

A New Hawaiian Engraulid Fish

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THE OCEANIC SKIPJACK or aku (*Katsuwonus pelamis*) is commercially the most important fish in the Hawaiian Islands. This tuna is captured by pole and line, using live bait as chum. Of the several species of small fish employed as bait, the endemic anchovy known as nehu (*Stolephorus purpureus*, family Engraulidae) forms the major skipjack bait resource. Its importance in this respect has made the nehu the subject of several studies, resulting in reports on its food habits (Hiatt, 1951), spawning (Tester, 1951, 1955), oxygen requirements (Pritchard, 1955), meristic variation (Tester and Hiatt, 1952), and taxonomy (Gosline, 1951). Biologically, the nehu is probably the best-known fish in the Hawaiian Islands.

The nehu is a carnivorous anchovy, living and breeding in estuaries and bays. It is captured by seine during the day, and by a combination of seine and electric light at night. The nehu has been regarded as neritic except for two puzzling circumstances: the nehu population in Maalaea Bay, Maui, is periodically augmented by incursions of fish apparently from the open sea, and eggs differing only slightly from those of nehu were once taken in the offshore waters of Oahu (Tester, personal communication).

During the summer of 1958 the research vessel "Charles H. Gilbert" of the U. S. Fish and Wildlife Service encountered several large schools of anchovies 5–30 mi. off Oahu. Samples were presumed to be nehu and were not preserved. Later, conversation with commercial fishermen revealed that, while not regularly occurring, such schools were not rare, and also that the fish differed from nehu in both color and shape. Some fishermen termed these fish "oki-washi," which is literally translated as "pelagic sardine-like fish," while others referred to them as "roundheads." The latter name was descrip-

tive of the short head which caused the fish to be gilled in seines used for nehu.

Thinking that this offshore anchovy represented either a different species or an ecological variant of nehu, we intensified our efforts to obtain specimens from areas removed from the inshore nehu grounds. Ultimately, two small collections were obtained, one through the interest of Captain Noboru Tsue of the M/V "Buccaneer," the other from biologists of the Territorial Division of Fish and Game (Honolulu). Examination of these specimens proved them to be not only distinct from nehu but also new to science. It is the purpose of this paper to describe and distinguish this new Hawaiian anchovy.

In addition to the collectors, thanks are due also to Drs. Albert L. Tester and William A. Gosline of the University of Hawaii, the former for making available meristic data for nehu, the latter for examining specimens of *Anchoviella mauui*. I am also grateful to Mr. John G. Simpson of the Inter-American Tropical Tuna Commission for data on Central American *Anchoviella*.

METHODS

All meristic data were enumerated from specimens stained with alizarin. Articulated and nonarticulated fin rays were not differentiated, and those rays split to a single base were counted as single rays. All gill rakers, including rudiments, were counted from the first arch on the right side. Distinction between the upper and lower limbs of gill arches was made on the presence of 1–3 rakers with bases embedded in connective tissue between the two portions of the arch. Because most specimens had lost their scales, the number of scale rows was obtained by counting the scale pockets. The only measurement needing description is maxillary length, which was taken as a straight line between the

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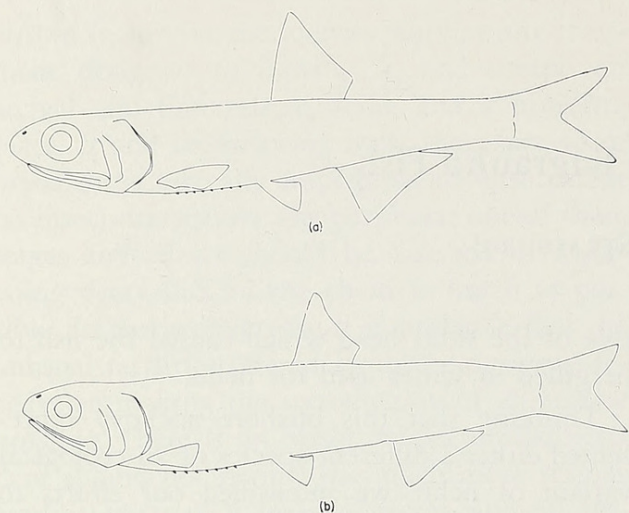


FIG. 1. Distinguishing features of Hawaiian engraulid fishes. Compare head length, maxillary length, and pectoral–pelvic interspace. *a*, *Stolephorus purpureus*; *b*, *Stolephorus buccaneeri*.

snout tip and the most posterior portion of the maxillary.

