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A review of the razorfishes (Perciformes: Labridae) of the eastern Pacific Ocean

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Abstract: Several new species of the razorfish genus *Xyrichtys* have been discovered recently in the tropical eastern Pacific region. The taxonomy of this group of fishes is not clear, since juveniles, females, and males often have different color patterns and morphologies, and some species descriptions are incomplete. We review the members of this genus in this region based on our recent collections and describe the juvenile, initial, and terminal phase color patterns of the Cape razorfish, *Xyrichtys mundiceps*. We question the validity of *Xyrichtys perlas*, which appears to represent the initial phase of *X. mundiceps*. We conclude that six species of *Xyrichtys* are present in the tropical eastern Pacific, including one undescribed species we have collected from the Galapagos Islands and one uncollected new species from the Revillagigedos Islands. *Xyrichtys mundiceps* is found in Baja California and in Panama. *Xyrichtys pavo* is a large species found throughout the Indo-Pacific and eastern Pacific. *Xyrichtys victori* is a colorful species native to the Galapagos and Cocos Islands, and *Xyrichtys wellingtoni* is apparently endemic to Clipperton Atoll. The undescribed species is known only from the Galapagos Islands and has a dark-colored juvenile with extended first dorsal fin rays that are not separated from the remainder of the fin. The terminal phase of this species is unknown. We present keys to the known juvenile and initial phase stages of five species. In addition, we document the allometric growth of the head of razorfishes and show that the head shape of small individuals of *Xyrichtys* razorfishes is no different from that of the razorfish genus *Novaculichthys*, and therefore we suggest caution in using this character to distinguish these genera.

Keywords: razorfish, taxonomy, wrasses, labridae, *Xyrichtys*, Pacific, review

The razorfishes comprise an interesting and unusual sub-group of wrasses (family Labridae) that are adapted to living on sandbeds, usually adjacent to reefs, and diving directly into the sand for refuge. The group is made up of several genera, including the small or monotypic genera *Ammolabrus*, *Cymolutes*, and *Novaculichthys* and a large genus, *Xyrichtys*, with many species found in all tropical oceans (Randall 1965, Randall and Carlson 1997, Masuda et al. 1984, Shen and Yeh 1987). The razorfishes have had a turbulent recent taxonomic past that has included changes in the nomenclature of genera and the discovery of many undescribed species, particularly in Hawaii, the central Indo-Pacific region, and in the eastern Pacific Ocean. Most of the razorfishes originally were placed in the genus *Hemipteronotus* (Randall 1965), however that name has been suppressed, and *Xyrichtys* (Cuvier, 1814) is now appropriate (Randall and Bauchot 1993;

nota bene not *Xyrichthys*). The number of razorfish species known from the tropical eastern Pacific region has recently doubled, from three to at least six species, and some species are either undescribed or described only from initial phase individuals, leading to some confusion about the true composition of the group.

Razorfishes are named after their most conspicuous attribute: a thin laterally compressed body with a blunt snout. This body form allows them to dive into the sand and travel through it rapidly. Most species are apparently haremic, with sex-changed large males dominating a number of local females (Clark 1983, Nemtzov 1985, Victor 1987a, Wellington 1992). The biogeography of the group is also remarkable. *Xyrichtys pavo* (Valenciennes, 1840) and *Novaculichthys taeniourus* (Lacepede, 1801) range from East Africa to Panama while others are apparently endemic to a single island, such as *Xyrichtys wellingtoni* (Allen and Robertson, 1995) at Clipperton Atoll in the eastern Pacific. Furthermore, they have generally long-lived larvae (up to several months) which can be found far out in the open ocean (Victor 1986, 1987b).

