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IDENTIFICATION PROBLEM OF YOUNG FISH (YELLOWFIN VS BIGEYE)

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I. Results of inquiry of the experience of experts

At the 1975 SCRS meeting, the Secretariat was assigned to solicit information from field workers, scientists and taxonomists, as to how the young yellowfin and bigeye tuna can be identified. Accordingly, the Secretariat prepared Circular 1976/11 (dated April 27, 1976) and requested such information. Comments were received from a small number of scientists. These comments are here below summarized:

G. Sharp (IATTC) - No problem in separation, using serum esterases, transferrins and an enzyme system (phosphoglucose isomerase).

B. M. Chatwin (Zapata Ocean Research, Inc.) - Perhaps the angle formed by the operculum and its posterior ventral margin is useful.

S. Kume (FSFRL) - The paper "Identification of young yellowfin and bigeye tunas in the Western Pacific Ocean" by H. Honma, Y. Warashina and Z. Suzuki (FSFRL Bull. 8, 1973) was sent in.

W. M. Matsumoto (NMFS, Honolulu) - The pectoral fin of bigeye is longer than that of yellowfin. Also, bigeye is more robust and has larger eyes.

W. J. Richards (NMFS, Miami) - When alive, young yellowfin have a very prominent gold lateral band. He also sent the English translation of "Note on Neothunnus albacora and Parathunnus obesus differentiation of the young - presence of a trematode parasite of the nasal sacs of N. albacora" by M. Rossignol and R. Repelin (ORSTOM Travaux du C.O. Pointe-Noire, 1962).

Based on the ICCAT "Field Manual" and taking into consideration all of these responses, a new identification key sheet has been drafted and is attached herewith as Appendix I. The keys have been prepared for the field workers for easy identification and, therefore, any methods which involve very advanced or complicated techniques are not included.

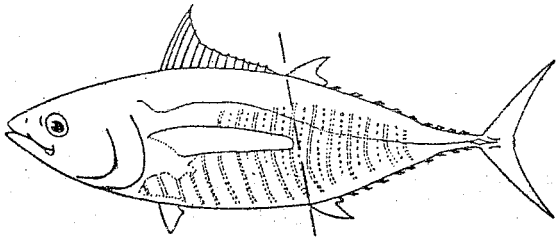
II. Biometric studies

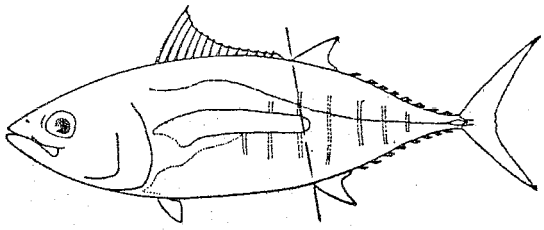
While visiting Abidjan (Ivory Coast), the Biostatistician, Dr. W. Schaaf, conducted some biometric studies on yellowfin and bigeye. His report is attached as Appendix II.

Appendix I

Identification keys for small size yellowfin (T. albacares) and bigeye (T. obesus) -- (20 cm - 60 cm)

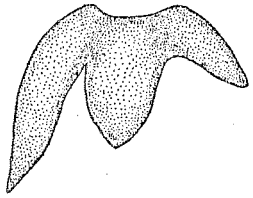
Yellowfin (T. albacares)	Bigeye (T. obesus)
1. Outside appearance	
a) White stripes on side of the body usually curve backwards toward ventral side.	a) White stripes run straight down.
b) White stripes appear alternatively in a broken line and in a chain of dots.	b) White stripes appear only as an unbroken line in bigeye.
c) More than 10 white stripes.	c) Less than 8 white stripes.
d) Pectoral fin does not reach the line between the anterior edges of the bases of the 2nd dorsal and anal fins.	d) Pectoral fin extends beyond the line between the anterior edges of the bases of the 2nd dorsal and anal fins.
e) Eye diameter is relatively small.	e) Eye diameter is relatively large.
f) Body is relatively slender (particularly hinder half).	f) Body relatively robust (particularly hinder half).

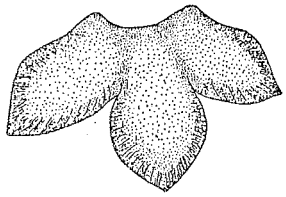




2. Liver

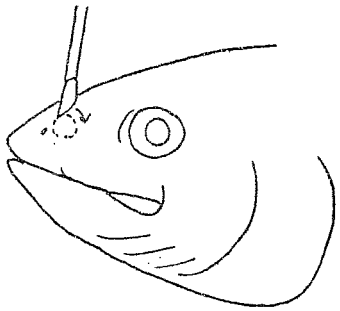
The right lobe of the liver is longer than the central lobe, and all lobes are pointed. Livers are not striated.	The central lobe of the liver is the longest and all lobes are less pointed. Livers are striated.

