Document submitted to 6 th meeting of South Pacific Albacore Research.
March 1996

Peculiarity of swimming bladders of large albacore (Thunnus alalunga) caught by longline.

by

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ECOTAP is a research program in French Polynesia aiming at description and assessment of tuna resources of the EEZ, and aivaibility of the main species to longlining. For this purpose, ECOTAP scientific team is currently conducting experimental fishing, using monofilament longline operated on vessel N.O. ALIS. Various species of pelagic fish are caught within a range of -50 to 450m. (Wendling , 1995). Among them the major species are tuna, albacore (T. alalunga), bigeye (T. obesus), yellowfin (T. albacares) and marlins (Makaira sp.). A more particular research activity is sonic tracking of the tunas, designed for understanding their behavior in the deep layers and relations with concentration of food. In such a case, tuna is caught using handline (with chunking) at -100 to -200 m.

During handling the fish for these activities, our attention has been drawn to the fact that swimming bladder of albacore seems more fragile than the ones of bigeye and yellowfin. When fish caught on a longline hook is hauled on board , the albacores are very otfen dying, sometimes with spectacular bubbles and blood oozing from gill chamber. Sometimes stomach is devaginated. Fish dies in few minutes. At dissection, the albacore shows clearly symptoms of an explosion of the swimming bladder with a tear (1-3 cm width) in the ventral medio-anterior wall of the bladder and a congested glandular area at the anterior part of the bladder. All these features show a problem of overpressure. The exceptions to this situation occur when albacore arrive dead and rigid, corresponding to death just after biting.
On the contrary, bigeyes arrive on the deck in good condition, stay still few minutes, then have frantic activity during some 5 minutes. At dissection swimming bladder is intact and often fully inflated. Yellowfins arrive generally alive and swimming bladder intact, but size of yellowfin bladder is modest compared to the one of bigeye.

This difference between tuna has been noticed by the first cruises of ECOTAP Program. During a longlining cruise of ALIS by January 96, condition of fish freshly caught was recorded in still alive, feeble or fully dead. (somtimes rigid). All the tunas swimming bladder were dissected. Table 1 summarizes the occurences of these various situat.ions for the 113 tunas observed.

This striking difference of reaction to overpressure between tunas is particularly interesting when compared to the classical behavior of large tunas as shown by sonic tracking. They can move vertically, quickly up and down in the oceanic layers from mixed layer to thermocline and deeper. Holland an al, (1992) showed for bigeye a clear behavior of regular dives permitting to chase in deep cold water under the thermocline. Such behavior is apparently permitted by changes in efficiency of heat exchangers. Vertical movements of yellowfins , (that we tracked several time), and according to various authors, are less wide, ranging from surface to thermocline, seldom below the thermocline. (Josse et al . 1995).

For albacore, vertical movements have been shown by sonic tagging on fish mainly caught by surface gears (.troll, baitboat). M.Laurs who conducted these experiments did not encountered problems with swimming bladder. (Pers. com.). But ECOTAP conducted a not so voluntary experiment of sonic tagging on a large albacore (20 kg) caught by handline off Tahiti by October 1995 (Figure 1). It showed that the fish, apparently intact when hauled on the deck (no bleeding,, stomach devaginated then spontaneously retracted), tracked during 1: 15 hour, first dived to -150 m, then drifted down slowly at a rate of 0.03 m/s . Obviously the fish was dying and absence of buoyancy due to impossibility of inflating swimming bladder dragged it down. Such observation agrees with conclusions on albacore hydrostatic equilibrium from Sharp and Dotson (1977).

We feel that the important point here is the fact, that apparently, albacore swimming bladder is more fragile that the one of bigeye, and yellowfin, and therefore that regulation of variations of pressure during vertical movement of fish is different between species. It should reflect different habitats, and consenquently different feeding ecology.

Large albacore, are known for inhabiting the depth of tropical waters at latitude ranging from 35° to 10 ° (N or S) in the major oceans, where they have been widely fished by Asiatic longliners since the mid 60's. Small albacore live closer to the surface in more subtropical waters and migrate in temperate waters in summer. In Polynesia large albacore (1m, 20kg) appeared to be fairly common, when fishing with handline developped around FADs moored in the vicinity of main islands. But a remarkable point is that albacore is never caught at surface in Fench Polynesia, on the contrary of yellowfins (and maybe some bigeye). Depth range of habitat of large albacore in this area seems to be the narrowest of all major tunas. Our failed experience of tracking was aiming at exploring this possibiliy.

A theory proposed by Sharp and Dizon (1978) is that difference of habitat between the of various age and size of tuna is guided by ecophysiological abilities of the tunas. Among these abilities, progressive improvement of efficiency of heat exchangers is important. It could be as well true for efficiency of swimming bladder, of which development seems allometric. All major tunas have swimming bladders (Collette and Nauen, 1986) but, degree of development, therefore efficiency of this organ is poorly known and could differ between areas and ecological stages. Pereira (1995) showed that in Azores, young bigeye have different size of swimming bladder (by measuring length of s.b. related to fork length) according to composition of the tuna school where they have been fished (by pole and line). Siez range of these bigeyes is 50-70cm. In pure school of bigeye, the swimming bladders are more developped than in mixed school of bigeye and skipjack (K pelamis). Skipjack has no swimming bladder.
One reason of such paucity of knoweldge on tuna swimming bladder is the very difficulty to measure the volume of swimming bladders in tuna. Shape is not easy to reduce to a geometric volume for modelisation , it varies between tunas and walls are fragile. Handling for measurement of volume (by filling it with water, by instance) often end with burst of the bladder !. We are currently working on this problem.