Several features of razorfishes, and in particular of the genus *Xyrichtys*, complicate species recognition and classification. One is the lack of meristic characters that differentiate species: indeed, many can be separated only by color patterns, which often do not persist in preserved specimens. Another is that juveniles, females, and males often have different color patterns as well as different shapes. Finally, these fishes are difficult to find in the field and sometimes very difficult to capture, leading to poor representation in collections and descriptions that often do not include juvenile, initial (IP), and terminal phases (TP). With the meristic similarities among species, the color patterns, both in life and preserved, become important characters for separating species. The color patterns of three recently described species have been well documented: *Xyrichtys victori* (Wellington, 1992), *Xyrichtys perlas* (Wellington, Allen and Robertson, 1994), and *X. wellingtoni* in Allen and Robertson (1995). *Xyrichtys mundiceps* (Gill, 1862) however, was originally described based on IPs after preservation (i.e. brown) and subsequently incompletely described (TP coloration in Jordan and Evermann (1898) and Thomson et al. (1979)) or erroneously described (IPs as plain without markings, in Jordan and Evermann (1898)).

In this paper we describe the coloration of the Cape razorfish *X. mundiceps* from our collections and evaluate the state of knowledge of the eastern Pacific razorfishes of the genus *Xyrichtys,* as well as provide a key to the known juveniles and initial phase individuals of the genus from the region. We question the validity of the recently described *X. perlas* and comment on a newly-discovered species from the Galapagos Islands and an uncollected species from the Revillagigedos Islands. Finally, we discuss some of the current confusion on generic classification of the eastern Pacific razorfishes and present some data comparing allometric growth of the head of *Xyrichtys* and *Novaculichthys* species in the region.

Material Examined

Xyrichtys mundiceps examined included SIO 87-19, 153 mm SL (one specimen), Bahia Magdalena, Baja California (BC); SIO 62-271-50; 27-51 mm SL (7), East Cape BC; UCLA W73-2,3,4, and 5, 17-108 mm SL (25), Los Frailes BC; personal collection BV-7-25-99, 32-111 mm SL (10), Punta Tecolote BC. *Xyrichtys pavo* examined included LACM 43975-3, 92 mm SL (1); LACM 6509-13, 59-152 mm SL (2); UCLA W59-251, 53-154 mm SL (6), Punta Pescadero BC; personal collection BV-11-17-82, 21 mm SL (1), Perlas Islands, Panama; BV-1-12-95, 198 mm SL (1), Genovesa, GI; BV-5-30-98, 12-28 mm SL (5), South James Bay, Galapagos Islands (GI); BV-6-1-98, 14 mm SL (1) Genovesa, GI. *Xyrichtys perlas* examined included CAS 76101, 38-41 mm SL (2), Perlas Islands, Panama; LACM 45903, 28-33 mm SL (2), Perlas Islands Panama. *Xyrichtys victori* examined included LACM 451371, 21-26 mm SL (2), Marchena, GI; personal collection BV-4-10-90, 24-138 mm SL (5), Marchena GI; BV-1-11-93, 103-143 mm SL (4), Marchena, GI; BV-1-10-95, 105-115 mm SL (2) Marchena, GI. *Xyrichtys wellingtoni* examined included personal collection GW-4-22-94, 22-29 mm SL (6), Clipperton Atoll. Information and measurements from pho-

tographs of NMNH 337445, 51 mm SL (1), Clipperton Atoll.; WAM P.30994-001, 64.7 mm SL (1), Clipperton Atoll. *Xyrichtys n. sp.* G examined included personal collection BV-4-9-90, 27-35 mm SL (3), Genovesa, GI; BV-1-12-95, 18-48 mm SL (2) Genovesa, GI. *Novaculichthys taeniourus* examined included LACM 31579-45, 57-107 mm SL (5), Isla Cano, Costa Rica; LACM 43929-1, 16-148 mm SL (3), Hood Island GI; SIO 56-138, 105 mm SL (1); SIO 59-225, 28 mm SL (1); SIO 61-239, 87 mm SL (1); SIO 61-243, 59 mm SL (1); SIO 61-252, 90 mm SL (1); personal collection BV-6-1-98, 11-54 mm SL (7), Genovesa, GI; BV-6-9-98, 17 mm SL (1), Bartolome, GI.

