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## SPINY LOBSTERS--IDENTIFICATION, WORLD DISTRIBUTION, AND U. S. TRADE

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### INTRODUCTION

The recent phenomenal increase in the commercial exploitation of spiny lobsters or rock lobsters in many parts of the world, particularly since the war, is reflected in the number of inquiries on the subject received by museum and fisheries specialists from importers, consumers, and fishermen. This brief survey of the species of spiny lobsters, their distribution and exploitation, is offered with the hope that it may answer some of the prevalent questions.

It is also hoped that information on the morphology and distribution of these crustaceans, received from those working with extensive series of fresh and frozen specimens, may appreciably increase the very incomplete data now available. The problem of shipping from all parts of the world and storing in museum collections specimens as large as adult spiny lobsters has curtailed the study of these forms to such an extent in the past that we know altogether too little of the variation, interrelation, and geographic distribution of many of the species. The names herein assigned to several of the species are therefore far from firmly fixed, and they may have to be replaced by others when additional data are available. The species from both sides of the North and South Atlantic are much better known than those from the Indo-Pacific region. Even the number of forms now recognized from the Indian and Pacific Oceans will probably have to be increased or decreased on the basis of information which will some day be accessible.

### BIOLOGY OF THE SPINY LOBSTER

STRUCTURE AND RELATIONSHIP: The spiny lobsters belong to that group of Crustacea known as the Decapoda; these ten-legged forms include most of the larger shelled arthropods familiar to fishermen: shrimps, lobsters, crabs and hermit crabs. Spiny lobsters are characterized by a large, inflated, and often spiny carapace or head shield covering the forward part of the body; a pair of stiff, thorny antennae or feelers extending from the head region; five pairs of walking legs; and a powerful abdomen, or tail, terminating in a flexible and somewhat leathery tail fan. They are readily distinguished from the true lobsters and freshwater crayfish by the absence of the large crushing claws characteristic of those animals as well as by the flexible rather than stiff tail fan. Whereas in the true lobsters the claws yield a considerable part of the edible flesh, the chief portion of the spiny lobster that is usually eaten is the muscular tail, and it is only this part of the animal that is normally seen by the distributor and consumer (Figure 1).

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**SEX:** The sexes of entire spiny lobsters can be distinguished easily by the form of the fifth or last walking leg. In the males, this leg ends in a single simple claw like those in front of it; in the female, on the other hand, it terminates in a pair of pincers which are used in caring for the eggs attached to the under surface of the tail.

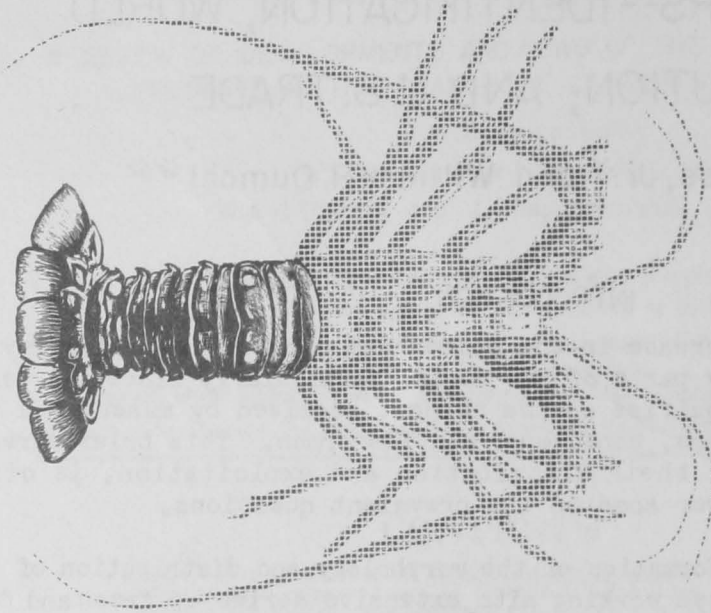


FIGURE 1 - SPINY LOBSTER (PANULIRUS ARGUS)

When the tail alone is available, the sexes can still be separated with little difficulty. In the males, the swimming legs on the under surface of the tail end in a single leaf-like joint. In the females, these legs end in two branches, both of those on the first pair being leaf-like, while the inner branch on the following legs is a rod-like joint to which the eggs are attached in berried specimens. Inasmuch as males are usually larger than females, the former are

likely to be more abundant in catches; fishermen usually prefer to fish those areas where the larger males are most common.

**GROWTH, SIZE, AND AGE:** The young spiny lobster goes through a series of peculiar larval stages before it settles to the bottom in its final form. The most peculiar and characteristic of these stages is the so-called phyllosoma stage. At this stage the young spiny lobster has the form of an extremely thin, flat, roughly circular, transparent disc somewhat more than an inch in diameter with eyes and legs protruding from the margins. After being carried about by currents near the sea surface, the young lobster undergoes a couple of moults and finally emerges on the ocean floor as a very small replica of its adult form. From this stage on, the spiny lobster grows by slow stages, shedding the shell and growing a slightly larger one periodically. There is little reliable information on the age of the various species at marketable size, and it is obvious that the rate of growth will vary somewhat with the food supply and the temperature of the water. From the meager data available, it is probable that females reach sexual maturity at a total length of four or five inches and an age of about three years, while males are not sexually mature until they are about nine inches long and correspondingly older. It is not improbable, therefore, that marketable specimens are upwards of five years old.

