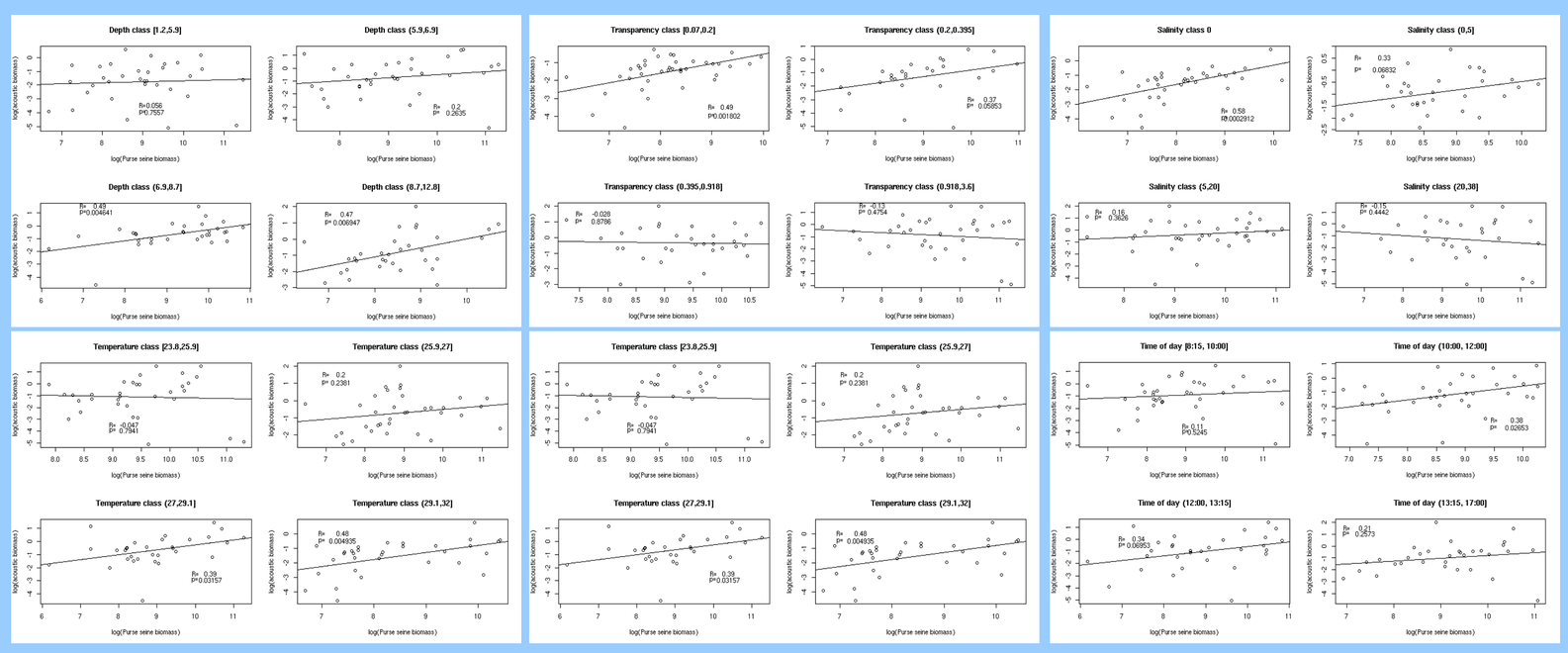
Throughout the world, estuaries are among the most modified and threatened environments (Blaber et al. 2000). Scientific interest is increasingly focusing on the effects of major natural or human perturbations on aquatic ecosystems, yet in this field of research few studies have been conducted on estuarine systems, particularly in the tropics. There are very few estuaries or coastal lagoons that can be used as an example of an undisturbed ecosystem. To some extent, the Gambia River Estuary may be considered an exception. It is the last and only large estuary in the West-African sub-region not to have been affected by extensive and/or intensive human disturbances.

Material and methods



Three types of complementary data were simultaneously collected: acoustic data, biological data and environmental data. Echosounding was performed vertically during daytime from a moored position during 30 minutes along with purse seine surveys performed from a second boat (Albaret *et al*., 2004, Guillard *et al*., 2004).
Acoustic biomass and fished biomass were log transformed and recorded as logSa and logBiom. Each numerical environmental variable was ranked into quartile classes. Within each variable class the correlation between logSa and logBiom was then calculated and the correlation coefficient significance was tested. Classes in which the correlation between logSa and logBiom was significant allowed to infer which environmental conditions favour or not the adequation between the two methods.