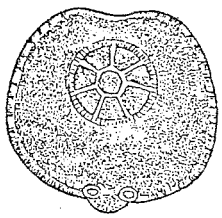




3. Quite frequently, parasitic trematodes, Tristoma sp. are found in the mucus of the nasal sacs. This can be examined by exposing the mucus of a nasal sac, by making two perpendicular incisions at the opening of the posterior nostril.
The parasite measures 13-4 mm x 12-3 mm, is disc shaped, flat and pearl-like in color.

No parasite in the nasal sacs. (The existence of the parasite is a means of positive identification for yellowfin, but its absence does not necessarily identify bigeye tuna.)





Appendix II

A short note on the species identification problem

by W. E. Schaaf

As many of you know, especially those who have read A. Fonteneau's paper (SCRS/75/72), there is a serious problem of properly identifying the species of mixed catches of small yellowfin and bigeye tuna. This is especially serious because there is a minimum size limit for yellowfin, because bigeye catches are becoming increasingly larger, and the state of the stock must be monitored much more closely in the near future.

There are two proposed methods to accurately separate the species. One is to examine the liver for striations, and the other is to examine the nasal cavity for a species-specific parasite. Both methods require time consuming field dissection, which is sometimes impossible (i.e. for frozen fish). It would be helpful if there were a morphometric technique available to separate the species with acceptable accuracy. Obviously, if one were to measure many body dimensions, a certain combination of them could be found which would separate the species. But measuring many dimensions defeats the purpose of saving time. The ideal situation would be to measure only one other dimension during routine length sampling (for small fish of suspected mixed species catches). The one other dimension which obviously suggests itself is eye diameter. The other dimension to expect for species separation is girth. If time permits the taking of three body measurements, we might expect a combination of eye diameter and girth, for a given (measured length) to be even more accurate at separating the species.

During a ten-day trip to Abidjan (Ivory Coast) in July, 1976, A. Fonteneau, J. Marcille and I collected these three morphometric data on a mixture of 59 small yellowfin and bigeye tunas. For 44 of the fish, we examined the liver for a positive species identification, then measured predorsal length (with a caliper), girth (with a tape) at the first dorsal fin, and vertical eye diameter (with a tape). An additional 15 fish were measured in these three dimensions, but without opening them, only "guessing" their species by outward appearance. The raw data for this experiment appear in Table 1. Figure 1 shows a plot of vertical eye diameter against LD_1 for the opened fish. The triangles are yellowfin and the points are bigeye (a circle around a point represents two fish at that point). Figure 1 demonstrates a fairly clear separation of the species. An estimated (by eye) linear discriminant function

$$(1)\quad y = 33 + 1.125x$$

mis-identifies only three fish, 7% of the sample, (two yellowfin and one bigeye).

Since, for a given length, bigeye are supposed to be deeper bodied than yellowfin, as well as bigger-eyed, it might be expected that a combination of these measures might discriminate species even better than one alone. Figure 2 shows a plot of eye diameter multiplied by girth, against LD_1. Again, the points represent bigeye and the triangles are yellowfin. The discriminant function (again eye-fitted)

$$(2)\quad y = 83.5 + 1.625x$$

mis-identifies only one bigeye (3% of the sample). Only the national tuna scientists can decide whether this gain in precision justifies the cost of additional time required to make three measurements. Of the 15 unopened fish, equation (2) correctly places all three yellowfin below the line, and misplaces only two (indicated by asterisks in the table) bigeye below the line.

I should like to add that eye diameter measurements can be made more precise by using a caliper instead of a tape. Also, my personal observation is that in bigeye, the eye is not only larger, but more elliptical. If the eye diameter were measured obliquely, along the major axis, perhaps this one measurement might separate species even better than the estimated 7% quoted above.

Table 1

Opened for liver identification

Bigeye

(1) LD1	(2) Ø	(3) girth	(2)x(3)/(1)
27.0	42	63.5	98.78
24.0	34	58.0	82.17
23.0	42	56.5	103.17
27.0	43	62.3	99.22
23.0	41	54.9	92.52
25.0	42	60.5	101.64
24.0	38	56.8	89.93
25.5	43	62.4	105.22
26.0	45	61.5	106.44
22.5	43	53.0	101.29
24.5	44	54.5	97.88
22.5	40	52.0	92.44
27.0	56	67.5	140.00
27.0	44	66.0	107.56
26.0	47	62.2	112.44
24.5	42	57.0	97.71
27.0	44	64.4	104.95
25.5	46	63.5	114.55
24.5	40	59.0	96.33
23.5	39	54.0	89.62
23.5	38	57.0	92.17
23.0	42	53.3	97.33
23.5	40	54.0	91.91
26.0	40	62.0	95.38
25.5	42		
24.5	40		
28.0	46		
26.5	48		
23.0	43		
26.0	48		
n 30	30	24	
x̄ 24.95	42.73	58.87	
SD 1.599	3.982	4.657	