**FOOD:** Spiny lobsters are omnivorous feeders, eating practically any animal food they can find or capture and even occasionally ingesting seaweeds. Their normal food probably includes marine worms, mollusks, smaller crustaceans, and dead and dying organisms of all kinds. Although they are scavengers to a degree, experiments have shown that they prefer fresh to putrid food; traps baited with decaying meat or fish have sometimes been less effective than unbaited ones.

**DISTRIBUTION:** The various species of spiny lobsters are found throughout the tropical and subtropical seas of the world, as well as in certain temperate regions (Figure 2). It should not be assumed that they will be encountered in all parts of the shaded areas shown on the accompanying chart, but it is probable

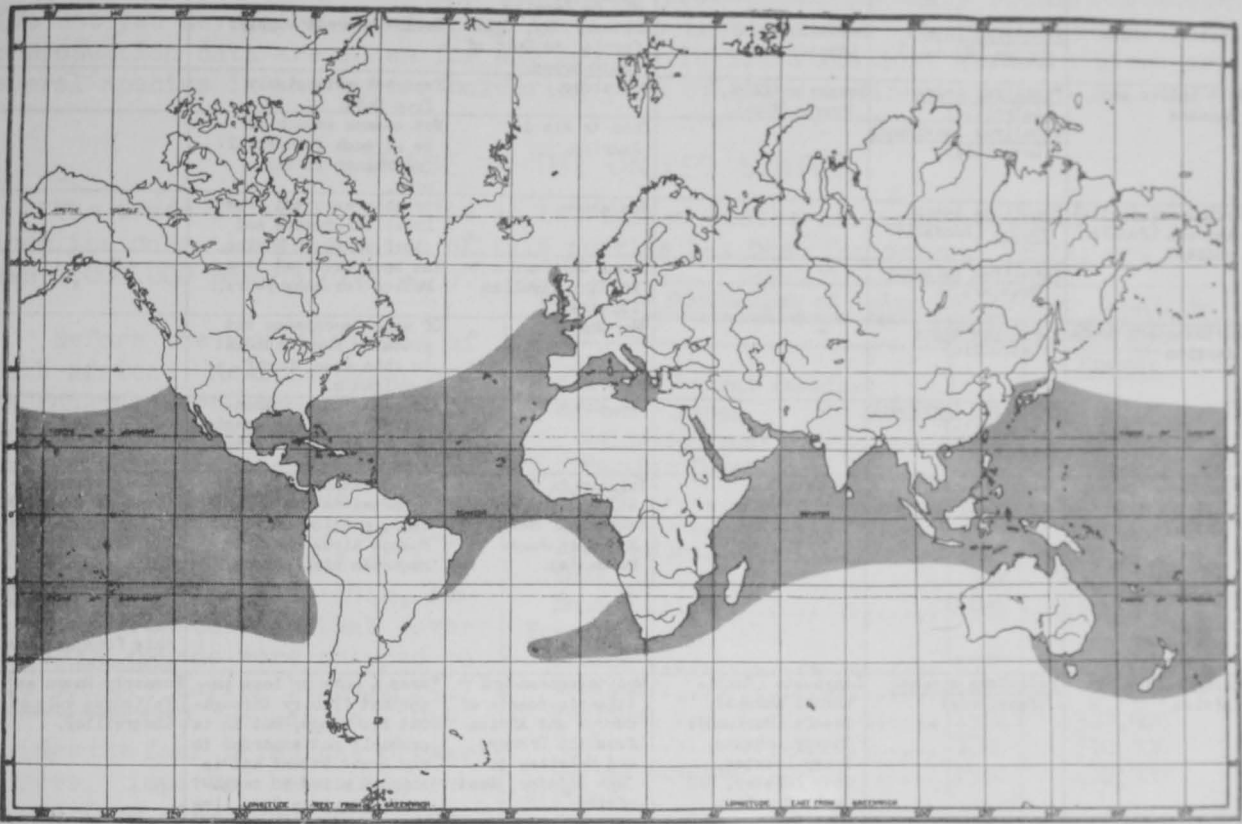


FIGURE 2 - THE DISTRIBUTION OF SPINY LOBSTERS (*PALINURIDAE*)

that they occur along most coasts in that zone wherever food is available and rocks or reefs are present to form suitable retreats. Although the adult spiny lobsters may migrate from place to place to a certain extent—sometimes covering considerable distances in a short time—their widespread distribution is largely accounted for by the dispersal of the pelagic larvae by ocean currents. Most of the species occur in tropical seas, but it is interesting to note that the form which is confined to the temperate regions of the southern hemisphere, *Jasus lalandei lalandei* (together with the subspecies *J. lalandei frontalis*), is the one that has formed the basis for much of the commercial exploitation up to the present time; it supports extensive fisheries in South Africa, South Australia, New Zealand, and Juan Fernandez. It is very possible that the increased demand for lobster tails will result in the early development of fisheries in areas not now fished commercially.

