Taxonomic Review and Meristic Variation in Marine Sculpins (Osteichthyes;Cottidae) of the Northeast Pacific Ocean[1]

by

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CONTENTS

CONTENTS
(Continued)

CONTENTS
(Continued)

ABSTRACT

Within the northeast Pacific Ocean (Baja California to the Aleutian Islands), 40 genera comprising 90 species of sculpins (Cottidae) have been recorded; this includes two members of the freshwater genus Cottus which are often found in nearshore marine waters. The species are listed and their distributions are indicated. At present, only one family, Cottidae, should be recognized for the sculpins. Each genus is discussed in terms of taxonomic problems and affinities and each is also diagnosed, indicating differentiating characteristics. Some genera should be synonymized and these are indicated although no formal synonymies are proposed at this time. In addition, other genera need to be studied as they appear closely related to other genera and might be synonymized without any loss of information. The species in some genera (i.e. Artediellus, Hemitripterus, Icelinus, Icelus, Malacocottus, Myoxocephalus, Triglops) are in serious need of study. Some of the species within these genera, as well as many species in other genera are noticably rare in museum collections. Each species within the northeast Pacific is also diagnosed and comments on depth distribution and relative rarity are provided. Meristic data compiled from museum specimens is provided for each genus as well as each species. Artificial keys to the cottid genera and cottid species in the northeast Pacific Ocean are included.

LIST OF TABLES

INTRODUCTION

Marine sculpins (Cottidae[3]) are one of the more speciose components of the north Pacific Ocean ichthyofauna. Most, if not all species are benthic as juveniles and adults and nekto-planktonic as larvae. Although nine species are of commercial importance in the Bering Sea (Fedorov 1973) and at least one species is of commercial and sport importance in the United States (Fitch and Lavenberg 1971), most species are not harvested. As a result, cottid fishes have received little study - taxonomically or ecologically. Without taxonomic study, a compilation of the variation in meristic characters is non-existent. Larval cottids are common members of ichthyoplankton surveys (Eldridge and Bryan 1972; Richardson and Pearcy 1977; Waldron and Vinter 1978; and others) but without compiled meristic data the identification of cottid larvae is difficult and often impossible. Because of the lack of data, this study was undertaken.

Preliminary plans and contract objectives were to gather meristic data and evaluate the taxonomic status of those cottid species which occur around Kodiak Island, Alaska. Soon after undertaking the project, we realized that it would be counter-productive to limit the work to that locality because of inadequate sampling within the region and because taxonomic problems in other areas of the northeast Pacific Ocean might influence work in the Kodiak area. Therefore, our work was expanded to include all cottid species which occur in the northeast Pacific Ocean from Baja California, the southern limit for cottids in the eastern Pacific, northward to and including the Aleutian Islands. Our objectives were to:

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[3]Many sculpin taxa are placed in separate families (e.g. Scorpaenichthyidae, Psychrolutidae) but within this report we follow Bailey et al. (1970) and recognize only one family - Cottidae.

1) prepare a species distribution list for all cottids which have been recorded from the northeastern Pacific Ocean;
2) prepare a review of the taxonomy of each genus including a discussion of generic characters and relationships based upon study of the adults and comments on apparent taxonomic problems; and,
3) compile meristic data for all cottid species recorded from the northeastern Pacific Ocean.

MATERIALS AND METHODS

Collections

In this study, specimens held in the collections of the following institutions were examined: British Columbia Provincial Museum, University of British Columbia, California Academy of Sciences, National Museum of Canada, Oregon State University and the University of Washington. Both catalogued and uncatalogued material was studied; no catalogue or accession numbers are given in this report but they are available from the authors. An attempt was made to gather data from specimens collected throughout the full range of each species but many species were poorly represented in the collections so this was not possible for all species. A further attempt was made to verify the distributional limits of all species but this was impossible, therefore, many species distributions are based on the literature. Northeast Pacific Ocean cottid species and their distributions are presented in Table 3, App. I.

Meristic Data

All fin rays were counted on both sides of each specimen. For species with embedded or flesh-covered fin rays, dissection was required. In the past, many workers have counted fin elements which arise from the same pterygiophore as a single element. Most commonly, the first two dorsal spines, the last two dorsal rays and the last two anal rays may arise from the same pterygiophore. Our observations have indicated that in some species, it is impossible to distinguish this condition without dissection and, in certain cases, there appears to be intraspecific variation in this condition. Therefore, all fin ray elements were counted whether or not they arose from the same pterygiophore.

Caudal rays were initially counted and branching noted but it became apparent that length of the specimen influenced the count; branching was not evident in the young of some species but was apparent in larger specimens of the same species. Therefore, caudal ray counts and branching is indicated only in the taxonomic section of this report where it may be useful for separation based on our studies.

Vertebral counts were taken from radiographs (which included the hypural plate). Only total counts are given because it is usually very difficult to distinguish abdominal and caudal vertebrae from radiographs without dissecting one or more specimens to determine the first caudal vertebrae.

Gill rakers were examined in most species (right side, first arch) and counted in many species. In many species, gill rakers are represented as small, spinous nubs and often these are obscure and/or the arch appears to be covered with small spines making definitive counts impossible. In certain cases, these may hold potential as a distinguishing character but

probably only among juvenile and adult individuals. We have noted in some species that gill raker number appears to increase with length (age). This condition is known in other fishes; gill raker number in Cottus and Gasterosteus does not stabilize until the fish is about 30-40 mm in length (Howe, unpubl. data). Therefore, we do not present gill raker numbers in our meristic data.

Branchiostegal rays were counted in most genera and many species. This single characteristic has been used to recognize and lump together one group of cottids (i.e. psychrolutids). We have found this character variable on a generic (e.g. Artedius) and specific (e.g. Cottus) level. Late in the study, we found that branchiostegal rays can only be definitely counted through the clearing of tissue and staining of bone (Alizarin Red S) or through careful dissection. Not all species could be examined through these methos; therefore, we present branchiostegal ray counts in the diagnosis portion of this report only when it appears to be a disgnostic character among those species that were carefully examined and which vary from the "typical" six branchiostegal rays found in most cottids.

For all genera and most species, other characteristics were studied which might provide useful means of distinguishing the taxa. Certain characters (e.g. lateral line pores, scale patterns) are similar to gill raker numbers; they increase sequentially with the length of the individual. Therefore, we do not present these in tabular form but where applicable, we discuss them in the taxonomic sections.

Meristic data for each northeast Pacific genus are presented in Tables 4-9, App. II; meristic data for each northeast Pacific species are presented in Tables 10-15, App. III.

Descriptive Summaries

The taxonomic review section of this report is based upon a comprehensive review of the literature and a study of specimens held in the aforementioned collections. Type material was studied when available.

Our objective is to present the current taxonomic status and information which may be useful in the identification of sub-juvenile to adult sculpins. Following the brief family discussion, each genus is listed alphabetically and includes information on synonymy, number of species within the genus (worldwide), taxonomic problems, affinities, generic diagnosis and component species occurring in the northeast Pacific Ocean. Each northeast Pacific species is listed alphabetically under the genus and includes information on synonymy, specific diagnosis, available illustrations or photographs, depth distribution, ecology and abundance. We do not present meristic data in the taxonomic review section.

Synonymies are presented only when an actual synonymy is involved; misidentifications, locality records and the like are not listed. Generic diagnoses are based on all species within the genus not just on those which occur in the northeast Pacific. Depth distributions should be considered minimums because of the limited information available for most species. Ecological information is based upon the literature and field work of the senior author; this field work has been limited to Oregon and California. Abundance is perhaps the most subjective of our available information. Our comments on abundance are based on literature records and museum holdings; these comments are relative but not necessarily equivalent among all species. In addition to actual rarity in the environment, a number of other explanations can be advanced for the seemingly rareness of some species - misidentification, localized distributions and/or lack of collecting,

recording or depositing in museums. We hope that in the future, some of these species will be deposited in museums along with the necessary ecological data. Throughout the text we will refer to museum lots; these are single collections taken at the same time and the same place and may contain only one specimen or numerous specimens. Different lots are taken at different times and usually different places. We have used this lot data to derive some of our comments on abundance. In any case, our abundance comments should be considered preliminary and subjective.

Our assessment of affinities (relationships) between and within genera is based upon post-larval specimens. We have utilized the studies of previous workers (cited in the appropriate sections) and our own continuing studies (primarily KMH) of the taxa. A suite of over thirty characters have been considered in our assessments but we do not believe that this report is the proper vehicle in which to discuss our systematic methodology; additional information concerning this matter can be obtained from the authors. These assessments are presented as aids but should be considered preliminary, tentative and unpublished.

An artificial key to the genera of northeast Pacific cottids is presented in App. IV and to the species in App. V. These keys were constructed using juvenile and adult specimens and are the sole responsibility of the senior author.