In a recent paper on the scientific name of the nehu, Gosline (1951) mentioned several problems incidental to the use of the term *Stolephorus*, and pointed out the need for a comparison between this genus and the related *Anchoviella*. Although both species of Hawaiian engraulids are referable to *Stolephorus* (Gosline, 1951; Weber and de Beaufort, 1913; Jordan and Seale, 1925, 1926), it is desirable to define this genus as exclusively as possible, for it has not been possible to undertake the needed study of the several engraulid genera. As it is here understood, *Stolephorus* includes those engraulid fishes having separate anal and caudal fins, the dorsal origin anterior to that of the anal, normal upper pectoral rays, bony scutes on the mid-ventral line, maxillaries not extending posterior of the gill opening, and a silvery stripe lengthwise on the body. The genus lacks canine teeth and free spines preceding the dorsal fin (spines are sometimes present in *S. tri* and *S. baganensis* (Hardenberg, 1933a)). As far as is known, the species of *Stolephorus* are Indo-Pacific in distribution. The Hawaiian forms can be distinguished from each other by characteristics presented in the following key, Figure 1, and Table 1. Differences between the new species and its congeners are mentioned in the species diagnosis.

KEY TO THE HAWAIIAN ENGRAULIDAE

1. Pectoral and pelvic fins far apart, distance between tip of depressed pectoral and pelvic base equal to twice eye diameter; maxillary short, failing to reach anterior edge of preopercle by a distance equal to $\frac{1}{2}$ to $\frac{2}{3}$ pupil diameter, maxillary length contained in head length 1.4–1.7 (usually 1.6) times; head short, its length contained 4.1–4.7 (usually 4.1–4.5) times in standard length.....Roundhead.

Stolephorus buccaneeri, new species

2. Pectoral and pelvic fins close together, distance between tip of depressed pectoral and pelvic base equal to $\frac{1}{4}$ to 1 eye diameter; maxillary long, just reaching anterior edge of preopercle, its length contained in head length 1.0–1.3 (usually 1.3) times; head long, its length contained 3.4–4.0 (usually 3.5–3.8) times in standard length.....Nehu.

Stolephorus purpureus Fowler

Stolephorus buccaneeri, new species

Figs. 1, 2

HOLOTYPE: USNM no. 177742, a male, 53.3 mm. in standard length, taken by seine 200 yd. west of Lehua Island, Niihau, Hawaiian Islands, on September 15, 1958, by Captain Noboru Tsue and crew of M/V "Buccaneer" of Honolulu.

PARATYPES: USNM no. 177743, 19 specimens, males and females, 44.7–58.9 mm. in standard length, taken with holotype; USNM no. 177744, 8 specimens, 40.5–51.5 mm. in standard length, taken from stomach of *Euthynnus yaito* captured 1 mi. off Makua, Oahu, Hawaiian Islands, on September 10, 1958, by Territorial Division of Fish and Game biologists aboard the M/V "Makua" of Honolulu.