### WORLD PRODUCTION

The known species of spiny lobster which are now of economic importance throughout the world are listed in Table 1. Besides the geographic distribution, the scientific and common names and importance in commercial trade is indicated.

Data on production of spiny lobsters for many countries where they are used as food are not available as the catch figures for these crustaceans are not shown

Table 1 - Spiny Lobsters (Palinuridae) of Economic Importance

Geographic Region	Species	Common Name	Distribution	Economic Importance	Remarks
United States: Atlantic coast	<i>Panulirus argus</i> (Latreille)	Spiny Lobster; Crawfish; Sea Crawfish; etc.	Bermudas, Bahamas, West Indies, and Atlantic and Gulf coasts of Americas from Florida to Rio de Janeiro.	Demand greatly exceeds supply.	
Pacific coast	<i>Panulirus interruptus</i> (Randall)	Lobster; Spiny Lobster	Monterey Bay, California, to Gulf of Tehuantepec.	Demand exceeds supply.	
West Indies and Bahamas	<i>Panulirus argus</i> (Latreille)	Langosta (Cuba, Puerto Rico).	See above.	Exported extensively from Cuba.	
	<i>Panulirus laevicauda</i> (Latreille)	-	Cuba to Rio de Janeiro.	Not common enough to be of much commercial importance in this area.	
Mexico and Central America (Pacific coast)	<i>Panulirus interruptus</i> (Randall)	-	See above.	Probably exported from Lower California and other parts of Mexico.	
	<i>Panulirus inflatus</i> (Bouvier)	-	Lower California to Panama; Hawaiian Islands.	Has been exported from Mexico for many years.	
Northeastern South America	<i>Panulirus argus</i> (Latreille)	-	See above.	Of some importance but probably less abundant in this area than <i>P. laevicauda</i> .	
	<i>Panulirus laevicauda</i> (Latreille)	-	See above.	Apparently the commonest of the three species caught along the Brazilian coast.	
Juan Fernandez (off coast of Chile)	<i>Jasus lalandei frontalis</i> (H. Milne Edwards)	Langosta.	Tristan da Cunha; St. Paul Is.; Tasmania; New Zealand; Juan Fernandez.	Caught extensively and exported to the mainland, particularly to Buenos Aires where it commands high prices.	Although very distinct at the limits of its range, from the South African and Australian form, <i>J. lalandei lalandei</i> , it is not yet certain that this form is a valid subspecies.
Europe and North Africa	<i>Palinurus elephas</i> (Fabricius)	Langouste (Continental Europe); Kreeft (Holland); Thorny Lobster, Spiny Lobster, Rock Lobster, Red Crab, Crawfish, Long Oyster (British Isles).	Mediterranean and Atlantic coasts of Europe and Africa from the Orkneys and Hebrides to Cape Bojador, West Africa.	Forms a more or less important fishery throughout its range, but it is probably not exported to any great extent and is shipped alive to neighboring markets from live cars, in which the spiny lobsters may be kept for two or three months.	Formerly known as <i>Palinurus vulgaris</i> (Latreille).
West and South Africa	<i>Jasus lalandei lalandei</i> (H. Milne Edwards)	Cape Crawfish, Crayfish; Crawfish; Kreef; Kreeft.	Cape Cross, West Africa, to Algoa Bay, South Africa; southeast Australia from Pt. Stephen, New South Wales, to Reevesby Is., South Australia.	Very common and forming an important fishery in the vicinity of Capetown, as well as at two large canneries at Houtbay and Hoetgesbay in Sandanah Bay. Exported both canned and frozen to Europe and America.	
	<i>Panulirus rissonii</i> (Desmarest)	Royal Langouste (France)	Western Mediterranean; west coast of Africa from Cape Barbas to Mossamedes and Praya Amelia, Angola; Cape Verde Islands.	Caught by French boats and brought into French markets where it is well known and esteemed despite attempted boycott.	Formerly known as <i>Panulirus regius</i> (Brito Capello).
Indo-Pacific Region	<i>Panulirus japonicus</i> (Von Siebold)	Spiny Lobster (Japanese authors).	East Africa to Japan; Polynesia.	This species does not seem to attain a large size, but it is used by the Japanese in preserves as well as fresh; it is of considerable commercial importance along the southeast coasts of the main islands of Japan.	
	<i>Panulirus polyphagus</i> (Herbst)	-	Mauritius and India; Malay Archipelago; Indochina; Japan; Polynesia.	This species seems to be the only one of commercial importance in the Calcutta area.	Frequently referred to as <i>Panulirus fasciatus</i> (Fabricius).
	<i>Panulirus ornatus</i> (Fabricius)	-	Red Sea and South Africa to Formosa and Polynesia.	Said to be very common on the coast of Madagascar, where it is sold to Europeans but never eaten by the natives.	
Australia	<i>Jasus lalandei lalandei</i> (H. Milne Edwards)	-	See above.	Exported in large quantity to the United States.	
	<i>Jasus verreauxii</i> (H. Milne Edwards)	Sydney Crawfish.	New South Wales; Tasmania; New Zealand.	The common form in the markets of Sydney; it is shipped alive to other Australian cities.	Formerly referred to as <i>Palinurus hügellii</i> (Heller).
Tasmania and New Zealand	<i>Jasus lalandei frontalis</i> (H. Milne Edwards)	Crayfish.	See above.	Caught in considerable numbers in New Zealand and exported in some quantity to the United States.	See above.



separately. Some idea of the production is possible, however, from the exports for some of those countries. While Table 2 is based on data from the FAO Yearbook of Fisheries Statistics, 1947, as well as consular reports of the State Department, it does not necessarily show the potential production for many countries which have not yet developed the fishery for these crustaceans. It will be noted that no production data are shown for any country in South America, although there are several species in the waters bordering part of this continent (Figure 2).