TAXONOMIC REVIEW AND TAXON CHARACTERISTICS

Cottidae

The higher classification of cottids (family and above) has never been studied in detail. Gill (1889), Regan (1913) and Taranets (1941) have

addressed the taxonomy of the group at the family or subfamily level but only generally and many taxa were not seen by those workers. Quast (1965) worked primarily with hexagrammid fishes but presented a synopsis of higher classification and noted that cottids are in need of intensive study. Recent students of higher classification (Greenwood et al. 1966; Nelson 1976) have not studied cottids but merely presented Berg's (1940) classification which itself is modified little from Regan (1913). The following are the cottid families recognized by Greenwood et al. (1966:399) along with their synonyms (in parentheses):

Icelidae (including Ereuniidae, Marukawichthyidae);
Cottidae (Sclerogenidae in part, including Jordaniidae, Blepsiidae, Scorpaenichthyidae, Ascelichthyidae, Synchiridae, Rhamphocottidae, Hemitripteridae, Neophrynichthyidae);
Cottocomephoridae (including Abyssocottidae);
Comephoridae;
Normanichthyidae;
Cottunculidae; and,
Psychrolutidae.

Within the northeast Pacific there exists Icelidae, Cottidae and Psychrolutidae but we lump these into Cottidae. For the present, it appears the most utilitarian classification until the systematics have been studied. As previously mentioned, our use of Cottidae includes all of the above mentioned families.

The family Cottidae contains some 300 described marine and freshwater species, of which over 230 are marine forms. Although sculpins occur in all oceans except the Indian Ocean, they are most speciose in the north Pacific Ocean and the Bering Sea (Table 1).

Within our area of concentration (Baja California to the Aleutians), we have recorded 40 genera comprising 90 species (Table 2; App. I); this includes two species of the freshwater genus Cottus which may be found in nearshore marine-estuarine waters. A number of taxa were known or were

Table 1. Diversity of Sculpins from Various Marine Regions.

References are given in Table 2, App. I.

Region	# of Genera	# of Species
California	20	42
Puget Sound	22	36
Gulf of Alaska	22	39
Aleutian Islands (inshore)	27	42
Bering Sea	35	78
Arctic Sea	11	28
Sea of Okhotsk	22	50
Japan	39	78
North Atlantic	9	19
South Pacific	4	13
South Atlantic	3	4

found to possess taxonomic problems and numerous species need to be synonymized, described or redescribed. Generic reorganization is also necessary. Time as well as economic constraints prevents formal revisions and descriptions of the taxa involved. Hence, our discussion should be considered preliminary.

Diagnosis: Branchiostegal membranes from each side may be fused to the isthmus or united to each other and forming a fold over the isthmus; this fold is variably connected to the isthmus but its connection is not visible from the exterior; jaw teeth always present with vomerine and/or palatine teeth present or absent; pelvic fin with a single, small concealed spine and two to five rays (pelvic fins absent in Ascelichthys and Ereunias); scales may nearly cover the entire body or be completely absent, when present, usually modified into plates, prickles or small spines and arranged in rows or appearing scattered; cirri present or absent, when present, most developed on head and above lateral line; head spines variously developed, sometimes only present in larvae, sometimes only present in adults (this important character has not been studied in most taxa); preopercular spines 0 to 4 and ranging in form from serrations to barely perceivable protuberances to strong, sharp armature; pectoral fins and anal fins without spines though two species have been described with a single anal spine [Icelus armatus (Schmidt, 1915) and Phasmatocottus ctenopterygius Bolin, 1936b]; third suborbital bone (suborbital stay) extending across cheek to preopercle; lateral line present but sometimes greatly reduced or with accessory pores (canals) radiating from or paralleling primary canal; branchiostegals 6 or 7.

Artediellus Jordan, 1885
Artedielloides Soldatov and Lindberg, 1930

At least 15 species have been described. These are distributed throughout the North Pacific Ocean from the Sea of Japan to Alaska, the Bering and Arctic Seas as well as the North Atlantic. Only one species (A. pacificus) occurs in our area; Schmidt (1950) recognized two subspecies, one in the eastern Pacific (A. p. pacificus) and one in the western Pacific (A. p. ochotensis).

This genus is in need of review. Type material was found to contain more than one species and some species need to be synonymized while others need to be described. The North Atlantic species (three) appear to be well studied and understood (Jensen 1952; Andriyashev 1954; McAllister 1963). The North Pacific and Bering Sea species were last reviewed by Schmidt (1927c) but he had not seen all species. Soldatov and Lindberg (1930) and Schmidt (1937b) later described more species and the latter author stated that a major review of the genus was in preparation; it has never been published.

Jordan (1885) believed this genus had affinities with Icelus whereas Jordan and Evermann (1898) suggested Artedius was its closest relative. Taranets (1941) and Schmidt (1950) suggested its close relationship to Zesticelus, Stlegicottus and other genera which occur outside of the northeast Pacific. We do not believe this genus is related to these genera but, at present, we cannot speculate on its relations.

Diagnosis: Branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays; no scales or dermal papillae present but one species (A. scaber) with minute prickles; cirri present on head of some species; two preopercular spines with the uppermost strongly curved and hooked upward.

Artediellus Species in the Northeast Pacific

A. pacificus Gilbert, 1895

Diagnosis: Occiput without bony tubercles; nasal spines present; lateral line with 22-26 pores.

This species has not been illustrated but illustrations of related forms may be found in Schmidt (1950) and McAllister (1963). It has been taken at depths of 15-112 m. Little is known of this species' ecology and abundance; museum lots are rare but each lot contains numerous specimens.

Artedius Girard, 1856

Astrolytes Jordan and Starks, 1895
Axyrias Starks, 1896
Pterygiocottus Bean and Weed, 1920
Allartedius Hubbs, 1926a
Parartedius Hubbs, 1926a
Parastrolytes Hubbs, 1926a
Ruscariops Hubbs, 1926a

This genus contains seven species. They are restricted to the northeast Pacific Ocean with one species possibly occurring in the Bering Sea.

Bolin (1944) reviewed this genus in detail. The group exhibits some confusing patterns of variation and a possible undescribed species is presently under study (KMH) but cannot be diagnosed at this time. A. delacyi was described from Kodiak Island but later synonymized with A. lateralis by Hubbard and Reeder (1965) and Quast (1968); we agree with these workers. Bolin (1947) and Rosenblatt and Wilkie (1963) have contributed to our knowledge of the species relationships. A. corallinus and A. lateralis appear to be closely related while A. creaseri and A. meanyi appear to be closely related. A. fenestralis and A. notospilotus share

some characteristics suggesting affinity but not to the extent as the above species pairs. A. harringtoni shares characteristics with A. creaseri and A. meanyi but again it does not appear to be as distinctive as with the species pairs.

The affinities of Artedius are most likely with Clinocottus and Oligocottus but certain aspects need to be explained before definitively establishing the relationship. The genus Orthonopias, off California, is very closely related to Artedius and could be synonymized with Artedius without any loss of information. The North Pacific genera Stelgistrum and Stlegicottus also appear to have close affinities with Artedius.

Diagnosis: Branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays (rarely two in A. meanyi); scales in well defined rows above lateral line and, in some species, on head; cirri variously developed - always present on head and usually on posterior portion of maxillary, above posterior portion of orbit, on opercle and along anterior portion of lateral line; low spines or bony protuberances on head of some species; four preopercular spines but only uppermost apparent, this may be simple or multifid but never long or antler-like; anus close to origin of anal fin.

Artedius Species in the Northeast Pacific

A. corallinus (Hubbs, 1926a)

Diagnosis: Scales absent from head; 3-10 scales present behind upper opercular flap; dorsal scale band of 39-49 oblique rows with 10-18 scales in longest row; uppermost preopercular spine bifid or trifid; no spines-tubercles apparent on head; preorbital cirrus absent.

Bolin (1944:121) presented an illustration of this species. It has been taken from the intertidal to 22 m in depth. It is common in California but quite rare from northern California northward. We have not recorded this species from Oregon.

A. creaseri (Hubbs, 1926a)

Diagnosis: Scales present on head including cheek and snout; 0-5 scales present behind upper opercular flap; dorsal scale band of 26-29 oblique rows with 15-19 scales in longest row; uppermost preopercular spine simple or bifid; preorbital cirrus present.

Bolin (1944:119) presented an illustration of this species. It has been taken from the intertidal to 28 m in depth. It is uncommon throughout its range.

A. fenestralis (Jordan and Gilbert, 1883)

A. asperulus Starks, 1896

Diagnosis: Scales present on cheek and head; dorsal scale band of 26-29 oblique rows with 9-11 scales in longest row and extending onto caudal peduncle; uppermost preopercular spine strong and multifid; preorbital cirrus absent; spines or bony protuberances sometimes present but usually only apparent in larger individuals.