DESCRIPTION: Counts made on *S. buccaneeri* are recorded in Table 1, and detailed measurements of the holotype and two paratypes appear in Table 2. Dorsal rays 13 or 14; anal 14–16, the last base usually with 2 rays; pectoral 14–17; pelvic 7; principal caudal rays 9 + 1 + 9; branchiostegal rays 11–13; gill rakers 16 or 17 + 2 or 3 + 23 or 24 (total 41–43); scales in a longitudinal series 41–44, in a transverse series 9(?) or 10(?); scutes on mid-ventral line

TABLE 1
COUNTS MADE ON HAWAIIAN SPECIES OF *Stolephorus*¹

	DORSAL RAYS		ANAL RAYS		PECTORAL RAYS		PELVIC RAYS		PRINCIPAL CAUDAL RAYS, <i>buccaneeri</i>	BRANCHIOSTEGAL RAYS, <i>buccaneeri</i>	SCALE ROWS		VENTRAL SCUTES		GILL RAKERS	
	<i>buccaneeri</i>	<i>purpureus</i>	<i>buccaneeri</i>	<i>purpureus</i>	<i>buccaneeri</i>	<i>purpureus</i>	<i>buccaneeri</i>	<i>purpureus</i>			<i>buccaneeri</i>	<i>purpureus</i>	<i>buccaneeri</i>	<i>purpureus</i>	<i>buccaneeri</i>	<i>purpureus</i>
0....	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	—
1....	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
2....	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—
3....	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—
4....	—	—	—	—	—	—	—	—	—	—	—	—	14	3	—	—
5....	—	—	—	—	—	—	—	—	—	—	—	—	5	1	—	—
6....	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
7....	—	—	—	—	—	—	19	40	—	—	—	—	1	—	—	—
10....	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
11....	—	1	—	—	—	—	—	—	—	9	—	—	—	—	—	—
12....	—	8	—	—	—	10	—	—	—	7	—	—	—	—	—	—
13....	21	126	—	—	—	77	—	—	—	3	—	—	—	—	—	—
14....	9	82	6	5	17	175	—	—	—	—	—	—	—	—	—	—
15....	—	2	19	55	18	65	—	—	—	—	—	—	—	—	—	—
16....	—	—	5	113	7	11	—	—	—	—	—	—	—	—	—	—
17....	—	—	—	43	2	2	—	—	—	—	—	—	—	—	—	—
18....	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—
19....	—	—	—	—	—	—	—	—	22	—	—	—	—	—	—	—
38....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
40....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
41....	—	—	—	—	—	—	—	—	—	—	1	1	—	—	2	2
42....	—	—	—	—	—	—	—	—	—	—	3	2	—	—	3	11
43....	—	—	—	—	—	—	—	—	—	—	1	5	—	—	5	14
44....	—	—	—	—	—	—	—	—	—	—	1	3	—	—	—	35
45....	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	41
46....	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	36
47....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
48....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18
49....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
50....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
51....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2

¹ Most data for *purpureus* were supplied by Tester. Both pectoral and pelvic fins were counted, except for the pectorals of some *purpureus*.

2–7 (usually 3–5); vertebrae 43 including urostyle (1 specimen).
Head 215–257, snout 44–59, bony interorbital 48–58, postorbital head length (horizontal) 100–130, maxillary length 141–168, eye diameter 54–79, snout to dorsal origin 473–534, snout to anal origin 672–730, snout to pelvic base 431–504, snout to anterior pectoral base 220–264, longest dorsal ray (2nd or 3rd ray) 119–168, longest pectoral ray 114–145, maximum depth 152–208, least depth of caudal

peduncle 75–98, maximum width 112–140 (all measurements as thousandths of the standard length, based on 22 specimens).
Teeth fine, noncaninoid, uniserial on premaxillary, maxillary, and mandible, in small patches and rows on palatines and hyoids, reduced to asperities on vomer; head naked, skin rugose in parietal region; opercle and preopercle without spines; pseudobranchiae well developed; both surfaces of gill rakers finely denticulate; mouth relatively small; posterior tip of maxillary

smoothly rounded dorsally, truncate ventrally, failing to reach anterior margin of preopercle by $\frac{1}{2}$ – $\frac{2}{3}$ pupil diameter; posterior tip of mandible bluntly pointed, just reaching anterior edge of preopercle; ventral profile slightly curved, the ventral mid-line moderately compressed; scutes restricted to region between pectoral and pelvic fins, each with a posteriorly projecting spine and a riblike lateral ramus nearly reaching a pleural rib; caudal forked, the sixth ray from the top and bottom with a fleshy alar flap.