### TRADE IN THE UNITED STATES

The trade in spiny lobsters in the United States is based mainly on imports, since the domestic production of this species has been for several years, not more than 1,000,000 pounds (Table 3).

Before the war, the Union of South Africa, Mexico, Cuba, and the Bahamas were the only shippers of fresh and frozen "lobsters" (spiny lobster). The imports reached a maximum of 5.6 million pounds in 1941. By 1945, this dropped to around 3.3 million pounds. Starting with 1946, imports increased so that over 6,000,000 pounds were shipped to this country during 1946 and 1947 and 7,755,000 pounds in 1948. Besides the four principal prewar sources, imports have been received from nine other countries. Australia, within the past year, has entered the export market with frozen spiny lobster tails and is now in fourth position as shipper to this country. The large proportion of the imports of frozen spiny lobster tails has been from South Africa and Australia, with some from Cuba and the Bahamas. Whole spiny lobsters—live, boiled, and iced—are imported from nearby islands and countries. The import data do not separate the tails from whole spiny lobsters. However, it is known that all the imports from the Union of South Africa, Australia, and New Zealand are tails. As the tail represents about one-third of the live animal, the imports from these three countries, although only 40 percent of the total import weight, represent nearly 10,000,000 pounds of live spiny lobsters, or over two times the combined imports from all the countries of the western hemisphere.

The South African tails are generally individually wrapped in cellophane before freezing. After grading into sizes, they are packed in flat slat boxes, holding 20 pounds each. The sizes are:  $\frac{1}{2}$ -pound to  $\frac{3}{4}$ -pound;  $\frac{3}{4}$ -pound to 1-pound; and over 1-pound.

Table 2 - Production of Spiny Lobsters by Countries

Country	Year	Production Pounds
<b>North and Central America:</b>		
<b>United States:</b>		
Atlantic Coast .....	1944	463,000
Pacific Coast .....	1944	513,000
Mexico .....	1947	3,000,000
Guatemala .....	1947	200,000
Br. Honduras .....	1947	700,000
Cuba .....	1945	6,700,000
Bahama Islands .....	1947	1,400,000
<b>Europe:</b>		
France .....	1937	710,000
Ireland .....	1946	30,000
Portugal .....	1944	383,500
Spain .....	1946	720,000
United Kingdom .....	1946	400,000
<b>Africa:</b>		
Algeria .....	1940	62,500
Fr. Morocco .....	1938	66,000
Tunisia .....	1939	40,000
Union of So. Africa and Southwest Africa .....	1947	25,000,000 <sup>1/</sup>
Mauritius .....	1947	50,400
Australia .....	1946	4,577,000
New Zealand .....	1947	1,985,700
Japan .....	1946	4,850,000
<sup>1/</sup> Production limited by Union of South Africa to 6,000,000 lbs. of tails for canning or freezing for export. This is equivalent to 18 million lbs. of whole spiny lobsters. Local consumption is around 2 million lbs., while the production in Southwest Africa is estimated to be around 5 million lbs.		

The shipment of fresh, frozen, and cooked spiny lobsters from Mexico, Cuba, and the Bahamas is dependent on the legal seasons in those countries. The large

Country of Origin	1948	1947	1946	1945
	Lbs.	Lbs.	Lbs.	Lbs.
Mexico .....	2,052,491	1,920,442	1,671,234	1,072,935
Honduras .....	6,606	-	-	-
Br. Honduras .....	136,264	157,538	79,220	-
Nicaragua .....	406	-	-	-
Bahamas .....	1,197,821	1,371,701	1,271,677	1,487,634
Cuba .....	1,150,792	425,201	250,100	353,881
Jamaica .....	7,150	53,376	-	-
Leeward Islands .....	2,085	13,587	3,500	-
Curacao .....	-	1,878	-	-
Fr. W. Indies .....	-	7,040	7,004	-
Australia .....	514,290	97,482	-	-
New Zealand .....	30,410	29,256	-	-
Union of So. Africa ...	2,657,178	2,236,780	2,564,345	433,600
Total .....	7,755,493	6,314,281	6,847,080	3,348,050

proportion of the imports from Mexico are shipped during the months of November to March (Table 4). The season for the Bahamas runs from October to March, while Cuba's shipping period is longer—July to December with smaller amounts coming in during January, February, and March. Shipments of frozen spiny lobster tails from South Africa may be made throughout

the year. The bulk of the shipments were made from December to May in 1947, but in 1948, there was no outstanding month.

