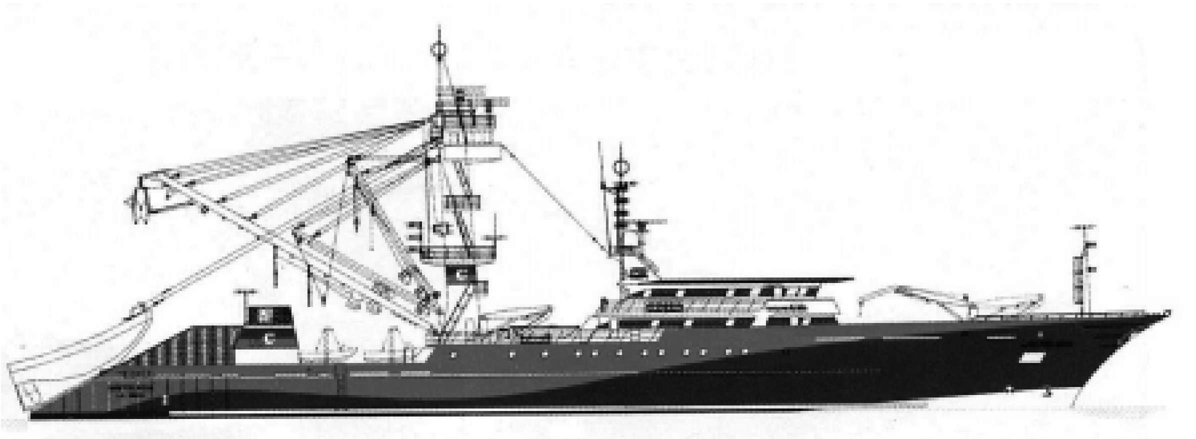
SCTB16 Working Paper

FTWG–1

An assessment of the accuracy of yellowfin and bigeye tuna species identification: by American Samoa port samplers.



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[1] Report prepared for the 16th Standing Committee on Tuna and Billfish, Fishing Technology Working Group, July 9-16, 2002, Mooloolaba, Austraila

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BACKGROUND

U.S. flag tuna purse seine vessels operate in the Western and Central Pacific Ocean (WCOP) within the framework of a multi-lateral fishery agreement, the Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the United States of America; often referred to as the South Pacific Tuna Treaty (SPTT). Under conditions outlined by the SPTT, the National Marine Fisheries Service (NMFS) collects various types of fishery information and submits the data to the Forum Fisheries Agency (FFA), managers of the Treaty. The information includes logbook data, unloading weights by species, size frequency and species composition data from landings, and biological samples from the fishery. The FFA administers an at-sea observer program that annually targets approximately 20% of the trips and collects size frequency and species composition data and other types of fishery data.

The fishery targets skipjack and yellowfin tuna with typical landings comprised of the two species at a ratio of approximately 3.5:1, skipjack tuna to yellowfin tuna. However, portions of the yellowfin tuna landings consist of juvenile bigeye tuna that receive the same cannery dock price as similarly sized yellowfin tuna and are canned as light meat tuna. Bigeye tuna taken by this fleet have been recorded at one to two percent of landings from the beginning of the SPTT sampling period of 1988 to 1995 (Coan and Sakagawa, 2002). Since that period, the proportion of bigeye tuna in the reported landings has increased in some years to 10% of the total catch and over 30% of the combined yellowfin/bigeye tuna catch in 1999 (Table 1).

The increase in proportion of bigeye tuna in landings of purse seine vessels is recognized in all major purse seine fisheries and results from an increased dependence, in some years and by some fleets, on fishing tuna schools found in association with floating objects (associated sets). Greater attention to the discrimination and identification of bigeye tuna in mixed yellowfin/bigeye tuna catches and landings is also an important factor to increased reported landings of bigeye tuna. Increasing concern over the condition of bigeye tuna stocks has highlighted the importance of accurately defining the level of bigeye tuna landings by all fleets and fisheries.