Scales deciduous, cycloid, with 11–13 radiating striae, the anterior 2 or 4 sometimes connecting centrally; anterior scale margin not crenulate; anterior half of scale with fine, parallel, dorsoventral grooves, posterior half with coarse crescentic grooves; an elongate alar scale above pectoral base, none (?) at pelvic base.

Ovarian eggs from a 49.3 mm. maturing female were oval and measured about 0.5 by 0.3 mm. These eggs were whitish and opaque and showed no signs of an oil globule when stained with Sudan IV.

Color in formalin straw or white with a silvery band lengthwise from eye to caudal base, band about $\frac{2}{3}$ eye diameter in width at eye and on caudal peduncle, but as wide as eye beneath dorsal fin; tips of snout and mandible blackish, a spray of fine black dots on occipito-parietal region; dorsalmost scale pockets margined in black, particularly on caudal peduncle; dorsal and caudal rays black-spotted, a row of 14 or 15 black spots along anal base.

In life *buccaneeri* is said to be purplish blue, in contrast to *purpureus* which is greenish or brownish.

AFFINITIES: Comparative material of the numerous species of *Stolephorus* was not avail-

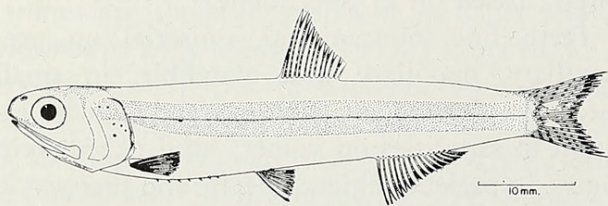


FIG. 2. Holotype of *Stolephorus buccaneeri*, new species (USNM no. 177742) from Lehua Island, Niihau, Hawaiian Islands.

TABLE 2
MEASUREMENTS, EXPRESSED IN THOUSANDTHS OF THE STANDARD LENGTH, MADE ON
Stolephorus buccaneeri

	HOLOTYPE	PARATYPE	PARATYPE
Standard length (mm.)....	53.3	49.8	55.3
Head length.....	250	215	230
Postorbital length of head.....	140	124	121
Eye diameter.....	67	60	54
Interorbital width.....	51	52	51
Snout length.....	46	48	49
Maxillary length.....	164	147	141
Maximum depth of body..	187	169	181
Least depth of body.....	79	76	78
Maximum width of body..	137	116	132
Snout to dorsal origin.....	529	488	528
Snout to anal origin.....	717	701	691
Snout to pectoral base.....	258	255	241
Snout to pelvic base.....	492	452	472
Longest dorsal ray.....	142	147	134
Longest pectoral ray.....	105	135	127
Sex.....	male	female	male

able, and the relationships of *buccaneeri* were determined almost solely from the literature. All nominal species referable to the genus (as defined above) were considered insofar as possible, but some poorly described forms could not be allocated, nor did descriptions always agree between authors. The authors cited below provided the information by which the species were separated. The order of presentation is not necessarily phylogenetic nor fully dichotomous.

Probably most distantly related to *buccaneeri* are those species of *Stolephorus* having the maxillary extending to the gill opening or nearly to it: *commersoni*, *waitei*, *rex*, *tri*, *baganensis*, and *insularis* (Jordan and Seale, 1926; Weber and de Beaufort, 1913; Fowler, 1941; Hardenberg, 1933*b*). Another distinctive group includes *evermanni* and *indicus*, both of which have the pectorals reaching or nearly reaching the pelvic bases (Jordan and Seale, 1906, 1926). According to Weber and de Beaufort (1913), the pectoral fins of *indicus* do not reach the pelvic base, but in their material the anal origin was below the middle of the dorsal base, whereas in *buccaneeri* the anal origin is slightly posterior to the rear of the dorsal base. *S. insularum*, *extensus*, *holodon*, *chinensis*, *nasuta*, and *aestuarium* differ from *buccaneeri* in having 20 or more anal rays (Jordan and Seale, 1926; Fowler, 1941);



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