In prewar years, over 400,000 pounds of canned spiny lobster meat from Cuba, Union of South Africa, and the British West Indies were imported into the United

Table 4 - Monthly Index of U. S. Imports of Spiny Lobster Tails (From the Principal Countries)

Country From Which Imported	Quantity Imported in 1948 (lbs.)	Percent Received per Month, 1948												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Mexico .....	2,082,491	22	26	14	1	1	1	1	1	1	2	12	18	100
Br. Honduras ...	136,264	20	1	-	2	12	-	3	-	-	12	44	6	100
Bahamas .....	1,197,821	7	19	16	3	-	-	-	-	-	9	28	18	100
Cuba .....	1,150,892	2	4	5	1	4	5	8	9	10	19	17	16	100
New Zealand ....	30,410	3	-	13	-	1	-	-	7	20	-	56	-	100
Australia .....	514,290	-	-	38	7	4	21	-	-	21	-	1	8	100
Union of So. Africa .....	2,657,178	-	16	11	6	10	-	15	1	10	5	13	13	100
Total .....	7,755,593	7	16	13	4	5	21	7	2	7	7	15	15	100

Note: Honduras, Nicaragua, Jamaica, and Leeward Islands were not included in the index since their shipments were insignificant.

States. During 1945 and 1946, Cuba was the only shipper and exported to the United States over 450,000 pounds of canned meat. The imports dropped drastically in 1947 when only 136,509 pounds of spiny lobster meat entered this country. However, imports for 1948 were over two times the 1945 imports and amounted to 1,037,710 pounds, with South Africa again assuming the position of the leading country. Small quantities were shipped from New Zealand, Guatemala, and China (Table 5).

Country of Origin	1948	1947	1946	1945
	Lbs.	Lbs.	Lbs.	Lbs.
Cuba .....	294,546	122,359	461,529	459,375
Guatemala .....	1,238	-	-	-
New Zealand .....	19,175	12,825	-	-
Union of So. Africa .....	722,151	1,325	-	-
China .....	600	-	-	-
Total .....	1,037,710	136,509	461,529	459,375

Since the tail of the spiny lobster (Figure 1) is often the only part seen in the wholesale and retail markets in many sections of the United States, a key to identify the tails has been worked up.

### IDENTIFICATION OF SPINY TAILS

The following tentative key to the identification of spiny lobster tails may be of assistance to the commercial fishing industry in determining the area from which a particular shipment of fresh or frozen tails was exported. Inasmuch as it is subject to the errors and limitations mentioned above in the introductory remarks, the key should be used with some caution.

Included in this key are all the species of spiny lobsters usually recognized today, with the exception of those of the genus Puerulus; the identification of the latter from tails alone is impractical, and the four known forms are not sufficiently common to be of commercial importance. Most of the species covered here will never be encountered in commercial catches because of their rarity. They are included only because one or two of these scarce forms might appear in a shipment and give a clue to the original locality not provided by the predominant species. For instance, there is no simple way of distinguishing a shipment of Jasus lalandei lalandei from South Africa from a lot of the same form from Australia. If, however, a tail of Panulirus homarus (a South African species) or of Jasus verreauxii (an Australian form) happened to be included, the exporting country could be determined with some assurance.

For the benefit of those unfamiliar with taxonomic keys of this kind, the following remarks are offered. It will be seen that the key is composed of numbered couplets of more or less contradictory statements. To identify a particular spiny lobster tail, one begins with the first couplet and selects the statement which describes the specimen at hand. Proceed to the couplet number indicated at the end of the appropriate statement and continue in the same manner until a species name is reached. The numbers in parentheses indicate the previous couplet used in each case so that, when it is obvious that the wrong choice has been made at some point, steps can be retraced to the questionable couplet without starting at the beginning once more.

The authors are well aware of the presence of errors and deficiencies in this key. Changes suggested by those using it will be gratefully received. Such corrections and additions, based on the examination of much more material than can be accommodated in even the larger museum collections, can materially advance our meager knowledge of the systematic relationship and distribution of spiny lobsters.

TENTATIVE KEY TO THE TAILS OF SPINY LOBSTERS (PALINURIDAE)  
WITH THE EXCEPTION OF THE GENUS PUERULUS<sup>1/</sup>

Species marked (\*) are known to be of commercial importance (see Table 1).

Species marked (+) are probably of some commercial importance because of their size and abundance, although definite confirmation is lacking.

Species marked (#) are probably of no commercial importance because of their small size or rarity.