The canneries in Pago Pago, American Samoa combine purse seine landed yellowfin and bigeye tuna, often size sorting them on board the vessel. In order to estimate the bigeye tuna catch, NMFS port samplers have conducted species composition sampling since 1988. Two samplers, hereafter referred to as sampler A and sampler B, conduct the majority of the sampling. The samplers were trained in identifying yellowfin and bigeye tuna when initially hired, but a refresher course or verification of identifications has not been conducted since the start of the program. Due to the increased catches of bigeye tuna in recent years, the current study was conducted in 2003 to assess how accurately the two species are identified by port samplers in American Samoa. NMFS contracted an expert (the primary author of this paper) in the identification of yellowfin and bigeye tunas to conduct the study.

METHODS

The Contractor was to follow each sampler through his daily sampling routine and observe at least two species composition samples per sampler where small to medium sized yellowfin and bigeye tuna were present. The sampler identified and measured each fish while the Contractor made his own identification and recorded the results in a manner that was not observable by the sampler.

Normally, the samplers draw a fifty fish sample by species and size category (if size sorted during unloading) for size sampling. If, in the course of drawing 50 of the targeted species (e.g. yellowfin tuna) for size sampling, another species is encountered, then a full 100 fish are drawn for a species composition sample. At the conclusion of the draw, an attempt is made to fill out a full 50 fish length frequency-sample of the other species encountered.

The samplers record species composition data on length-frequency forms with a tick mark next to the column entry representing the nearest whole cm of fork length (FL). For the purposes of the verification experiment, data was recorded on specific forms that allowed for entry of the Sampler's ID, the Contractor's ID without cutting, and the Contractor's ID with cutting to allow verification by internal characteristics. The Contractor modified the form to record the FL of each fish examined so that size-related bias toward misidentification could be examined. Sample forms were printed on water-resistant paper for use in the field. An example of a filled data sheet is included in this report as Figure 1. Both species composition samples and length-frequency samples were observed, verified and recorded by the Contractor.

Sampling was conducted on the cannery dock of pre-sorted, size segregated samples and of sorted or unsorted samples taken on the vessel's wet deck. The lighting conditions, working conditions and other factors vary significantly between locations, so verification efforts attempted to test the samplers in each environment.

RESULTS

Sampler A:

The Contractor verified 215 yellowfin tuna and 155 bigeye tuna (370 total) with Sampler A at 100% accuracy (Table 2). The sizes of yellowfin and bigeye tuna encountered ranged from 40 to 128 cm FL with a mean FL of 63 cm for bigeye tuna and 55 cm for yellowfin tuna. A good mix of sorted dock samples and wet deck samples were made and no species identification problems were noted. The Contractor is fully convinced that Sampler A is accurately identifying yellowfin and bigeye tuna of the sizes encountered during this study, in a wide range of conditions and under different sampling environments.

Sampler A preferred to use the following features for discriminating and identifying yellowfin and bigeye tuna: body shape, head size and shape, eye size, finlet coloration (Appendix A). He also stated that the width of the caudal fin (straight line – dorsal tip to ventral tip) was longer on a comparably sized yellowfin tuna compared to bigeye tuna.

On many fish that Sampler A identified, the Contractor noted that the small bumps on either side of the caudal notch remained a consistent feature (thicker, more pronounced on yellowfin tuna) as well as the shape of the caudal notch. However, these features did not seem to be high on sampler A's list of identifying characters. Also, the pectoral fin length and tip characteristics were often very good for identification purposes on the fish that were examined.