Bolin (1944:120) provided an illustration of this species. It has been recorded from the intertidal to 56 m in depth. It is rare in California but common northward to at least southeast Alaska.

A. harringtoni (Starks, 1896)

Pterygicottus macouni Bean and Weed, 1920

Diagnosis: scales present on head but usually not on cheek and never on snout; dorsal scale band of 38-51 oblique rows with 9-16 scales in longest row; uppermost preopercular spine short, bifid or trifid; preorbital cirrus present; branchiostegals 7.

Bolin (1944:120) provided an illustration. It has been recorded from the intertidal to 22 m in depth. While uncommon in California, it increases in abundance northward. It is common-very common in rocky subtidal areas in Puget Sound and British Columbia (Peden and Wilson 1976).

A. lateralis (Girard, 1854b)

A. hankinsoni Hubbs, 1926a

A. delacyi Hubbs and Schultz, 1941

Diagnosis: scales absent from head; no scales behind opercular flap; dorsal scale band of 18-29 oblique rows with 3-11 scales in longest row; uppermost preopercular spine usually bifid, rarely simple or multifid; preorbital cirrus absent; spine-tubercles apparent on head of large individuals.

Bolin (1944:122) provided an illustration of this species. It has been recorded from the intertidal to 8 m in depth. This species is common in California and Oregon and apparently locally common to the north.

A. meanyi (Jordan and Starks, 1895)

Diagnosis: scales present on head including cheek and snout; 1-3 scales behind opercular flap; uppermost preopercular spine usually bifid; preorbital cirrus present. Lea (1974)

states that his specimens had only two pelvic rays. We studied these specimens and only one small specimen appeared to have two rays - all others had three rays.

Rosenblatt and Wilkie (1963:1506) provided a photograph and Hart (1973:483) an illustration of this species. It has been recorded from depths of 1 to 18 m. This small sculpin is rare throughout its range; Peden and Wilson (1976) found it on large rocks or vertical rock faces.

A. notospilotus Girard, 1856

Diagnosis: scales present on head sometimes on posterior portion of cheek; dorsal scale band of 24-31 oblique rows with 7-11 scales in longest row sometimes extending onto caudal peduncle; spines-protuberances well developed on head; preorbital cirrus absent.

Bolin (1944:121) provided an illustration of this species. It has been taken from the intertidal to 52 m in depth. It is uncommon in California and Washington (Puget Sound) but more common in Oregon.

Ascelichthys Jordan and Gilbert, 1881

This genus contains only one species (A. rhodorus) which is restricted to the northeast Pacific.

The affinities of this monotypic genus are obscure. Jordan and Gilbert (1881) suggested it was related to Oligocottus but our preliminary study indicates there is little evidence for an affinity between these genera. Ascelichthys differs from Oligocottus and its allies in the configuration of the preopercle, the branching of soft rays, absence of scales-papillae-prickles and near absence of cirri and the lack of genital papillae-clasping mechanism in the male. Poss (1975) found the circumorbitals of Ascelichthys

to be distinctive from other cottids including Oligocottus. At this time, we cannot speculate on the affinities of Ascelichthys.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fins absent; no scales or papillae; cirri present only above orbit and behind upper end of opercular flap; one sharp, recurved preopercular spine.

Ascelichthys Species in the Northeast Pacific

A. rhodorus Jordan and Gilbert, 1881

Diagnosis: see generic diagnosis.

Bolin (1944:131) and Hart (1973:484) provided an illustration of this species. It has been recorded from tidal and subtidal areas. This species appears to be localized but common throughout its range; museum lots usually contain numerous specimens.

Asemichthys Gilbert, 1912

This genus contains a single species (A. taylori) which is restricted to the northeast Pacific.

This species has been placed into the genus Radulinus by Clemens and Wilby (1946, 1961) and others though not in a formal synonymy. Our studies indicate that it should be placed into Radulinus. The primary differences are scale pattern and a short body. It is quite similar to the five other species of Radulinus in many characters including the relatively specialized genital papillae in the male; the type of Asemichthys was described from a single female. Within Radulinus it appears to occupy an intermediate relationship between the subgenus Radulinellus (includes R. vinculus) and the subgenus Radulinus (includes R. asprellus and R. boleoides) (subgenera follow Bolin 1950).

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and three rays; lateral line with 34-36 strongly ctenoid-like scales; ctenoid-like scales also present below lateral line in 1-4 rows, the rows not distinct and the scales smaller than lateral line scales; naked area between scales and dorsal fin approximately equal in size to the scale band; scales present on top of head and in the posterior portion of interorbital space; a few scales present below orbit but absent from snout; postorbital and parietal cirrus present and cirri present on mid-side of body below lateral line; nasal spine without cirri; 3 preopercular spines, all small or inconspicuous.

Asemichthys Species in the Northeast Pacific

A. taylori Gilbert 1912

Diagnosis: see generic diagnosis.

Wilby (1936:116) provided a photograph and Hart (1973:485) gave an illustration. Peden and Wilson (1976) reported on several specimens and stated that they appear most commonly between depths of 6 to 18 or more m on clean shell subtidal bottoms near rocky outcroppings.

Blepsias Cuvier, 1829

Peropus Lay and Bennett, 1839

Histiocottus Gill, 1889

This genus contains at least two species; both are distributed throughout the North Pacific Ocean and the Bering Sea.

This genus is well defined and distinctive. Schmidt (1929a) reviewed

the genus and synonymized one species. Examination of the type material of the synonymized species suggests the need for study; meristic data as well as other characters exhibit differences not discussed by Schmidt (1929a). These differences may be minor relative to the variation within the taxon, therefore, Schmidt's review is accepted. This genus appears to have affinities to Nautichthys but the degree of affinity must await osteological study. Our preliminary studies also suggest that Hemitripterus may have affinities to these genera as well. The primary characteristic(s) indicating affinity is the complex sculpturing (ridges-knobs) of the skull.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays; most of the body covered with embedded single-spine scales which are covered with skin giving the feel and appearance of small dermal papillae or prickles; long, slender cirri present on snout and three pair of cirri on the lower jaw; body rather deep, not depressed; skull with 4 preopercular spines, lower two short and blunt, upper two developed with the second most developed; well-developed complex of ridges and knobs on head.

Blepsius Species in the Northeast Pacific

B. bilobus Cuvier and Valenciennes, 1829

Diagnosis: spinous dorsal fin without notch or indentation; body usually completely covered with scales-papillae; cirri absent from head and body except for those mentioned in generic diagnosis.

An illustration of this species was given in Hart (1973:487). This species is taken in nearshore waters but no depth records could be found. It is rare in the southern portion of its range but no information exists for the more northern portion.

B. cirrhosus (Pallas, 1811)

Blepsias trilobus Cuvier and Valenciennes, 1829

Blepsias draciscus Jordan and Starks, 1904

Diagnosis: spinous dorsal fin with notch or indentation; body usually without scales-papillae in area behind pectoral fins, posterior end of lateral line and dorsal portion of caudal peduncle, other small naked areas may also occur on body; cirrus usually present above eye and on nasal spine.

Illustrations of this species may be found in Jordan and Starks (1904:323), Bolin (1944:134), Watanabe (1960:Pl.4) and Hart (1973:489). It has been recorded from the intertidal to 37 m in depth. It is somewhat uncommon.

Chitonotus Lockington, 1882

This genus contains a single species, C. pugetensis, restricted to the northeast Pacific.

This genus appears to be close to Icelus or Icelinus. The primary differences between the genera concern the size, number and arrangement of dorsal body scales and the genital papillae of the male. The degree of affinity may be quite close but must await study.

Diagnosis: branchiostegal membranes united and forming a fold of the isthmus; vomerine and palatine teeth present; pelvic fin with one spine and 3 rays; lateral line scales

enlarged with spinous-ctenoid posterior margins; smaller scales covering most of the area above the lateral line as well as most of the head including parts of the eye, cheek and snout; cirri present on nasal spine, eyeball and upper posterior area of orbit; cirri sometimes present on end of maxillary and opercular flap; 4 preopercular spines, uppermost antler-like with recurved barbs.

Chinonotus Species in the Northeast Pacific

C. pugetensis (Steindachner, 1876)

C. megacephalus Lockington, 1882

Diagnosis: see generic diagnosis.

This species was illustrated in Bolin (1944:113) and Hart (1973:491). It has been recorded from the intertidal to 142 m in depth. Based on published and museum records, this species is common but localized in certain areas.

Clinocottus Gill, 1861

Blennicottus Gill, 1861
Oxycottus Jordan and Evermann, 1898
Rusulus Starks and Mann, 1911
Allocottus Hubbs, 1926b
Montereya Hubbs, 1926b

This genus contains five species, all restricted to the northeast Pacific Ocean and the Bering Sea.