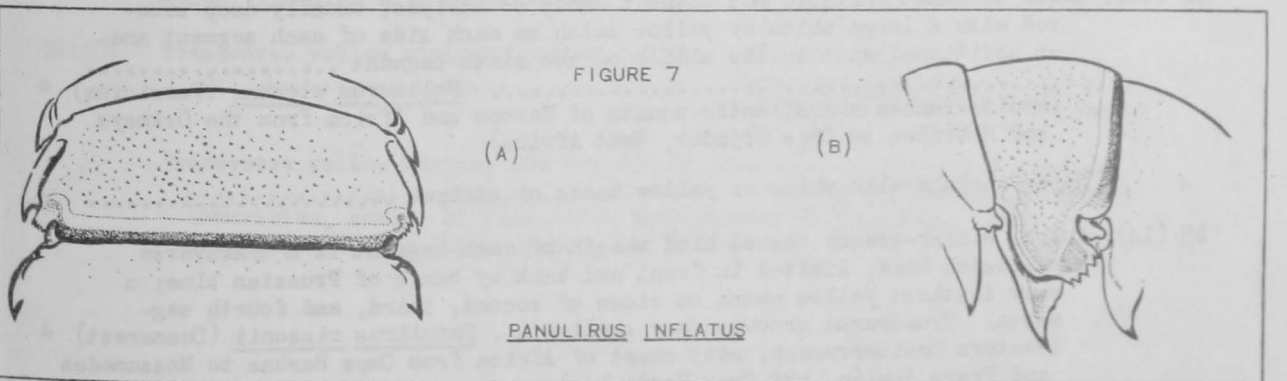
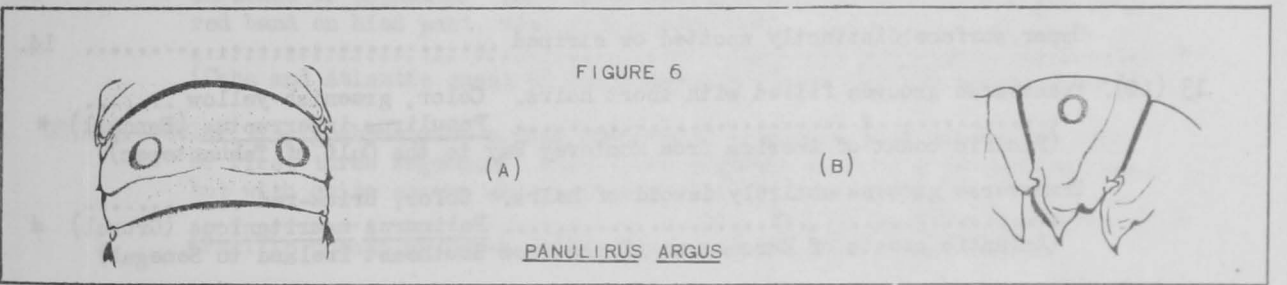
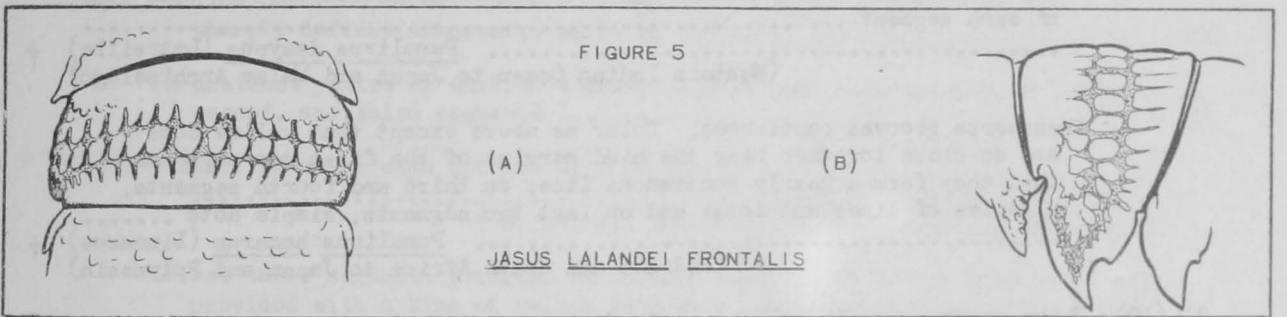
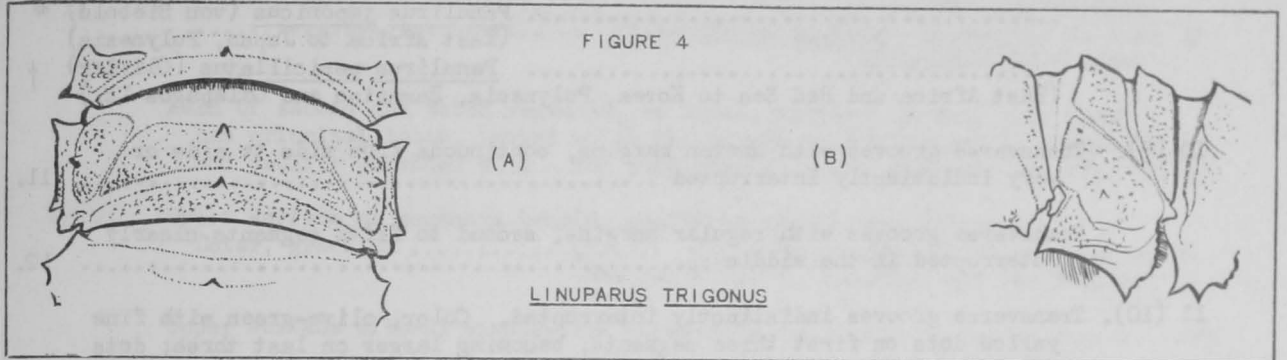
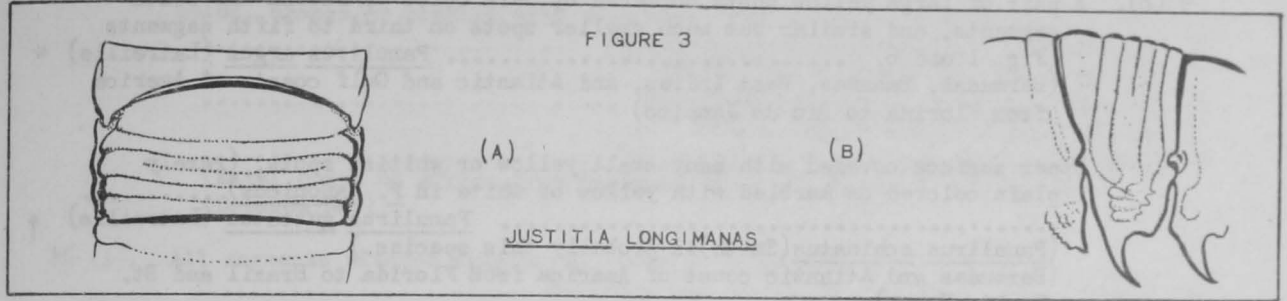
1. One or more transverse grooves on each of first five segments ..... 2.
- No transverse grooves on any segments (Fig. 7a) ..... 16.