Yellowfin

(1) LD1	(2) Ø	(3) girth	(2)x(3)/(1)
23.5	29	56.5	69.72
23.0	36	54.4	85.15
28.5	35	75.0	92.11
27.5	37	68.5	92.16
27.5	34	67.7	83.70
27.0	35	67.0	86.85
22.5	37	56.5	69.64
29.5	37	71.5	89.68
23.5	25	52.8	56.17
22.0	30	53.5	72.95
25.0	36	60.0	86.40
28.0	33	65.0	76.61
24.5	37		
25.0	37	—	
n 14	14	12	
x̄ 25.50	34.14	62.28	
SD 2.457	3.697	7.735	

unopened

Bigeye

24.5	36	60	88.2
25.0	45	59.5	107.1
29.5	47	72.0	114.7
23.0	40	54.3	94.4
27.0	47	66.2	115.2
24.0	39	59.4	96.5
25.0	39	59.0	92.0
25.0	43	61.7	106.1
23.5	39	56.0	92.9
24.5	37	58.2	87.9
27.0	41	66.0	100.2
27.5	46	65.2	109.1
12	12	12	

Yellowfin

22.0	32	50.5	73.5
25.5	32	61.5	77.2
27.0	34	63.5	80.0

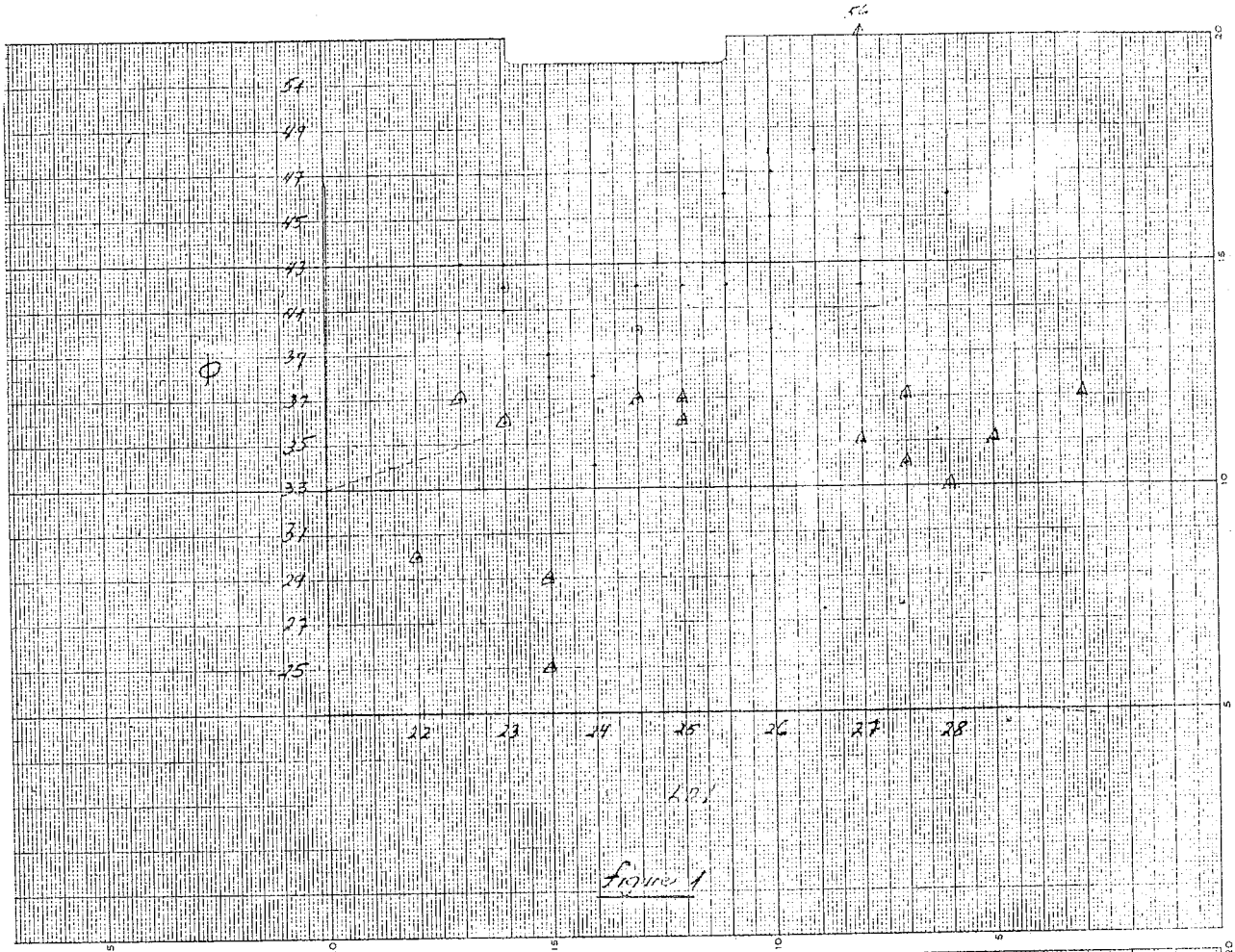


Figure 1

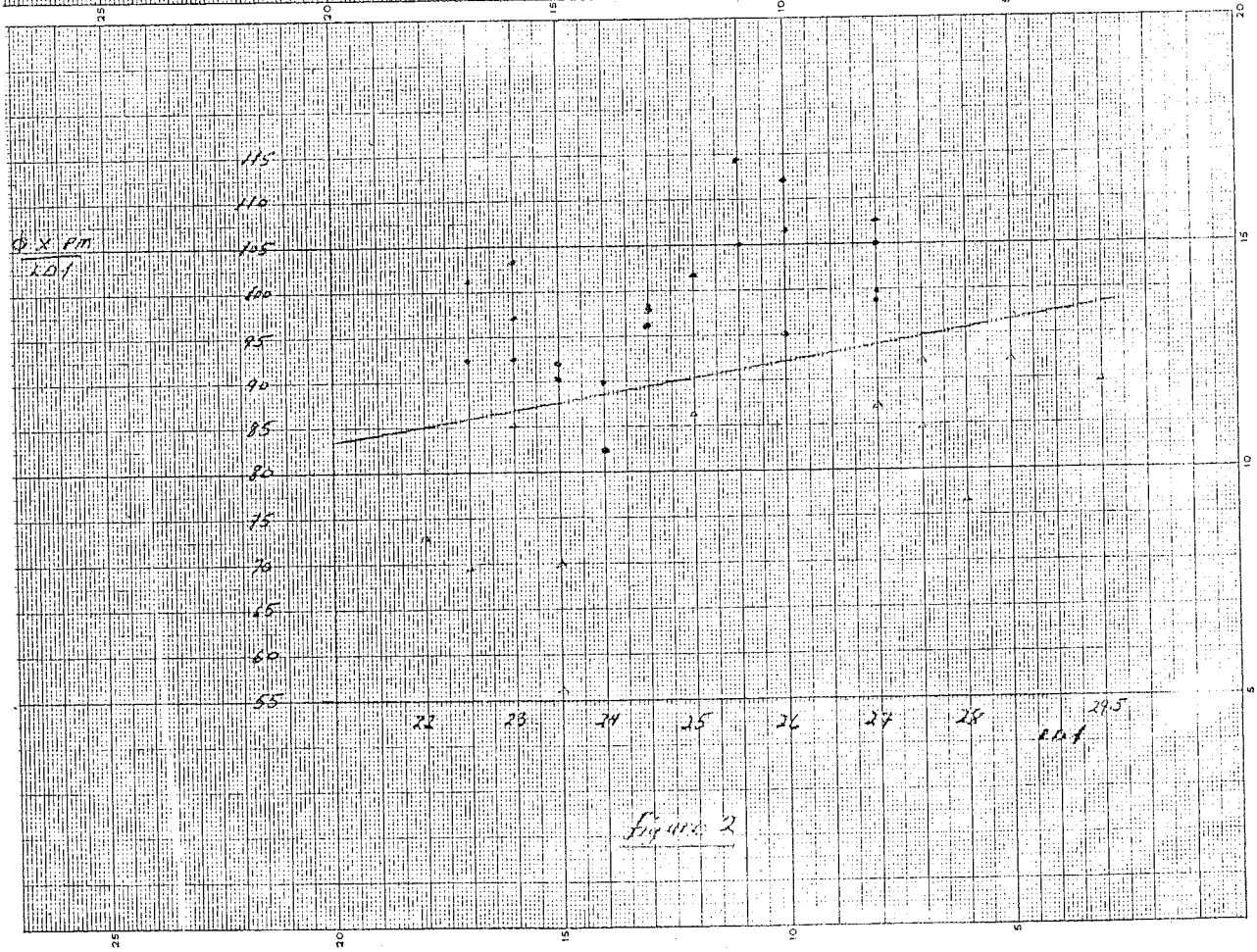


Figure 2