This is a well defined group following the study of Hubbs (1926b) and Bolin (1944). Although Bolin (1947) suggested that Clinocottus is as closely related to Artedius as it is to Oligocottus, our preliminary studies

suggest Oligocottus and Clinocottus are more closely related to each other than either is to Artedius. This does not negate the relatively close relationship that Artedius appears to share with those two genera. Leiocottus shares many advanced characteristics with Clinocottus but differs in lesser cirri development, the lack of palatine teeth and the elongation of the anterior dorsal spines; they are closely related and might be placed into the same genus upon detailed study. The more northern genera Phallocottus and Sigmistes exhibit characteristics of both Oligocottus and Clinocottus though as we presently define Clinocottus, Phallocottus and Sigmistes are quite close to that genus. The more northern populations of Clinocottus exhibit some interesting variation and the potential for new species to be found should not be ruled out. The interrelationships of the species within the genus are in need of study. They differ in numerous aspects but most emphasis has been placed upon cirri patterns and this is often absent in young specimens. C. acuticeps and C. analis do not appear closely related to each other nor to the other three species. C. globiceps and C. recalvus appear quite closely related and C. embryum appears more closely related to these two species than the others.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present and palatine teeth sometimes present; pelvic fin with a single spine and three rays; one species with patch of minute scales embedded in body between dorsal fin and lateral line, these are often obscured by skin and cirri; cirri usually well developed on head and body, always a large postorbital cirrus, at least two cirri on top of head, one or more on

base of opercular flap and one or more at each pore on the anterior portion of lateral line; 4 preopercular spines but lower 3 are obscure; anus in middle third of the distance between pelvic fin base and anal fin origin.

Clinocottus Species in the Northeast Pacific

C. acuticeps Gilbert, 1895

Diagnosis: upper preopercular spine simple and strong; no scales or cirri between lateral line and dorsal fin; one or more cirri present on end of maxillary; no cirri behind upper opercular flap; cirri usually present on eyeball; nasal spines with cirri; inner pelvic ray adnate to abdomen by flap of skin.

Bolin (1944:130) and Hart (1973:493) provided illustrations of this species. This species has been taken in intertidal and subtidal areas; often in waters with some freshwater influence. It is common throughout its range.

C. analis (Girard, 1858)

Cottus criniger Gunther, 1860

Clinocottus australis Jordan, Evermann and Clark, 1930

Diagnosis: upper preopercular spine multifid; minute scales and cirri present between lateral line and dorsal fin; one or more cirri present on end of maxillary; cirri sometimes present behind upper opercular flap; no cirri on eyeball; cirri present on nasal spines; inner pelvic ray not adnate to abdomen.

Bolin (1944:127) gave an illustration of this species. This

species has been taken from the intertidal and subtidal areas. This species is uncommon in California but less so to the northern portion of its range.

C. globiceps (Girard, 1858)

Diagnosis: upper preopercular spine simple and well developed; no scales or cirri between lateral line and dorsal fin; no cirri on maxillary; cirri present behind upper opercular flap; no cirri on eyeball; cirri rarely present on nasal spines; inner pelvic ray not adnate to abdomen; cirri present in anterior portion of interorbital space; this species cannot be distinguished from C. recalvus when less than 35 mm in length (see Bolin 1944:77).

Bolin (1944:129) and Hart (1973:496) gave an illustration of this species. It has been recorded from intertidal and subtidal areas. It is very common from Oregon northward but uncommon-rare to the south especially south of Santa Cruz, California.

C. recalvus (Greeley, 1899)

Diagnosis: upper preopercular spine simple and well developed in young, less so in older specimens; no scales or cirri between lateral line and dorsal fin; no cirri on maxillary; cirri present behind upper opercular flap; no cirri on eyeball; cirri present on nasal spines; inner pelvic ray not adnate to abdomen; on specimens greater than 35-40 mm, no cirri in anterior portion of interorbital space; this species cannot be distinguished from C. globiceps when less than 35 mm in length (see Bolin 1944:77).

Bolin (1944:128) gave an illustration of this species. It has been recorded from intertidal and subtidal areas. It is common in the central portion of its range; to the north it apparently is replaced by C. globiceps.

Cottus Linnaeus, 1758

No generic synonyms are given due to the complexity of the nomenclature.

This genus is composed of more or less exclusively freshwater species. Although at least six species occur in streams draining directly into the northeast Pacific, only two species are commonly taken in nearshore marine waters, usually estuaries.

These are well defined species and, although closely related generically, the species are quite separate.

Diagnosis: branchiostegal membranes fused to the isthmus; vomerine teeth present, palatine teeth present or absent; pelvic fin with single spine and usually four rays; no cirri or papillae on body but prickles (modified scales) sometimes present; 2-4 preopercular spines, uppermost largest; rarely 7 instead of 6 branchiostegals present.

Cottus Species in the Northeast Pacific

Cottus aleuticus Gilbert, 1895

Uranidea microstoma Lockington, 1880

Cottus protrusus Schultz and Spoor, 1933

Diagnosis: prickles, if present, restricted to area behind pectoral fin; posterior pair of nares tubular; palatine teeth absent.

Scott and Crossman (1973:820) provided an illustration. The young of this species does not appear as common as C. asper in nearshore marine environments at least in Oregon (Howe, unpubl. data).

Cottus asper Richardson, 1836

Trachidermus richardsonii Heckel, 1840

Cottopsis parvus Girard, 1852

Diagnosis: prickles often present, sometimes slight patches or completely covering body; posterior pair of nares not tubular, flat or slightly mound-like; palatine teeth present.

Scott and Crossman (1973:832) provided an illustration. The young of this species appears more commonly in nearshore marine areas of Oregon than does C. aleuticus (Howe, unpubl. data).

Dasycottus Bean, 1890

This genus is restricted to the North Pacific Ocean and Bering Sea. Three species have been described but one of them, D. japonicus, has been synonymized with another, D. setiger (Schmidt 1950). Dasycottus japonicus appears to have been based upon a juvenile. Soldatov and Lindberg (1930) mention a new species but this also was based on a juvenile (Schmidt 1950). Our limited study of specimens from various localities indicates only one species in the northeast Pacific.

This genus belongs to a group of cottids (Psychrolutidae) that have been characterized as possessing 7 branchiostegals (Taranets 1941). Other cottids may also have 7 branchiostegals suggesting this group may not be composed of related taxa. Dasycottus is certainly not closely related to the other taxa in the group on the basis of skull armature, cirri and scales (unpubl. data). Superficially, Dasycottus resembles Hemitripterus but our studies are not complete. It also shares some characters with Malacocottus but we cannot advance any opinion as to relationship. At this time, we can only state that it is not a member of the psychrolutid group.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with single spine and three rays; scales in the form of spinous plates in a scattered arrangement of 1-2 rows along base of dorsal fin; 2-4 such scales on top of head; large and small cirri scattered on head and body, lower portion of opercle, lateral line pores, snout and lower jaw; 4 preopercular spines with uppermost 2 well developed; head with moderate to strongly developed spines and tubercles above orbit, on frontals and on occiput; spinous and soft dorsal fins connected but separated by a deep notch; 7 branchiostegals.

Dasycottus Species in the Northeast Pacific

D. setiger Bean, 1890

Dasycottus japonicus Tanaka, 1914

Dasycottus sp. Soldatov and Lindberg, 1930

Diagnosis: see generic diagnosis.

Hart (1973:497) provided an illustration of this species. It has been recorded at depths of 18-122 m. This species is not uncommon at least in certain areas.

Enophrys Swainson, 1839

For generic synonymy see Sandercock and Wilimovsky (1968)

This genus was recently revised by Sandercock and Wilimovsky (1968) and these workers recognized six species distributed throughout the North Pacific Ocean, Bering Sea, Arctic Ocean (part) and the northeast Atlantic Ocean. Four species occur in the northeast Pacific.

Sandercock and Wilimovsky (1968) produced a review of the genus. Twelve nominal species were reduced to six. Two of the four in the northeast Pacific, E. diceraus and E. lucasi, are not definitively separable according to Quast and Hall (1972). Working with Alaskan specimens, Quast and Hall (1972) suggest the key characters are size specific. Our limited study could not resolve this discrepancy and therefore we mention both species but warn the reader of this problem. Sandercock and Wilimovsky (1968) indicate that they believe these two species are very closely related and characterize E. diceraus as a shallower water taxon and E. lucasi as a deep water taxon. The two other species in the northeast Pacific are separable using meristics but otherwise quite similar. They are ecologically-systematically equivalent to the two aforementioned species. Enophrys bison and E. taurina are quite closely related, with bison a shallow water taxon and taurina a deep water taxon. Sandercock and Wilimovsky (1968) suggest other species of Enophrys may occur in the deep waters of the northeast Pacific; these would be forms closely related to E. diceraus and E. lucasi.