Sampler B:

The Contractor verified 283 yellowfin tuna and 117 bigeye tuna (400 total) with sampler B at 100% accuracy (Table 3). The sizes of yellowfin and bigeye tuna encountered ranged from 41 to 82 cm FL with a mean FL of 54 cm for bigeye tuna and 52 cm for yellowfin tuna. The verification sampling favored dock sampling but Sampler B appeared confident and accurate in all species identifications. The Contractor is convinced that Sampler B is accurately identifying yellowfin and bigeye tuna of the sizes encountered during this audit and under a wide range of conditions and environments

Sampler B preferred to use the following features for discriminating and identifying yellowfin and bigeye tuna: body shape, pectoral fin length and characteristics, tail notch shape, size of eye, shape of head and shape of the trailing edge of the caudal fin (flatter in bigeye tuna, Appendix A). He appeared to use a good mix of features when discriminating species and quickly and accurately identified all samples.

Bent fish, tail damaged fish and mouth damaged fish were correctly rejected for sampling. Also, fish with gouges and unloading scars but still had measurable fork lengths were correctly chosen for random sampling and measured.

SUMMARY AND DISCUSSION

Estimation of the accuracy of port samplers in discriminating between yellowfin and bigeye tunas was accomplished during a week of sampling in Pago Pago, American Samoa. Given the vessels and fish available, Sampler A was verified on two 100 fish species composition dock samples, one 100 fish wet deck species composition sample, and 70 extra fish drawn for length-frequency samples on the dock and wet deck. Sampler B was verified on two 100 fish species composition samples on the dock, one 100 fish wet deck species composition sample and 100 extra fish drawn for length-frequency samples on the dock and wet deck.

The NMFS port samplers used a variety of identifying characteristics during a week of observation and were found to be very accurate in identifying yellowfin and bigeye tuna of the sizes encountered (smallest bigeye tuna was 45 cm FL and yellowfin tuna, 40 cm FL). Both samplers accuracy was at 100%. However, this sampling program, and many other port sampling and observer programs, could benefit from periodic training and verification experiments. Very small yellowfin and bigeye tuna (<40 cm) were not available during this week of verification and another experiment should be conducted when these small fish are available. The identifying features of yellowfin and bigeye tuna less than 40 cm FL are quite different from fish larger than 40 cm.

The Contractor was able to closely observe each sampler and gain a good understanding of the sampling procedures in theory and in practice. It is clear that a well trained dock sampler should never need to cut yellowfin or bigeye tuna to verify species, at least of the sizes encountered during the week[2]. Also, the sampling conditions on the dock and on the vessel's wet deck should be adequate to allow accurate species discrimination regardless of location.

The dynamic nature of the unloading process necessitates the active investigation of activities on board the vessel to determine unloading activities with potential to impact the sampling and recorded data. In order to keep up with these factors, samplers need to keep moving between the dock and the vessel's wet deck.

It would be desirable, in this program and in other port and observer sampling programs in the area, if measuring calipers were verified prior to each sampling day and a place on the forms was added to note the calibration. Even while no problems were noted during this week of observation, calibration strengthens the program's claim of accurate measurements.

In summary, the Contractor felt the samplers were highly accurate in their species identifications and adherence to their duties in port sampling. Still, periodic re-training and verification can only reinforce and improve their skills and further strengthen the

[2] It should be noted that the samplers were reluctant to cut fish and probably would never do so as this would be unacceptable to cannery personnel, the fishermen and vessel personnel.

credibility of this program. Also, the mere act of verification tends to reinforce the importance and quality of their work which should enhance job performance and dedication to accurate data collection.

ACKNOWLEDGMENTS

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Table 1. Catch (mt) and number of U.S. tuna purse seiners fishing in the central-western Pacific Ocean (Coan and Sakagawa 2002) <Catches include discards, estimates for 1988 based on six months only>