Xyrichtys mundiceps (Gill)

Color Description

Color in life (Fig 1): Juveniles are pale brown and show a faint barred pattern with five wide darker bars; the first under the origin of the dorsal fin and the last on the caudal peduncle. The median fins are tinged red, especially along the rays. The iris is gold with an irregular red ring around the pupil. There is a prominent thin blue line down the midline of the snout starting on the first dorsal spine and extending down to the tip of the upper jaw. There is a red wash over the tip of the snout and around the mouth, followed by yellow coloration below and around the eye and extending into a yellow patch from the eye posteriorly to the mid-anterior body. There is a vertical crescent-shaped translucent window posterior to the preopercular region which hence appears darker. The remaining surface of the preopercle, opercle, and abdominal wall extending to the anus exhibit an opaque reflective white that extends onto the pelvic fins.

Initial-phase fish are orange-red with the median fins darker red. Each scale on the body has a lighter posterior edge leaving a diamond-shaped darker red central portion. The cheek below the eye is paler orange, with a yellow wash. The iris is gold with a variably present irregular red ring around the pupil. There is a prominent thin blue line down the midline of the snout starting at the tip of the first dorsal spine and extending down to the tip of the upper jaw. The thin blue line reappears for a short segment at the ventral midline at the isthmus. There are several faint yellow bands running across the ventral midline from the tip of the lower jaw to the isthmus. There is a yellowish area starting at the superior posterior corner of the eye extending back and widening to occupy the mid-lateral portion of the anterior body above the pectoral fin. There is a crescent-shaped translucent window around the preopercular region which hence appears darker. The remaining surface of the preopercle, opercle, and abdominal wall extending to the anus exhibit an opaque reflective white that extends onto the pelvic fins.

Terminal-phase males are grey-green with blue and yellow markings. There is a thin blue line down the midline of the snout starting at the tip of the first dorsal spine and extending down to the tip of the upper jaw. The line picks up again at the anterior isthmus at the midline of the lower jaw and runs along the ventral midline to the origin of the pelvic fins. There is a blue line along the outer edge of each of the pelvic fins. Several (five to eight) thin blue lines, some discontinuous, run vertically on the cheek from the level of the eye down towards the ventral midline where they merge with a pattern of thicker reticulated blue lines against a yellowish background that extends along the lower jaw, the ventral midline, over the pelvic fins and covers all of the median fins. Irregular blue short lines and spots cover the opercular region and the body forward of the pectoral base and merge with the pattern of blue on the scales of the body.The iris is gold with a blue patch on the posterior portion. There is a prominent short blue line running along the base of the pectoral fin at the insertion of the pectoral fin rays. The dorsal and anal fins continue the pattern of reticulating blue lines against a yellow background, roughly approximating the scale rows in number and placement. The caudal fin has about five relatively thick vertical blue lines against a yellow background.

Each body scale has bright blue markings on the anterior-most exposed portion of the scale that often outlines the edge of the