Bolin (1947) and Sandercock and Wilimovsky (1968) suggest that Enophrys is an early offshoot during the evolution of the family. Bolin (1947) places Enophrys close to Leptocottus and Zesticelus but indicates this is only a possibility. A number of characters are mutually shared by these genera but various specialized (advanced) characters (i.e. male genital papillae) must be studied before affinities can be elucidated. We can offer no opinion on these affinities.

Diagnosis: branchiostegal membranes fused to isthmus, no fold; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and two or three rays; scales

along lateral line modified into a series of plates often with tubercles and a small keel; scales variously developed in some species as prickles, absent in some or present only in young specimens; cirri variously developed but never abundant, may occur on maxillary, preopercle, below lateral line, chin and tips of dorsal fin spines; 4 preopercular spines, uppermost relatively long and single or with recurved barbs; at least in juveniles, the bones of the skull are covered with radiating patterns of minute bony tubercles.

Enophrys Species in the Northeast Pacific

We do not diagnose these species because the most definitive method of separation is the use of meristics. Enophrys diceraus and E. lucasi possess 2-8 recurved barbs (cusps) on the large, uppermost preopercular spine whereas E. bison and E. taurina do not possess barbs (cusps). Sandercock and Wilimovsky (1968) state that the barbs may not be present in individuals smaller than 4 cm. This character probably cannot, therefore, be used with small specimens. No other stable characters could be found to separate these species. Illustrations of all these species may be found in Sandercock and Wilimovsky (1968). Aside from what was mentioned above, depth information on these species is lacking.

E. bison Girard, 1854a

Clypeocottus robustus Ayres, 1854b

E. diceraus (Pallas, 1787)

Cottus stelleri Bloch and Schneider, 1801

Synanceia cervus Tilesius, 1811

Cottus claviger Cuvier and Valenciennes, 1829

Cottus elegans Gray in Cuvier and Valenciennes, 1829

Ceratocottus namiyei Jordan and Snyder, 1904

E. lucasi (Jordan and Gilbert in Jordan and Evermann, 1898)

Cottus clavigero Smitt, 1893

E. taurina Gilbert, 1914

Eurymen Gilbert and Burke, 1912

Japanopsychrolutes Nojimi, 1936

This genus contains only one species, E. gyrinus. It is limited to the North Pacific Ocean and Bering Sea.

Soldatov and Lindberg (1930) described E. bassargini from a single specimen collected in Peter the Great Bay. Schmidt (1937a) compared that specimen with E. gyrinus and concluded they were the same species.

This genus belongs to the 7 branchiostegal group)psychrolutid) of sculpins. Although it shares some characteristics suggesting affinity with Gilbertidia and Psychrolutes, it also differs in equally significant characters (i.e. well developed genital papillae in male). Therefore, we cannot at this time suggest the affinities of the genus.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present - in larger individuals - according to Schmidt (1937a), vomerine teeth are not present in specimens smaller than about 78 mm; palatine teeth absent; pelvic fin with a single spine and three rays; no scales or papillae on head or body; cirri present, scattered on head, opercle and especially apparent on lower jaw and posterior edge of maxillary; no preopercular spines; spinous and soft dorsal fins broadly connected with little to no notch.

Eurymen Species in the Northeast Pacific

E. gyrinus Gilbert and Burke, 1912

Gilbertidia ochotensis Schmidt, 1915

Eurymen bassargini Soldatov and Lindberg, 1930

Diagnosis: see generic diagnosis.

An illustration may be found in Gilbert and Burke (1912:64), Schmidt (1915:624,262), Soldatov (1927:402) and Watanabe (1960:Pl. 14-15); based on specimens seen by us, Watanabe's illustration most accurately depicts the fish. This species has been taken at depths of 14-126 m. Nothing is known of this species and it is very rare in museums.

Gilbertidia Berg, 1898

This genus contains two species; one species (G. sigalutes) occurs in the northeast Pacific Ocean and the Bering Sea while the other (G. pustulosa) is restricted to the Sea of Okhotsk.

This genus is in need of study both on the generic and the specific levels. It is a member of the 7 branchiostegal group (psychrolutid) and its affinities appear to be most close to Psychrolutes but our study has been preliminary.

As pointed out by Schmidt (1937a, 1950), various descriptions of G. sigalutes (Jordan and Starks 1895; Evermann and Goldsborough 1907) differ substantially. Further problems are apparent when one compares these descriptions with those of Gilbert and Thompson (1905), Starks (1911) and Welander and Alverson (1954). Schmidt also points out that the differences in the descriptions and illustrations are great enough to consider that different genera are involved. Our preliminary study of specimens of G. sigalutes suggests that variation is great or that undescribed species are involved. We cannot resolve this problem at present and consider there to

be only one species in the northeast Pacific. We have not seen specimens of G. pustulosa but it does appear to be valid based on literature descriptions.

Diagnosis: branchiostegal membranes fused to the isthmus with no fold; no vomerine or palatine teeth; pelvic fin with a single spine and three rays; no scales but papillae various, developed on side of body and head; cirri absent; no preopercular spines; body soft; spinous dorsal covered with thick (soft) skin to the extent that only the tips of the dorsal spines are evident; cephalic pores large and apparent especially on lower jaw and below the orbit; 7 branchiostegals.

Gilbertidia Species in the Northeast Pacific

G. sigalutes (Jordan and Starks, 1895)

Diagnosis: see generic diagnosis.

Illustrations of this species may be found in Jordan and Starks (1895:Pl.86), Evermann and Goldsborough (1907:326) and Hart (1973:501); none of these illustrations adequately depict this species. This species has been taken from the surface to over 213 m in depth. It is locally common in some areas being found on both rock and mud substrates.

Gymnocanthus Swainson, 1839

For generic synonymy, see Wilson (1973).

A recent revision of this genus recognized six species out of seven genera and eleven nominal species that previously had been erected for the group (Wilson 1973). These six species are distributed in the North Pacific, Arctic and North Atlantic Oceans. Two species were recorded for the northeast Pacific.

This is a well defined and distinct genus. Wilson (1973) was unable to elucidate its relationship to other cottid genera though he noted it had evolved considerably from the primitive cottid envisioned by Bolin (1947) and Sandercock and Wilimovsky (1968). We cannot speculate, at present, on its relationships, either; other cottid genera need morphological and osteological study before speculation can be advanced.

Until Wilson (1973), the last review of this genus was Schmidt (1927b). Schmidt's review, which was also the first, suffered from lack of specimens so some forms were inadequately reviewed. Although Wilson (1973) recognized six species, previous workers had synonymized some of these into a single, quite variable species (see Wilson 1973 for discussion). The six species of Wilson (1973) are also quite variable with the ranges in meristic characters overlapping in many, though modes and means are different. Most other distinguishing characteristics are relative, not mutually exclusive. Our studies did not allow a complete review of the genus but we did note certain possible problems with the review of Wilson (1973). Some material in museum collections appeared to have been misidentified by Mr. Wilson but this may have been the result of the senior author's unfamiliarity with the group. In any case, it is a perplexing group and Wilson (1973) has made a notable contribution.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; no vomerine or palatine teeth; pelvic fin with a single spine and three rays; flat bony granulations (modified scales?) present on nape and sometimes extending onto opercle, infraorbitals and interorbitals; modified T-shape scales present in pectoral axil, body

otherwise without scales; cirrus present in some, at least over orbit; 4 preopercular spines, the uppermost well developed with 1-6 cusps on dorsal margin.

Gymnocanthus Species in the Northeast Pacific

The two species within our area can only be distinguished by the totaling of meristic characters (both dorsals, both pectorals and anal). Although other characters including morphometrics appear to separate these species, Wilson (1973) indicates this is not possible. He notes this is particularly true for small (< 6 cm) specimens. Therefore, we do not diagnose the two species in the northeast Pacific. Both species are apparently moderately common.

G. galeatus (Bean, 1881)

Andriyashev (1954:373 in Russian edition, 401 in English translation) and Wilson (1973:127, 128) provided partial illustrations of this species. It has been recorded from 0 to 167 m in depth. Wilson (1973) notes that of the two species, G. galeatus post-juveniles are seldom taken at less than 50 m in depth.

G. pistilliger (Pallas, 1811)

Andriyashev (1954:372 in Russian edition, 400 in English translation) and Watanabe (1960:Pl. 22) provided illustrations of this species. It has been recorded from 0 to 100 m in depth. Wilson (1973) notes that of the two species, G. pistilliger post-juveniles are seldom taken at more than 50 m in depth.

Hemilepidotus Cuvier, 1829

For generic synonymy, see Peden (1964).

A recent revision of this genus recognized six species restricted to the North Pacific Ocean and Bering Sea (Peden (1964). Four of these species occur in the northeast Pacific.

This genus is well defined and distinct. It is considered by Bolin (1947) and Peden (1964) to be one of the most primitive or generalized groups of cottids. We concur, this genus retains numerous characters which are thought to be primitive. This retention of primitive characters and the lack of information (morphological and osteological) on other cottid taxa, do not allow us to determine the systematic relationships of this genus.