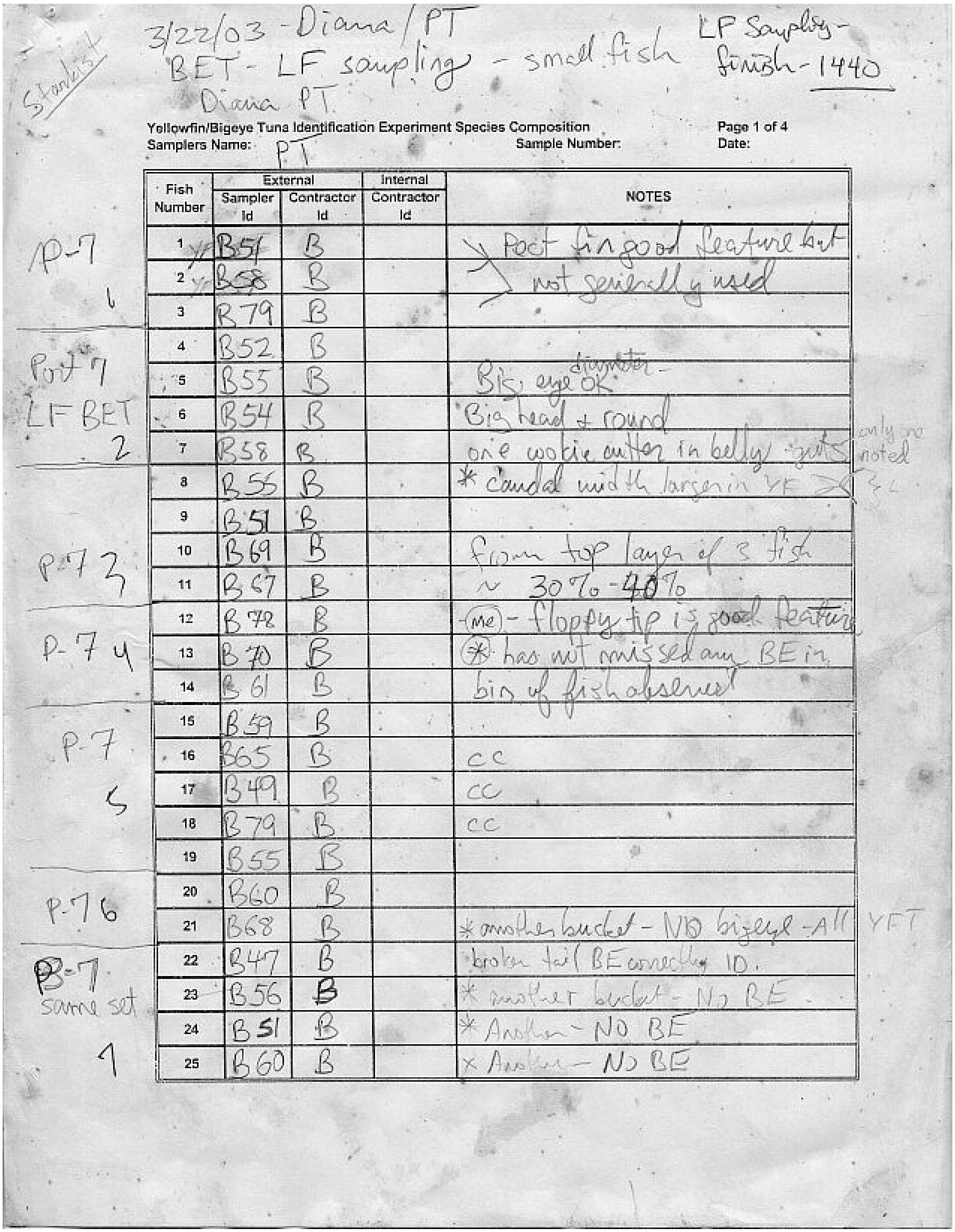
Year	# seiners	SKJ	YFT	BET	SKJ %	YFT %	BET %	Total
1988	31	93,636	18,832	1,948	82%	16%	2%	114,416
1989	35	95,027	42,886	2,421	68%	31%	2%	140,334
1990	43	110,044	52,089	1,762	67%	32%	1%	163,895
1991	43	177,389	37,330	1,550	82%	17%	1%	216,269
1992	44	155,898	43,693	3,480	77%	22%	2%	203,071
1993	42	148,419	46,011	3,731	75%	23%	2%	198,161
1994	49	151,486	56,426	1,711	72%	27%	1%	209,623
1995	44	132,518	31,845	3,190	79%	19%	2%	167,553
1996	39	120,127	19,417	9,860	80%	13%	7%	149,404
1997	35	79,386	54,638	10,058	55%	38%	7%	144,082
1998	39	131,573	37,530	5,525	75%	21%	3%	174,628
1999	36	129,262	35,820	17,403	71%	20%	10%	182,485
2000	33	80,272	32,126	12,953	64%	26%	10%	125,351
2001	31	85,436	23,430	6,658	74%	20%	6%	115,524