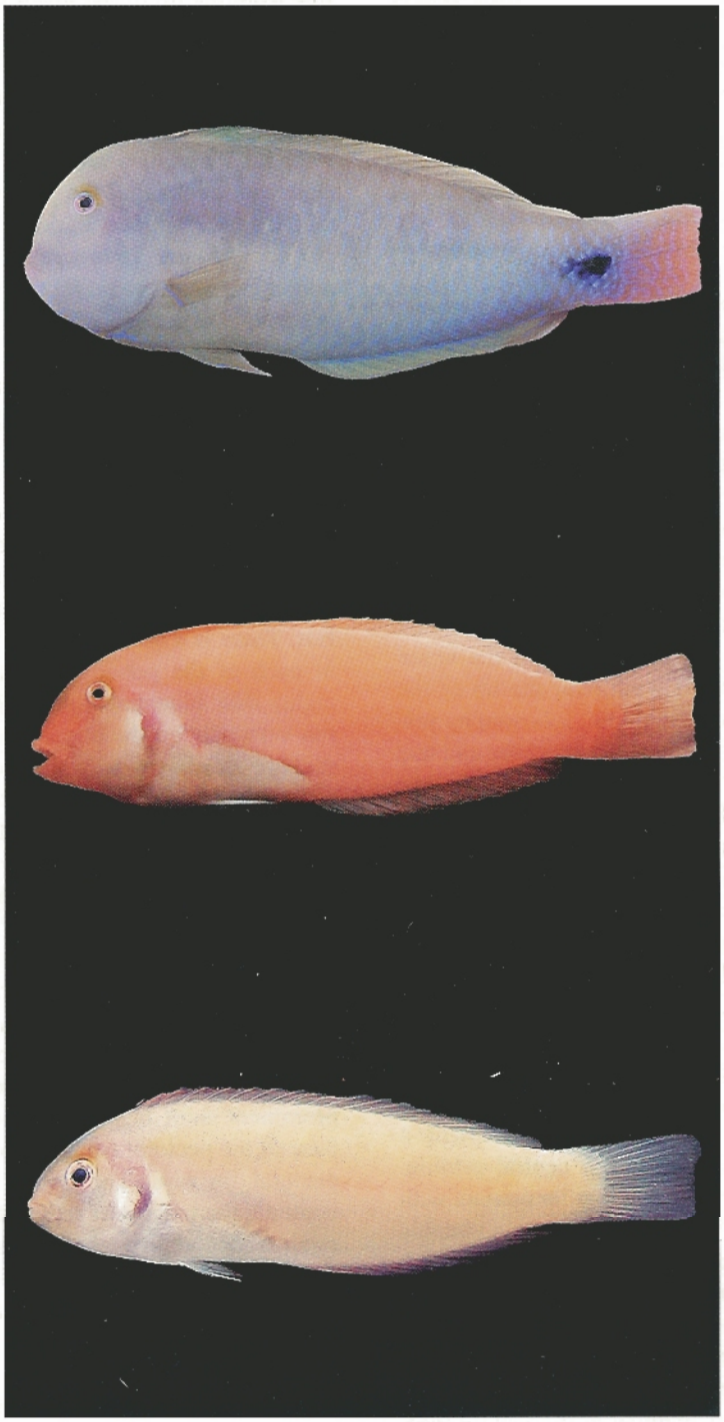

Fig. 1. *Xyrichtys mundiceps* from La Paz, Baja California: TP 145 mm SL (top), IP 109 mm SL (middle), and juvenile 43 mm SL (bottom).

overlapping two adjacent scales to form a pattern of vertical parenthesis-like markings. On larger scales of the upper body there are additional single central blue spots on each scale. The blue markings on the scales occupy progressively more of each scale towards the caudal peduncle where they become diamond to round spots about the size of the pupil of the eye. There is a prominent solid-black rounded spot at the base of the caudal peduncle and continuing onto the basal portion of the caudal fin, usually centered around the last one or two pored scales of the lateral line, occupying all or part of four to six scales and about twice the diameter of the eye.

Color in alcohol: Juveniles are uniformly light brown with a fine scattering of small melanophores over the body and the upper portion of the head including around the upper and lower jaw. In some individuals the pattern of melanophores forms a row of about five faint bars along the body. Initial-phase fish are light brown and paler towards the lateral midline. Some individuals have a thin brown line running along the lateral midline. Terminal-phase fish are also light brown and paler towards the lateral midline. Well-preserved specimens show no evidence of the complex color patterns in live individuals other than the black caudal peduncle spot on TPs. In several collections many individual IPs and TPs have one to three small black spots per side. They measure about 0.3 cm in diameter and occur apparently randomly on the body and head on the skin and scale surface. At least two other species of razorfishes have individualized patterns of spots (Clark 1983, Wellington 1992). The function of these spots is unknown, although they may serve to enhance recognition of individuals by other conspecifics.

Taxonomic Review of Eastern Pacific *Xyrichtys*

In contrast to the other local *Xyrichtys* species which are all regional endemics, *X. pavo* is a wide-ranging Indo-Pacific species. *X. pavo* is easily distinguished from other eastern Pacific razorfishes by the separation of the first two dorsal spines into a separate fin. In addition, this species grows much larger than other razorfishes and has been reported to reach 350 mm SL (Allen and Robertson 1994). The remaining *Xyrichtys* species of the eastern Pacific, however, appear markedly similar morphologically.