Prior to the work of Peden (1964), certain now-recognized species had been considered subspecies. Schmidt (1929b), Andriyashev (1937) and Gorbunova (1964) have contributed to the taxonomy of the group. Watanabe (1960) has perpetuated errors. Schmidt (1929b) considered H. hemilepidotus and H. jordani to be subspecies; Peden (1964) has shown that they are full species and we concur. Bolin (1947) and Peden (1964) consider H. spinosus to be the most generalized species within the genus and placed it within its own subgenus (Calycilepidotus). Concerning the other three species in the northeast Pacific (H. hemilepidotus, H. jordani and H. zapus), all are placed in the subgenus Hemilepidotus. These three are closely related and there is discrepancy over which two are more closely related (Bolin 1947 vs. Peden 1964). One factor contributing to this discrepancy is that no large specimens of H. zapus are known. In any case, the work of Peden (1964) is excellent and his recognition of four species in the North Pacific is valid and justified.

Diagnosis: branchiostegal membranes united and forming a fold across isthmus or fused to isthmus with no fold (H. spinosus);

vomerine and palatine teeth present; pelvic fin with a single spine and 4 rays; scales present in three bands, one at base of dorsal fin, second band immediately above lateral line and the third between lateral line and anal fin; other scales may also be present on body; cirri present mostly on head and lateral line; 4 preopercular spines small but strong with the two upper spines most developed; spines and ridges variously developed on head.

Hemilepidotus Species in the Northeast Pacific

Although we have examined and studied these northeast Pacific Hemilepidotus, we could not materially add any new information to the work of Peden (1964). While we did study the specimens, he had laid the framework. Meristic characters should also be consulted to distinguish these species.

H. hemilepidotus (Tilesius, 1811)

For synonomy, see Peden (1964).

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; dorsal scale rows 4-5; nasal cirri well developed with many branches; pyloric caecae 6 or 7; lateral line pores 60-68; width of maxillary cirri more than 1/2 its length.

Peden (1964:21, 21, 147) and Hart (1973:502) provided illustrations of this species. It has been recorded from the intertidal to 48 m in depth. It is mostly encountered in shallower waters (juveniles-adults). It is common from at least northern California to British Columbia.

H. jordani Bean, 1881

For synonymy, see Peden (1964).

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; dorsal scalerows 4-5; nasal cirri simple or with 2 branches; pyloric caecae 4-5; lateral line pores 59-68; width of maxillary cirri less than 1/2 its length.

Peden (1964; 43, 44, 148) provided illustrations of this species. Little specific depth information is available but it apparently occurs in deeper water than does H. hemilepidotus. This species is apparently common.

H. spinosus (Ayres, 1855)

For synonymy, see Peden (1964).

Diagnosis: branchiostegal membranes fused to isthmus, no fold; dorsal scale rows 6-8; nasal cirri simple, short; pyloric caecae 4-5; lateral line pores 60-72; width of maxillary cirri about 1/2 its length.

Peden (1964:11, 12) and Hart (1973:504) provided illustrations of this species. It has been recorded from the intertidal to 78 m in depth. At least as juveniles-adults, this species is less common than H. hemileptidotus and H. jordani but it apparently occurs in deeper water which may account for its supposed rarity. It does appear to be more common in the South than in the North.

H. zapus Gilbert and Burke, 1912

For synonymy, see Peden (1964).

Diagnosis: branchiostegal membranes united and forming a fold over isthmus; dorsal scale rows 4-5; nasal cirri simple or with 2 branches; pyloric caecae 7; lateral line pores

47-58; width of maxillary cirri more than 1/2 its length.

Peden (1964; 35, 36, 147) provided illustrations of this species. Little depth information is available but it has been taken between 61-107 m. It is rare, at least in museum collections.

Hemitripterus Cuvier, 1829

Ulca Jordan, 1896

This genus contains one to three species found in the North Pacific and northwest Atlantic Oceans and the south Bering Sea.

This genus is in need of review. Although the genus is distinctive, the component species are not well defined or understood. One problem concerns two nominal species, one found in the North Pacific (H. villosus) and one found in the North Atlantic (H. americanus). These are quite similar species and led Andriyashev (1937a) and Schmidt (1950) to believe they should be recognized as two subspecies of H. americanus. Our limited study of specimens suggests that the two taxa are different and should be recognized as two full species. Ecologically, these taxa appear to avoid cold waters (Schmidt 1950) neither is found in the intervening Arctic region; hence they exhibit complete allopatry. Until these taxa can be compared in detail, we should regard them as separate species though closely related. A second nominal species in our area of concentration is H. bolini. This species was described as H. marmorata by Bean (1890), subsequently this was placed in the monotypic genus Ulca by Jordan (1896). The name H. marmorata was preoccupied which lead Myers (1934) to propose the species bolini to replace marmorata. Chapman (1940) pointed out the weak generic separation between Hemitripterus and Ulca and synonymized Ulca with Hemitripterus. Chapman (1940) also mentioned the close similarity of H. villosus and H. bolini; they may be the same species. Therefore,

although we provide meristic data, we do not diagnose these species. Hemitripterus cavifrons was synonymized with H. villosus by Jordan and Starks (1904).

The genus appears to have affinities with Nautichthys and Blepsius. This proposed affinity is based on similarities of the body prickles-papillae and the complex sculpturing of the skull (ridges-knobs).

Diagnosis: branchiostegal membranes united and forming a fold across the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays; most of the body covered with embedded single-spine scales which are covered with skin giving the feel and appearance of small dermal papillae or prickles; cirri large and numerous on head and around mouth; 4 preopercular spines, lower two short and blunt; upper two developed with the second most developed; body depressed; skull with well developed complex of ridges and knobs.

Hemitripterus Species in the Northeast Pacific

H. bolini (Myers, 1934) following Bean, 1890

Hemitripterus marmorata Bean, 1890

Ulca marmorata Jordan, 1896

Ulca bolini Myers, 1934

Hemitripterus bolini Chapman, 1940

Hart (1973:505) provided an illustration of this species. It has been recorded from depths of 30 - 217 m and is not uncommon.

H. villosus (Pallas, 1811)

H. cavifrons Lockington, 1880a

Watanabe (1960:Pl.13) provided an illustration of this species. It has been recorded from depths of 27-54 m. This species is quite rare

in the northeast Pacific; we have not seen specimens from the northeast Pacific.

Icelinus Jordan, 1885

Tarandichthys Jordan and Evermann in Jordan, 1896

This genus contains 8 described and at least one undescribed species. They are all restricted to the northeast Pacific with one species reaching the Bering Sea.

Icelinus was reviewed by Bolin (1936a, 1944) and he later discussed its affinities (Bolin 1947). It is in need of review again and Alex Peden (pers. comm.) is presently undertaking a study of the group. The genus is a distinct taxon which shares many characteristics with other groups. Chitonotus as noted by Bolin (1947) is perhaps the most closely related but Icelinus has undergone more reduction in various attributes (i.e. scales, pelvic rays). Bolin (1936a, 1947) also notes that Artedius, Icelus and Radulinus are its nearest relatives. These genera do share some characteristics but together they appear to form a mixed group with characters exhibiting a mosaic of attributes. Like most cottid genera, Icelinus is in need of systematic study.

One undescribed species, known presently from off La Jolla, California, is under study by C.L. Hubbs (pers. comm.). This is an interesting species as it resembles a deep-bodied Artedius. The relationships of the other species within the genus have been presented by Bolin (1936a, 1947). Four subgenera were proposed. Icelinus cavifrons, I. filamentosus and I. tenuis formed one subgenus (Tarandichthys) which prior to Bolin (1936a) had been recognized as a separate genus. These are characterized by reduction in dorsal scales, retention of scales in the pectoral axilla and development of filimentous spines in the first dorsal, at least in males. Icelinus

burchami was placed in its own subgenus (Medicelinus) characterized by lesser dorsal scale reduction and no scales in pectoral axilla. Icelinus fimbriatus and I. oculatus formed another subgenus (Penicelinus) characterized by no (little) loss of dorsal scales and great development in the male genital papillae. Icelinus borealis and I. quadriseriatus were placed in the fourth subgenus (Icelinus) and are very closely related; they were characterized by no (little) loss of dorsal scales and little development of male genital papillae. Our study did not allow a full review of Bolin's proposed relationships. Some of his proposal is based on reduction of characters which may not be the best choice of attributes to use in establishing affinities but we cannot offer any more information. Some of the species conflict with the descriptions of Bolin (1936a) as well as Bolin (1936a, 1944) appears to have presented some ambiguities in his keys and descriptions.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and two rays; scales present, along lateral line and two rows of scales below dorsal fins extending at least to middle of second dorsal; cirri variously developed on head and body, with end of maxillary (sometimes very small) and supraorbital cirri always present; 4 preopercular spines, uppermost antler-like with 1 to 5 barbs on dorsal margin.