<sup>1/</sup>Identification of this species from the tails alone is impractical.



- 2 (1). Four transverse grooves on second to fifth segments (Fig. 3a). Each segment produced on each side into one well-developed tooth and, behind it, a shorter one which may have a few very small teeth or denticles on the hind margin (Fig. 3b). Color, brick red with yellowish stripes and dots .....  
 ..... Justitia longimana longimana (H. Milne Edwards) ≠  
 ..... (West Indies)  
 ..... Justitia longimana mauritiana (Miers) ≠  
 ..... (Mauritius)  
 Not more than one or two transverse grooves on second to fifth segments ... 3.
- 3 (2). Two transverse grooves on second to fifth segments, forward groove of each segment continuous from side to side, the hind one interrupted in the middle. Each segment produced on each side into two curved teeth, the forward one being the larger. Color, reddish to yellowish-brown .....  
 ..... Palinustus truncatus (H. Milne Edwards) ≠  
 ..... (West Indies)  
 ..... Palinustus mossembicus (Barnard) ≠  
 ..... (Portuguese East Africa and Sulu Sea)  
 Only one transverse groove on each of first five segments (Fig. 4)..... 4.
- 4 (3). Each segment provided on each side with three nearly equal teeth and one or two smaller ones behind them (Fig. 4b). A lengthwise ridge at middle of each segment (Fig. 4a). Transverse grooves on first to third segments continuous from side to side, those on the other segments interrupted by the ridge. Color, yellowish with brick-red tint on the upper surface ...  
 ..... Linuparus trigonus (von Siebold) ≠  
 ..... (Japan, Formosa)  
 Each segment produced on each side into not more than two principal teeth, often with much smaller teeth or denticles behind them ..... 5.
- 5 (4). Each segment produced on each side into two principal unequal teeth (Fig. 5b) ..... 6.  
 Each segment produced on each side into one principal tooth, behind which the margin of the segment is rounded and often provided with several much smaller teeth or denticles (Fig. 7b) ..... 10.
- 6 (5). Upper surface more or less covered with prominent scale-like ornamentations (Fig. 5a). Color, reddish-brown ..... 7.  
 Upper surface largely smooth, without scale-like ornamentation ..... 8.
- 7 (6). Scale-like ornamentation covering nearly all of upper surface except in the transverse grooves .....  
 ..... Jasus lalandei lalandei (H. Milne Edwards) \*  
 (Cape Cross (West Africa) to Algoa Bay (South Africa) and southeast coast of Australia from Pt. Stephen (New South Wales) to Reevesby Is. (South Australia))  
 Broad, smooth regions devoid of scale-like ornamentation along forward and hind margins of each segment and on entire forward half of first segment (Fig. 5) .....  
 ..... Jasus lalandei frontalis (H. Milne Edwards) \*  
 (Juan Fernandez, New Zealand, Tasmania, St. Paul Is., and Tristan da Cunha)
- 8 (6). Color reddish or plum-colored with a broad yellow transverse band on each segment in the region of the transverse groove .....  
 ..... Pamulirus japonicus marginatus (Quoy & Gaimard) †  
 ..... (Hawaiian Islands)  
 Upper surface without stripes, usually spotted, occasionally plain ..... 9.