Numbers of dorsal; (IX,12) anal; (III,12) pectoral (12); and principal caudal fin rays (14) are identical for eastern Pacific and Caribbean *Xyrichtys* species (Randall 1965, Allen and Robertson 1994). Apparent errors in the literature include anal rays as III, 11 for *X. mundiceps* in Jordan and Evermann (1898) and pectoral rays as both 12 and 15 for *X. wellingtoni* in Allen and Robertson (1995)(we count 12). Differences in definitions for caudal ray counts have contributed to confusion, however most authors accept the principal caudal ray count of 14 for all razorfishes (Leis 1983, Watson 1996). Among the species descriptions, only Allen and Robertson (1995) recorded fewer than 14 principal caudal rays (in their case 12). Branched caudal ray counts can differ since juveniles may show less branching. Other than for *X. pavo*, most scale counts differ among these species by only one scale at most, making scale counts of little value in separating eastern Pacific species. Reported gill-raker counts among these species are also close (range 20-24) and based on few individuals; given the broad range when more individuals are sampled (e.g. Randall 1965), it is unlikely that these counts will delineate species.

Initial phase *X. mundiceps* captured in Baja California and *X. perlas* captured in the Perlas Islands of Panama have essentially the same color pattern. The distinctive features for *X. perlas* recorded in Wellington et al. (1994) apply equally to IP *X. mundiceps*. According to the description of *X. perlas*, it is distinguished by a pale yellowish patch above the eye extending to the anterior mid-body and a distinct blue line down the midline of the head. Both of these features are prominent

characters of IP *X. mundiceps*. Two other features of *X. perlas*, a transparent window posterior to the preopercle and the opaque white pelvic fins, well-illustrated in Allen and Robertson (1994), are also characteristic of IP *X. mundiceps*. There are no other distinguishing features of *X. perlas* not present in IP *X. mundiceps*. In addition, the largest specimen of *X. perlas* captured was only 47 mm SL and no TP was observed or collected. We therefore consider *X. perlas* a junior synonym of *X. mundiceps*, representing the initial phase of the species and the Perlas Islands specimens thus represent a range extension for *X. mundiceps*.

In summary, there appear to be six eastern Pacific *Xyrichtys* species, two of which are so far undescribed. Besides *X. pavo*, there is *X. mundiceps*, previously recorded as a Gulf of California endemic. Very few specimens are represented in museum collections and our review revealed the species to be reported only from the southern Baja California peninsula, from Bahia Magdalena on the Pacific side (SIO 87-19) around Cabo San Lucas up to Punta Tecolote near La Paz on the Sea of Cortez side. We found no records from the Mexican mainland coast or further south (although now it appears to extend to Panama, assuming *X. perlas* to be a junior synonym). *X. victori* is found in the Galapagos and Cocos Islands (Grove and Lavenberg 1996) and is a larger species with a conspicuous TP coloration of iridescent blue and green with a pattern of large black spots that differs among individuals. *X. wellingtoni* is apparently endemic to Clipperton Atoll and is distinguished by the absence of spots, stripes, or other specific markings. The largest individual captured was only 65 mm SL and the absence of any prominent bright colors or markings suggests the possibility of an undiscovered terminal phase male for this species.

One of the undescribed species occurs in the Galapagos Islands (*Xyrichtys* sp. G). We have collected only juveniles and IPs and await the discovery of the TP of the species. This species is clearly differentiated by extended first two dorsal-fin rays (not separated from the remainder of the dorsal fin) and a uniformly dark brown to black coloration until about 40-50 mm SL. Initial phase fish are red with equal-length dorsal fin rays and difficult to separate from *X. victori*. The terminal phase is unknown. Another apparently new species has been photographed but not collected in the Revillagigedos Islands by Gotshall (1998)(*Xyrichtys* sp. R). The putative IP is grey-white with a broad brown line along the lateral midline from the eye to the caudal peduncle and a possible TP is described as dark (Gotshall, pers. comm.).