Icelinus Species in the Northeast Pacific

The undescribed species from off La Jolla, California, cannot be diagnosed at this time - it resembles a deep-bodied Artedius. One other species (I. australis Eigenmann and Eigenmann, 1889) was described from

two half-digested specimens taken from the stomach of a "rock-cod" caught off southern California. Bolin (1936a) notes it is probably not an Icelinus and can be ignored. Meristic characters are useful to separate some species.

I. borealis Gilbert 1895

I. strabo Starks, 1896

I. microps Starks, 1896 [Name an apparent mistake.]

Diagnosis: dorsal scales beginning below 1st or 2nd dorsal spine and extending onto caudal peduncle; no distinct upper post-orbital spines; no scales in pectoral axilla; base of nasal spines with cirri; small, single cirri present on end of maxillary; top of head gently concave; pelvic fins extending more than one-third the distance from pelvic base to anal fin origin.

This species was illustrated by Gilbert (1895:Pl.25), Evermann and Goldsborough (1907:298) and Hart (1973:507). It has been recorded at depths of 18-247 m and is common, at least off British Columbia.

I. burchami Evermann and Goldsborough, 1907

I. fuscescens Gilbert, 1915

Diagnosis: dorsal scales beginning below 5th or 6th dorsal spine and not extending onto caudal peduncle; no distinct upper postorbital spines; no scales in pectoral axilla; no cirri at base of nasal spines; single, small cirri present on end of maxillary; top of head flat or slightly concave; pelvic fins extending less than one third the distance from pelvic base to anal fin origin.

This species was illustrated by Evermann and Goldsborough (1907:297), Bolin (1944:116) and Hart 1973:508). It has been recorded from 244 to 567 m in depth and is rare.

I. cavifrons Gilbert, 1890

Diagnosis: dorsal scales beginning under 5th or 6th dorsal spine and not extending onto caudal peduncle; 2 distinct upper postorbital spines present; 1-5 scales present in pectoral axilla; no cirri at base of nasal spines; single, small cirri present on end of maxillary; top of head with abrupt depression (pit) about the size of pupil; pelvic fins extending one-third or more the distance from pelvic base to anal fin origin.

This species was illustrated by Bolin (1944:116). It has been recorded from depths of 11-91 m. It is not common.

I. filamentosus Gilbert, 1890

Diagnosis: dorsal scales beginning under 3rd or 4th dorsal spine and not extending onto caudal peduncle; no distinct upper postorbital spines; 2-6 scales present in pectoral axilla; single, long cirri present at base of nasal spines; single, long cirri present on end of maxillary; top of head slightly concave; pelvic fins extending one-third or more the distance from pelvic base to anal fin origin.

This species was illustrated by Jordan (1896:Pl.28), Bolin (1944:114) and Hart (1973:510). It has been recorded at depths of 37 to 373 m. It is relatively common.

I. fimbriatus Gilbert, 1890

Diagnosis: dorsal scales beginning under 2nd or 3rd dorsal spine and extending onto caudal peduncle; 2 low upper postorbital spines present; no scales in pectoral axilla; long cirri present at base of nasal spines; numerous or fringe or cirri present on end of maxillary; top of head gently concave; pelvic fins extending about one-third the distance from pelvic fin base to anal fin origin.

This species was illustrated by Bolin (1944:117). It has been recorded from depths of 60 to 265 m and is rare.

I. oculatus Gilbert, 1890

Diagnosis: dorsal scales beginning under 2nd or 3rd dorsal spine and extending onto caudal peduncle; spines in upper postorbit small or absent; no scales in pectoral axilla; small cirri present at base of nasal spines; single cirri present on end of maxillary; top of head gently concave; pelvic fins extending one-third or less the distance from pelvic base to anal fin origin.

This species was illustrated by Bolin (1944:117) and Hart (1973:511). It has been recorded at depths of 82-196 m. It is very rare.

I. quadriseriatus (Lockington, 1880b)

Diagnosis: dorsal scales beginning under 4th or 5th dorsal spine and extending onto caudal peduncle; no distinct upper postorbital spines; no scales in pectoral axilla; cirri present at base of nasal spine; single cirri present on

end of maxillary; top of head gently concave; pelvic fins extending more than one-third the distance from pelvic base to anal fin origin.

This species was illustrated by Jordan (1896:Pl.29) and Bolin (1944:118). It has been recorded from depths of 6 to 101 m. It is somewhat common.

I. tenuis Gilbert, 1890

Diagnosis: dorsal scales beginning under 4th or 5th dorsal spine and not extending onto caudal peduncle; 2 distinct upper postorbital spines present; 5-19 scales in pectoral axilla; no cirri at base of nasal spines; small cirri at end of maxillary; top of head gently concave; pelvic fins extending about one-third the distance from pelvic base to anal fin origin.

This species has been illustrated by Bolin (1944:115) and Hart (1973:513). It has been recorded from depths of 33 to 373 m. It is somewhat uncommon.

Icelus Kröyer, 1845

Rastrinus Jordan and Evermann, 1896

Agonocottus Pavlenko, 1910

Ochotskia Schmidt, 1915

This genus contains 13 nominal species distributed in the North Pacific, Arctic and North Atlantic Oceans. Six nominal species are recorded for the northeast Pacific.

This genus is somewhat well defined on a generic level. The affinities of this genus are somewhat obscure though at least some other genera are

closely related. Jordan (1923) placed this genus into Icelidae along with most other scaled cottid genera. Berg (1940) also recognized Icelidae though containing only three genera - Icelus, Marukawichthys and Ereunias. The latter two genera are Japanese endemics (both monotypic) and prior to Matsubara's (1936) paper, they had both been in their own monotypic families. Matsubara (1936) indicated that their relationships are with Icelus. Taranets (1941) ignored (or had not seen) Matsubara's paper and placed the two Japanese genera again into their own monotypic families. In the same paper, Taranets placed Icelus close to Chitonotus, Icelinus, Artedius and others. Schmidt (1950) followed Taranets. As mentioned in our discussion of Cottidae, Greenwood et al. (1966) and Nelson (1976) follow Berg (1940) and recognize Icelidae as containing the three genera. Matsubara (1936) suggested the three genera should be in Cottidae, not their own family. We concur; these three genera fit the description of the family Cottidae quite well. If they are recognized as a separate family many other cottid genera should be elevated to family status with the result of loss of information and nomenclatural burden.

The direct affinities of Icelus are somewhat obscure. The group shares many characteristics with other genera - Icelinus, Paricelinus, Artedius and others. Its closest affinities must await further study. The aforementioned genera appear to possess common attributes (primitive and advanced) but in a mosaic fashion suggesting among other things, these groups would be ideal subjects for systematic study of cottid genera.

The component species of Icelus have been little studied with a few regional exceptions. Schmidt (1927a, 1935) reviewed the genus recognizing 7 species in the earlier paper and 10 species in the later paper.

Taranets (1936) described 3 new species, one of which had been included in Schmidt's (1936) key to the species. Some of the species recognized by Schmidt (1927a, 1935) had not been seen by him. Schmidt (1950) later reviewed the Icelus species of the Sea of Okhotsk but added little new information. Soldatov and Lindberg (1930), Andriyaskev (1937b) and Taranets (1937) also contributed some regional information on North Pacific species. Arctic and North Atlantic species have been studied by Jansen and Volsoe (1949), Andriyashev (1954) and McAllister (1963). The group is in need of review and it would be premature to attempt to draw relationships. A number of subspecies have also been described which also adds to the taxonomic confusion.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays; scales present, large and plate-like along lateral line, series of large, usually spiny plate-like scales near dorsal fin base, smaller spinous scales present or absent on head and above or below lateral line; cirri generally absent but present in some species; 4 preopercular spines, uppermost hooked and simple or bifurcate; spines present on top of head and on cheek region though in some species reduced or absent.

Icelus Species in the Northeast Pacific

Various workers (Jordan and Evermann 1898; Jordan et al. 1931; and others have referred to Icelinus australis but with no indication that a generic revision had taken place. Apparently, Jordan and Evermann (1898) erred in placing it in Icelus; they indicate to the reader it was described

as an Icelus but that was wrong, it was described as an Icelinus. Later workers have sometimes followed the error of Jordan and Evermann. For a discussion of this probably invalid species, consult the Icelinus section of this paper.

In some cases, very few specimens are known and differentiation has been based upon male genital pallillae - a poor character for differentiation.

I. canaliculatus Gilbert, 1895

Diagnosis: single series of large plates above lateral line with small spines on dorsal and posterior margins; band of small scales above the large plates; rows of scales below lateral line reaching or nearly reaching anal fin; eye about one-third head length and about 1-1/2 the length of snout; opercle and head sparcely covered with scales-prickles or naked.