Table 2. Yellowfin / Bigeye species verification summary for Sampler A

	Correct ID		Incorrect ID		Score	Total
	YF	BE	YF	BE	%	
Dock sampling	156	88	0	0	**100%**	**244**
Wet deck sampling	59	67	0	0	**100%**	**126**
All verified sampling	215	155	0	0	**100%**	**370**
Correctly identified	**Dock sampling**		**Wet deck sampling**		**All verified sampling**	
and verified	**YF**	**BE**	**YF**	**BE**	**YF**	**BE**
Count	**156**	**88**	**59**	**67**	**215**	**155**
Min	44	46	40	46	40	46
Max	119	91	63	128	119	128
Range	75	45	23	82	79	82
Mean	58.4 cm	57.7	47.0	70.3	55.3 cm	63.1 cm
Standard Deviation	15.7	8.8	4.4	26.2	14.5	19.4

Table 3. Yellowfin / Bigeye species verification summary for Sampler B.

	Correct ID		Incorrect ID		Score	Total
	YF	BE	YF	BE	%	
Dock sampling	259	41	0	0	**100%**	**300**
Wet deck sampling	24	76	0	0	**100%**	**100**
All verified sampling	283	117	0	0	**100%**	**400**
Correctly identified	**Dock sampling**		**Wet deck sampling**		**All verified sampling**	
and verified	**YF**	**BE**	**YF**	**BE**	**YF**	**BE**
Count	**259**	**41**	**24**	**76**	**283**	**117**
Min	41	46	42	45	41	45
Max	68	60	82	72	82	72
Range	27	14	40	27	41	27
Mean	52.2	51.3	49.2	55.0	51.9	53.7
Standard Deviation	5.9	3.7	7.3	7.1	6.1	6.4



3/22/03 - Diana / PT
BET - LF sampling - small fish
Diana PT
LF Sampling - finish - 1440
Starboard

Yellowfin/Bigeye Tuna Identification Experiment Species Composition
Page 1 of 4
Samplers Name: PT
Sample Number:
Date:

	Fish Number	External: Sampler Id	External: Contractor Id	Internal: Contractor Id	NOTES
P-7 1	1	B51	B		Pect fin good feature but
	2	B58	B		not generally used
	3	R79	B		
Port 7 LF BET 2	4	B52	B		
	5	B55	B		Big eye diameter OK
	6	B54	B		Big head + round
	7	B58	B		one cookie cutter in belly guts (only one noted)
	8	B56	B		* caudal width larger in YF
P-7 3	9	B51	B		
	10	B69	B		from top layer of 3 fish
	11	B67	B		~ 30% - 40%
P-7 4	12	B72	B		(me) - floppy tip is good feature
	13	B70	B		* has not missed any BE in
	14	B61	B		bin of fish observed
P-7 5	15	B59	B		
	16	B65	B		cc
	17	B49	B		cc
	18	B79	B		cc
P-7 6	19	B55	B		
	20	B60	B		
	21	B68	B		* another bucket - NO bigeye - All YFT
P-7 same set 7	22	B47	B		broken tail BE correctly ID.
	23	B56	B		* another bucket - No BE
	24	B51	B		* Another - NO BE
	25	B60	B		* Another - NO BE

Figure 1. Form used to assess the accuracy of port samplers species identifications.

Appendix A. Internal and external characteristics of yellowfin and bigeye tuna useful for species identification and discrimination.