As a conclusion, we would like to point out that difference of habitat of size and species of tunas are guided by ecophyiological abilities, allowing them to forage in differents regions and layers of oceans. The behavioral regulation of internal temperature is certainly very important, but consequently, vertical movements allowed by hydrodynamic and hydrostatic adaptations are as well important. And for hydrostatic, swimming bladder is paramount. How the tuna manage fast variations of pression and volume ?. And how they manage variations of partial pressure of dissolved gases in the blood and internal fluids ? Such problem is known for SCUBA diving,, no doubt that tuna have their solutions, but we have been unable to find out a study on that point of physiology of tuna.

Any observation, or references to this problem on albacore, apparently the tuna most dependant of swimming bladder condition would be of much interest for fully understanding its ecology.

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Table 1: Numbers of tunas, alive or dead, observed with swimming bladder intact or exploded. ALIS Cruise ECOTAP 5- Jan. 96. Fish range from 70 cm to 165 cm. **Al** refer to still active tuna on the deck, **Fe** refers to feeble, **Dead** refer to dead and sometimes rigid tuna (rigor mortis).

TUNAS species	Swimming bladder intact			Swimming bladder damaged			Total
	Al	**Fe**	**Dead**	**Al**	**Fe**	**Dead**	
Albacore	2	7	11	4	11	13	48
Bigeye	28	2	8	1	0	0	39
Yellowfin	12	1	13	0	0	1	27

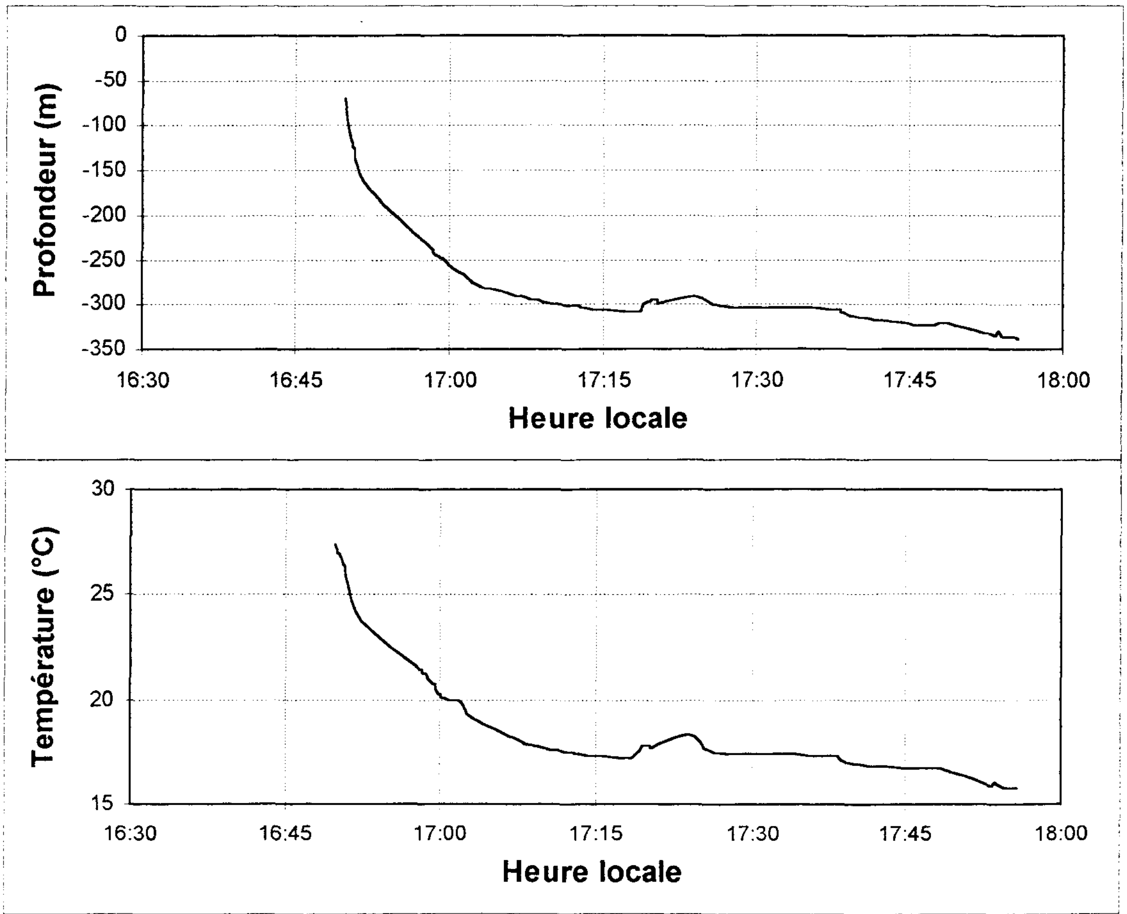

Figure 1: Depth versus time of an albacore (1m, Fl) tracking, off Raiatea island, 18 Oct 95. Corresponding water temperature is computed from a bathysond record.