Comments

One additional species of razorfish not in the genus *Xyrichtys*, the rockmover or dragon wrasse *Novaculichthys taeniourus*, occurs in the tropical eastern Pacific Ocean. It is clearly separable from *Xyrichtys* species by fin-ray counts (13 pectoral rays), the lack of a markedly inferior mouth in adults, and the greatly-extended fin rays of juveniles. The validity of the genus *Novaculichthys* (Bleeker, 1862) has been in question, initially united with *Hemipteronotus* (now *Xyrichtys*) by Randall (1965), then retained for the two species *N. taeniourus* and *N. macrolepidotus* (Randall 1981, Masuda et al. 1984). The original distinctive features of the genus (the membranes between the dorsal spines connected near the tips, the membrane between the second and third spines not incised, and the first two dorsal spines flexible, not pungent) are apparently not reliable (Randall 1981) and the genus in general awaits revision (Randall, pers. comm.). An additional difficulty is the problematic *Xyrichtys woodi*, originally placed in *Novaculichthys* and then in *Novaculops* (Schultz,1960), which likely represents a complex of closely-related species, including some of the new eastern Pacific species (Randall, pers. comm.).

Some authors have considered some of the new eastern Pacific razorfishes as *Novaculichthys* species: in Eschmeyer (1998),

Key to Eastern Pacific Species of *Xyrichtys*

Key to *Xyrichtys* juveniles (<30 mm SL):

1 a) First two dorsal spines greatly elongated and separated from remainder of fin ..... *X. pavo*

b) No separation between first two dorsal spines and remainder of fin 2

2 a) First two dorsal spines elongated but not separated from remainder of fin (first-spine length greater than 1.5 times third spine), body uniformly dark brown black ..... *sp. n.* G

b) Dorsal spines all about equal in length, body light colored 3

3 a) Body relatively narrow, body depth at origin of anal fin less than 0.27 of SL (less than 0.23 below 20 mm SL), thin blue line along midline of snout in life ..... *X. mundiceps*

b) Body depth at origin of anal fin more than 0.27 of SL (more than 0.23 below 20 mm SL), no thin blue line along midline of snout in life 4

4 a) Stripe along upper body from caudal peduncle to eye, faint in lightly-pigmented individuals ..... *X. victori*

b) No evidence of stripe or other dark pigment on body ..... *X. wellingtoni*

Key to *Xyrichtys* IPs (30-100 mm SL):

1 a) First two dorsal spines greatly elongated and separated from remainder of fin ..... *X. pavo*

b) No separation between first two dorsal spines and remainder of fin 2

2 a) Pelvic fins opaque white, thin blue line along midline of snout in life ..... *X. mundiceps*

b) Pelvic fins translucent, no thin blue line along midline of snout in life 3

3 a) No scales around orbit ..... *X. wellingtoni*

b) Row of scales around orbit at lower posterior border ..... *X. victori* (and *X.* sp G?)

Xyrichtys perlas is considered *Novaculichthys perlas*, and Gotshall (1998) listed the putative new Revillagigedos species as *Novaculichthys* sp. The reason for the persistence of the use of *Novaculichthys* for these species has been the apparent lack of the classic blunt head shape of *Xyrichtys* (Gotshall pers.comm., Randall pers.comm). However, the characteristic blunt head of razorfishes is not present in juveniles and develops as the fish grows. Furthermore, different species show differing degrees of this characteristic head shape. This feature is most pronounced in *X. pavo*, where it develops early. We decided to review the allometric changes of the head shape in the eastern Pacific razorfishes in order to evaluate the usefulness of this feature in separating the genera.

The relative bluntness of the snout can be expressed in three morphometrics in razorfishes: the length of the snout, the depth of the head, and how low the mouth is on the profile of the head. The combination of these features characterizes the classic appearance of the head of adult razorfishes. We measured the length of the snout as the horizontal distance from a vertical line through the midpoint of the eye to the tip of the upper jaw. Head depth is the depth at a vertical through the midpoint of the eye. We quantified the low position of the mouth as the portion of the head depth above the horizontal line

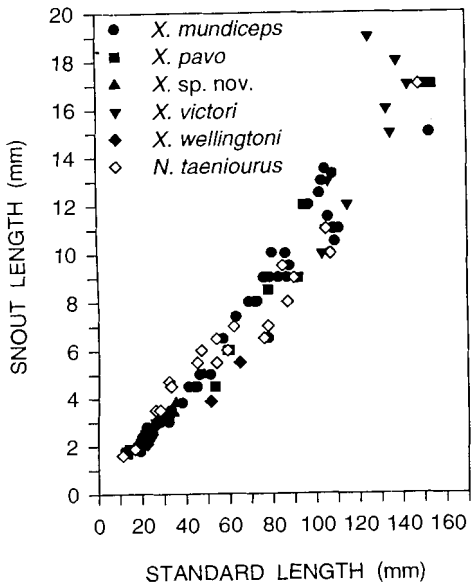

Fig. 2. The relationship between snout length and standard length for the eastern Pacific razorfishes.