Characteristic		Yellowfin	Bigeye	Comment
Internal Character	Liver	Smooth, clear, no striations. Right lobe longer and thinner than rounded medial and left lobes.	Three rounded lobes of similar size and shape with medial lobe slightly larger. Ventral surface of lobes striated.	Large, conspicuous organ that lies along anterior-ventral portion of gut cavity.
	Swim bladder	Occupies anterior half of body cavity. Small, inconspicuous, often deflated or slightly inflated in dead specimens.	Occupies almost entire body cavity. Large, tapered, conspicuous. Often inflated in dead specimens. An inflated swim bladder may force the stomach to evert and protrude from the mouth.	Translucent, balloon-like structure attached along dorsal wall of body cavity below vertebrae.
External Character	Coloration	Black on back, bright yellow lateral band, silvery gray sides, whitish belly.	Dark blue/black on back, thin iridescent cobalt blue line visible in life, golden lateral band, silvery sides, whitish belly.	Colors fade to black back, golden lateral band with whitish sides and belly after death for both species.
	Markings	Conspicuous lateral markings of narrow evenly spaced lines extending from below origin of pectoral fin to region of caudal peduncle. Lines consist of solid silvery-white bands alternating with rows of spots or broken dashes. Noticeable chevron pattern of lines in smaller fish, particularly on posterior half of body.	Irregular lateral markings extending from ventral midline to above lateral line restricted primarily to posterior half of body. Continuous straight whitish lines, irregular and separated by dusky regions in life. Broken blotchy lines or spots may be present but not closely spaced, regularly alternating bands as for yellowfin.	Banding highly evident in small and medium yellowfin, less evident in small to medium sized bigeye. Post-mortem, markings can remain clearly evident in yellowfin but fade in bigeye. Markings become less evident or may disappear in large individuals.
	Body morphology	Body elongate, thin. Outline flattish between second dorsal and caudal fin.	Body deep, forming rounded dorsal and ventral outline.	Bigeye clearly deeper bodied, more rounded in outline compared to yellowfin of same fork length.
	Head morphology	Relatively short head length relative to bigeye.	large head length and depth relative to yellowfin.	
	Eye	Smaller in diameter compared to bigeye. Round.	Larger in diameter compared to yellowfin. May appear to elongate ventrally in an oblong shape.	

Appendix A. Continued

Characteristic		Yellowfin	Bigeye	Comment
	Caudal fin notch	Central portion of posterior trailing edge forms distinct “V” shaped notch or appearing like a distinct “M”.	Central portion of posterior trailing edge forms a flattened or slightly crescent shaped cup.	Noticeable in all sizes of yellowfin and bigeye larger than 30 cm FL.
	Caudal fin morphology	Central region of caudal fin thicker in cross section. Two distinctly raised, elongated mounds present between caudal peduncle and caudal fin notch.	Central region of caudal fin thinner than yellowfin. Two mounds between caudal peduncle and caudal fin notch flat, inconspicuous.	
	Caudal fin color	Yellow in life, fading to golden color after death.	Purple – black in life, fading to dusky black after death.	Both may appear blackish in brine frozen fish.
	Pectoral fin length	Shorter, thicker and stiffer than for bigeye, reaching to anal fin but not beyond.	Long, thin, often extending to posterior insertion of anal fin.	Most pronounced difference in middle sized fish 45 – 105 cm FL.
	Pectoral fin shape	Stiff, blade-like when erect.	Describes a smooth, back swept arc when erected away from body.	
	Pectoral fin tip	Stiff, blade-like.	Thin, flexible and “floppy” tip. May point ventrally when folded against body.	
	Finlets	Bright yellow in color.	Golden yellow, may have black edge, especially trailing edge.	
	Cookie cutter shark bites	May be present but less common than for bigeye.	More common than for yellowfin taken from same waters. Often present on lateral or ventral surface posterior to 2nd dorsal fin.	Fresh bites appear as round, smooth wounds that eventually heal flush with existing body outline with round scar.