- 9 (8). A pair of large yellow spots bordered by dark color on second and sixth segments, and similar but much smaller spots on third to fifth segments (Fig. 1 and 6) ..... Panulirus argus (Latreille) \*  
(Bermudas, Bahamas, West Indies, and Atlantic and Gulf coasts of America from Florida to Rio de Janeiro)
- Upper surface covered with many small yellow or whitish spots, (rarely plain colored or marbled with yellow or white in P. japonicus) .....  
..... Panulirus guttatus (Latreille) †  
(Panulirus echinatus (Smith) is probably this species.)  
(Bermudas and Atlantic coast of America from Florida to Brazil and St. Paul's Rocks)
- ..... Panulirus japonicus (von Siebold) \*  
(East Africa to Japan, Polynesia)
- ..... Panulirus penicillatus (Olivier) †  
(East Africa and Red Sea to Korea, Polynesia, Hawaiian and Galapagos Is.)
- 10 (5). Transverse grooves with uneven margins, continuous from side to side or very indistinctly interrupted ..... 11.
- Transverse grooves with regular margins, second to fifth segments clearly interrupted in the middle ..... 12.
- 11 (10). Transverse grooves indistinctly interrupted. Color, olive-green with fine yellow dots on first three segments, becoming larger on last three; dots not forming lines near hind margins of segments; yellow spot on each side of each segment .....  
..... Panulirus dasyopus (Latreille) †  
(Western Indian Ocean to Japan and Malay Archipelago)
- Transverse grooves continuous. Color as above except that yellow dots are so close together near the hind margins of the first two segments that they form a nearly continuous line; on third and fourth segments, a series of lines and dots; and on last two segments, simple dots .....  
..... Panulirus homarus (Linnaeus) †  
(Red Sea and South Africa to Japan and Polynesia)
- 12 (10). Upper surface evenly colored, not spotted or striped ..... 13.
- Upper surface distinctly spotted or striped ..... 14.
- 13 (12). Transverse grooves filled with short hairs. Color, greenish-yellow .....  
..... Panulirus interruptus (Randall) \*  
(Pacific coast of America from Monterey Bay to the Gulf of Tehuantepec)
- Transverse grooves entirely devoid of hairs. Color, brick-red .....  
..... Palinurus mauritanicus (Gruvel) †  
(Atlantic coasts of Europe and Africa from Southeast Ireland to Senegal)
- 14 (12). Color somewhat variable but without bands or stripes, usually deep wine-red with a large white or yellow patch on each side of each segment and an additional spot in the middle of the sixth segment .....  
..... Palinurus elephas (Fabricius) \*  
(Mediterranean and Atlantic coasts of Europe and Africa from the Orkneys and Hebrides to Cape Bojador, West Africa)
- Upper surface with white or yellow bands or stripes ..... 15.
- 15 (14). Color, bluish-green; toward hind margin of each segment is a transverse yellowish band, limited in front and back by bands of Prussian blue; a very distinct yellow patch on sides of second, third, and fourth segments. Transverse grooves very shallow ... Panulirus rissonii (Desmarest) \*  
(Western Mediterranean, west coast of Africa from Cape Barbas to Mossamedes and Praya Amelia, and Cape Verde Is.)

- Color, orange or pinkish with transverse stripes of yellowish-white .....  
 ..... Palinurus gilchristi gilchristi (Stebbing) #  
 (False Bay to Algoa Bay, South Africa)
- ..... Palinurus gilchristi delagoae (Barnard) #  
 (Delagoa Bay, Portuguese East Africa)
- ..... Palinurus gilchristi natalensis (Barnard) #  
 (Natal coast of Africa from Umkomaas River to Tugela River, and off  
 Delagoa Bay)
- 16 (1). All segments without side teeth, nearly rectangular .....  
 ..... Palinurellus gundlachi gundlachi (von Martens) #  
 (Cuba and Barbados)
- ..... Palinurellus gundlachi wienecki (de Man) #  
 (Mauritius and Sumatra)
- Each of second and third segments, at least, produced on each side into  
 one principal tooth, behind which the margin of the segment is rounded  
 and usually provided with a few much smaller teeth or denticles (Fig. 7b) 17.
- 17(16). Upper surface of segments bearing scattered pimple-like elevations.  
 Color, greenish ..... Jasus verreauxii (H. Milne Edwards) \*  
 (New South Wales, Tasmania, and New Zealand)
- Upper surface without pimple-like elevations ..... 18.
- 18(17). Yellow color on dorsal surface restricted to spots or marbling, no  
 sharply defined transverse bands of yellow ..... 19.
- A distinct yellow or whitish transverse band near hind margins of first,  
 second, and third segments ..... 20.
- 19(18). Color, greenish with patches of blue and yellow .....  
 ..... Panulirus ornatus (Fabricius) \*  
 (Red Sea and South Africa to Formosa and Polynesia)
- First three segments greenish on forward part, dirty red on hind part, and  
 provided with a line of yellow dots very near hind margin; yellow spots  
 on sides of segments. Last three segments dull green with a broad deep  
 red band on hind part, also with yellow dots .....  
 ..... Panulirus laevicauda (Latreille) \*  
 (Cuba and Atlantic coast of South America from French Guiana to Brazil)
- 20(18). Color, indigo-blue with a fine transverse line near hind margins of each  
 of first three segments. Last three segments without a transverse line,  
 but with quite strong and regularly placed yellow spots (Fig. 7) .....  
 ..... Panulirus inflatus (Bouvier) \*  
 (Pacific coasts of Lower California and Panama, and Hawaiian Is.)
- Color, greenish with transverse yellow stripes on all segments ..... 21.
- 21(20). Transverse yellow stripes bounded by blue on either side .....  
 ..... Panulirus versicolor (Latreille) #  
 (East Africa to Japan and Polynesia)
- Transverse yellow stripes not bounded by blue .....  
 ..... Panulirus polyphagus (Herbst) \*  
 (Mauritius, coasts of India from Baluchistan to Singapore, Malay  
 Archipelago, Indo-China, Japan, and Polynesia)



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