Results and discussion

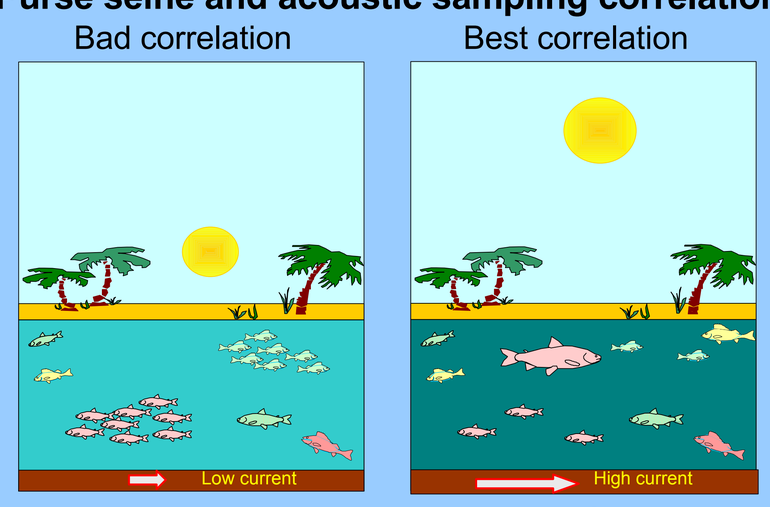


The following were the environmental conditions of **best correlation between the two methods** :
1. **Depth >= 6.9 m** (third quartile: R=0.49, p=0.004 and fourth quartile: R=0.47, p=0.007)
2. **Transparency <= 0.2 m** (first quartile: R=0.49, p=0.0018)
3. **Null salinity** (first quartile: R=0.58, p=0.00029)
4. Temperature >29.1 (fourth quartile 4, R=0.48, p=0.0049)
5. **Oxygen <=76%** (first quartile: R=0.53, p=0.001 and second quartile: R=0.63, p<0.000)
6. **Time: best correlation in the middle of the day** (between 10h AM and 1 PM)
7. **Current speed: high current** (Classes 2 and 3)
8. **Field campaign: end of the dry season**.

The lack of correlation between acoustics and seining at depths lower than 6.9 m is probably related to the fact that acoustics is expected to be less performing in very shallow waters. The purse seine is expected to perform well in a depth range from 2 to 18 m.

Both methods perform well when turbidity is high. The visual stimuli of the boat presence, and possibly of the net towing at the begining of the seine haul is expected to be reduced when turbidity is high.

Purse seine and acoustic sampling correlation



Salinity and temperature are corrected for bias during acoustic operations and it is unlikely that purse seine had different performances with regard to these two variables. We suggest that the better correlation observed in fresh water and at high temperatures than at high salinities and low temperatures was related to the species composition associated with each environmental conditions. At higher salinities and temperatures, most species are pelagic clupeids living in schools, and the probability of such schools being seen by the sonar is higher than that of a school being captured by the purse seine.

Fish show complex day/night behaviour patterns in relation to environmental variables, the combination of which may explain the fact that the best correlation was observed in the middle of the day. Yet current speed, turbidity, depth, salinity and thus species composition and behaviour are expected to play the greatest role (Krumme and Saint-Paul, 2003).

Conclusions

As a rule, the major source of bias and imprecision in acoustic abundance estimates of semi-demersal fish is detectability, defined here as the proportion of the true abundance of a target species within the ensonified volume (surface to bottom) that is detected by an echosounder and included in integration (Lawson and Rose, 1999). The purse seine catches as well as acoustic detections are subjected to environmentally induced variations. Both are submitted to variability related to species presence and fish habitat preferences. Variations in detectability are also caused by species composition and diel vertical movements. The patterns observed during this work reflect this complex interaction of environmental factors and fish behaviour.

Albaret, J.J., M. Simier, F. S. Darboe, J.-M. Ecoutin, J. Raffray and L. Tito de Morais, 2004. Fish diversity and distribution in the Gambia Estuary, West Africa, in relation to environmental variables. Aq. Living Res., 17: 35-46.
Blaber, S.J.M, Albaret, J. J and C. V. Ching, 2000. Effects of fishing on the structure and functioning of estuarine and nearshore ecosystems. ICES J. Mar. Sci., 57 : 590-602.
Guillard, J., J.-J. Albaret, M. Simier, I. Sow, J. Raffray and L. Tito de Morais, 2004. Spatio-temporal variability of fish assemblages in the Gambia Estuary (West Africa) observed by two vertical hydroacoustic methods: Moored and mobile sampling, Aq. Living Res., 17: 47-55.
Krumme, U. and U. Saint-Paul, 2003. Observations of fish migration in a macrotidal mangrove channel in Northern Brazil using a 200-kHz split-beam sonar. Aq. Living Res., 16: 175-184.
Lawson, G.L. and G. A. Rose, 1999. The importance of detectability to acoustic surveys of semi-demersal fish. ICES J. Mar. Sci., 56 (3): 370-380.

Poster Presented at the INTERNATIONAL CONFERENCE ON COASTAL ECOSYSTEMS:
Towards and Integrated Knowledge for an Ecosystem Approach for Fisheries
June 26 –29, 2006 Campeche, México