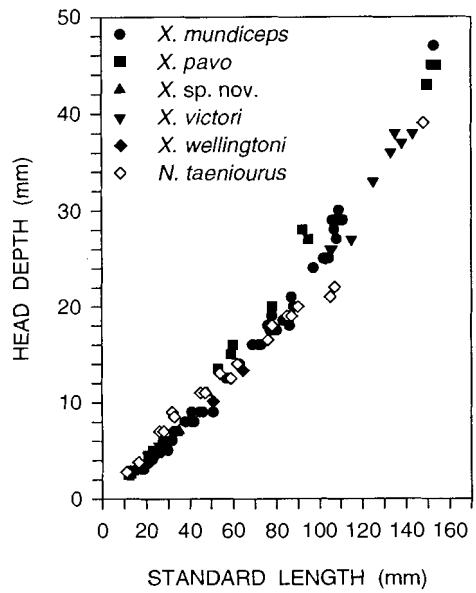

Fig. 3. The relationship between head depth and standard length for the eastern Pacific razorfishes.

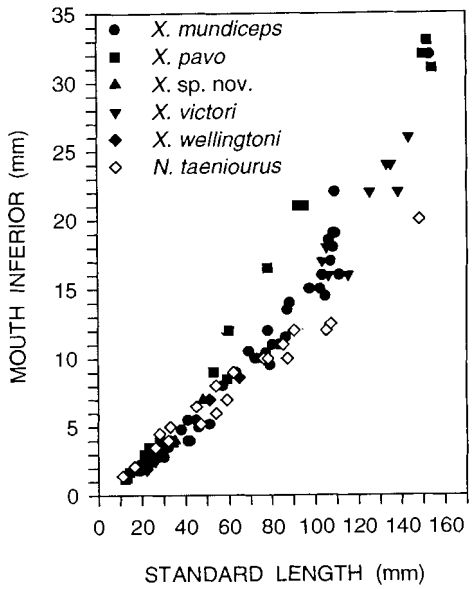

Fig. 4. The relationship between the inferior placement of the mouth and standard length for the eastern Pacific razorfishes.

through the tip of the upper jaw. Measurements were made in millimeters and plotted against standard length (mm SL).

Our analysis shows that the snout of *Xyrichtys* species is no shorter than the snout of *N. taeniourus* of the same size, even in large male individuals (Fig. 2). The graph of head depth shows no obvious divergence, although there is a tendency for small *N. taeniourus* to have slightly deeper heads and mid-sized ones to have less deep heads (Fig. 3). The only real divergence between genera occurs in the plot of the inferior position of the mouth: above about 80 mm SL, the *Xyrichtys* species tend to have their mouths placed lower on the head than *N. taeniourus* (Fig. 4). *X. pavo*, in particular, deviates from other razorfishes at a relatively small size. Above about 60 mm SL this species shows its characteristic low mouth position.

The most notable finding of the analysis of allometric growth of the head of razorfishes is that below about 80 mm SL there is no difference in measured head shape between

the two genera in the eastern Pacific. We therefore recommend that head shape be used with caution in differentiating *Novaculichthys* from *Xyrichtys*, especially when based on small individuals. The fact that the divergence of adult *Novaculichthys* from most *Xyrichtys* species in the placement of the mouth is of about the same degree (but opposite direction) as that of *X. pavo* from other *Xyrichtys* species argues that this feature may not deserve to be a generic-level character among razorfishes.

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RESUMEN

El género *Xyrichtys* es muy variable en morfología y coloración, y la forma de la cabeza es inadecuada para ciertas identificaciones. Se revisa el género, estimándose que tiene seis especies en el Pacífico Oriental Tropical y se describe, *Xyrichtys mundiceps*. Dudamos de la validez de *Xyrichtys perlas*, que podría ser una fase temprana de *X. mundiceps*.

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