This species was illustrated by Gilbert (1895:Pl.24) and Evermann and Goldsborough (1907:301). The types were recorded at depth of 730 m and Schmidt (1950) records a specimen from 525 m. This species appears to be rare.

I. euryops Bean, 1890

Diagnosis: single series of large plates above lateral line with small spines on dorsal and posterior margins; band of small scales above the large plates; scales below lateral line restricted to a patch of spinous plates behind pectoral fin; eye about 2/5 head length and about twice the snout length; head and opercle covered with scales-prickles.

This species has not been illustrated and the depth is unknown though apparently it is found in deep water. This species is rare.

I. scutiger Bean, 1890

Diagnosis: small, spinous scales above lateral line nearly covering back and back without series of plates; scales present below lateral line - behind pectoral fin and above anal fin; eye about 2/5 head length and about twice snout length; head densely covered with scales-prickles.

This species was illustrated by Evermann and Goldsborough (1907:300). It has been recorded at depths of 117 to 291 m. This species appears to be rare.

I. spatula Gilbert and Burke, 1912

This species is very similar to I. uncinalis.

Diagnosis: single series of large plates above lateral line with small spines on dorsal and posterior margins; band of small scales above large plates; scales below lateral line restricted to patch behind pectoral fin; eye about 1/2 head length and less than 1-1/2 snout length; head covered with prickles; male genital papilla spatulate, widening from base to tip.

This species was illustrated by Gilbert and Burke (1912:42). It has been recorded at a depth of 88 to 126 m. Schmidt (1954) recorded a "subspecies" at depths of 55 to 150 m. Andriyashev (1950) recorded it at depths of 13 to 130 m. This species appears to be uncommon.

I. spiniger Gilbert, 1895

Diagnosis: single series of large plates above lateral line each with a large curved spine; few scales above plates; scales below lateral line restricted to patch behind pectoral fin; eye about 1/3 head length.

This species was illustrated by Gilbert (1895:Pl.24), Evermann and Goldsborough (1907:300) and Hart (1973:515). It has been recorded at depths of 31 to 247 m. While uncommon, this species appears to be the most common Icelus in the northeast Pacific though this is probably because of its geographic and depth distribution.

I. uncinalis Gilbert and Burke, 1912

This species is very similar to I. spatula

Diagnosis: single series of large plates above lateral line with small spines on dorsal and posterior margins; band of small scales above large plates; scales below lateral line restricted to patch behind pectoral fin; eye about 1/3 head length and less than 1-1/2 snout length; head covered with prickles, male genital papillae cylindrical throughout length.

This species was illustrated by Gilbert and Burke (1912:40). It has been recorded at depths of 79 to 247 m. Schmidt (1950) records a "subspecies" from 10 to 115 m. This species appears to be rare.

Jordania Starks, 1895

This genus contains a single species (J. zonope) restricted to the northeast Pacific.

The generic relationships of this genus are obscure. Jordan and Starks (1895) stated that it was related to Icelus and Artedius. We do

not believe this genus is related to those genera. It appears to be related to Triglops but primary observations suggest that the relationship is distant. Bolin (1947) suggested that it had affinities to Paricelinus but our observations suggest the relation may be quite distant. Though not studied in any detail, Jordania shares certain characteristics with the genus Radulinus but the affinity is speculation.

Diagnosis: branciostegal membranes united and forming a fold over the isthmus; vomerine and palatine present; pelvic fin with a single spine and five (rarely four) rays; scales covering most of the body, lateral line scales with posterio-ventral ctenoid margins, above the lateral line the scales are in the form of small spines arising from a basal plate; below the lateral line they form long, oblique, serrated folds, head scales irregularly arranged; cirri present near nasal spines, above eyes and on top of head; 2 preopercular spines, the lower well developed, sharp and curved upward; larger individuals with branched rays in some fin rays of all fins except first dorsal.

Jordania Species in the Northeast Pacific

J. zonope Starks, 1895

Diagnosis: see generic diagnosis.

This species was illustrated by Bolin (1944:110) and Hart (1973:516). It has been recorded from the intertidal to 38 m in depth. Although appearing uncommon in California, Oregon and Washington (?), Peden and Wilson (1976) report it to be common in northern British Columbia.

Leiocottus Girard, 1856

This genus contains a single species (L. hirundo) confined to the northeast Pacific.

The affinities of Leiocottus appear to be close to Clinocottus as noted by Bolin (1947). It differs primarily in size (slightly larger), attachment of branchiostegal membranes, the anterior rays of the spinous dorsal being elevated and the absence of palatine teeth. These latter two characters are somewhat expressed in Clinocottus. The degree of affinity should be investigated.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and three rays; no scales; cirri present near nasal spines, on preopercle, on end of maxillary, near upper edge of gill slit and along anterior portion of lateral line; 4 preopercular spines present, only the uppermost bifid and conspicuous; anus in middle third of distance between pelvic fin base and anal fin origin.

Leiocottus Species in the Northeast Pacific

L. hirundo Girard, 1856

Diagnosis: see generic diagnosis.

Bolin (1944:131) provided an illustration of this species. It has been recorded from the intertidal to 37 m and is uncommon.

Leptocottus Girard, 1854a

This genus contains a single species (L. armatus) restricted to the northeast Pacific.

The affinities of this genus are obscure. Bolin (1947) suggested that Leptocottus is closest to Enophrys and Zesticelus but indicates this is only a possibility. A number of characters are mutually shared but some major differences are apparent. We can offer no opinion on these affinities at this time.

Diagnosis: branchiostegal membranes fused to isthmus, no fold; vomerine and palatine teeth present; pelvic fin with a single spine and four rays; no scales on head or body; no cirri on head or body; 3 preopercular spines, uppermost well developed and antler-like with 2-5 recurved barbs on dorsal margin.

L. armatus Girard, 1854a

Diagnosis: see generic diagnosis.

This species was illustrated by Bolin (1944:133) It has been recorded from the intertidal to 91 m in depth. Throughout its range, this is a very common estuarine species.

Malacocottus Bean, 1890

This genus contains five nominal species which are restricted to the North Pacific Ocean and Bering Sea.

Aside from four described species, Federov (1973) lists one undescribed species from the Bering Sea and Jordan and Gilbert have material of two undescribed species deposited in the Stanford Collection at California Academy of Sciences. The genus and its component species are in need of review. The two described species within our area of concentration are perplexing. Although they were seemingly adequately described, we propose that: 1) variation in both species may be great; 2) they overlap in ranges especially to southern limit; 3) perhaps only one species is involved,

and, 4) other undescribed species may be involved. Preliminarily, our studies suggest that the two described species may be the same variable species but one to three undescribed species are found in this area (including 'globby' types of SLR). At present, we cannot resolve this confusing situation and, therefore, do not diagnose the two described species of Malacocottus. On a generic level, we cannot determine the affinities of Malacocottus. It is a 7 branchiostegal cottid belonging to the psychrolutid group (see Psychrolutes discussion). This group is a mixed group and we presently do not understand the affinities of Malacocottus.

Diagnosis: branchiostegal membranes fused to isthmus, no fold; no vomerine and palatine teeth; pelvic fins with single spine and three rays; scales present in the form of minute sharp spines (prickles); cirri variously developed; 4 preopercular spines, well developed and sometimes with accessory spine at base of largest; 7 branchiostegals; dorsal fins completely separated, not connected by membrane.

Malacocottus Species in the Northeast Pacific

We have mentioned above why we do not diagnose these species.

M. kincaidi Gilbert and Thompson, 1905

M. zonurus Bean, 1890

Illustrations of a Malacocottus were provided by Watanabe (1960:Pl.37), Clemens and Wilby (1961:313) and Hart (1973:519). It has been recorded from depths of 27 to 275 m.

Myoxocephalus Tilesius, 1811

Due to the complexity of the group, no synonymy is given.

This genus is large and complex but 18 species are presently recognized by Cowan and Wilimovsky (pers. comm.); these workers are presently revising the genus. The species are found in the North Pacific, Arctic and North Atlantic Oceans. Cowan and Wilimovsky (pers. comm.) recognized three described and one undescribed species as occurring in the northeast Pacific.

This genus is large, complex and in need of review; as mentioned, this review is presently in progress by Cowan and Wilimovsky. Cowan (1971, 1972a, 1972b) has presented a series of enlightening papers on many of the species within the genus. Prior to Cowan's work, information on the group has been limited to regional works (e.g. Schmidt 1950; Andriyashev 1954; and, of lesser importance, many others) and the revision of Schmidt (1929c). More detailed information must await the further work of Cowan and Wilimovsky.

The relationships and affinities of the genus within the family are, with certain exceptions, somewhat obscure. It appears that Argyrocottus, Megalocottus and Porocottus are closely related to Myoxocephalus. Only Porocottus occurs in the northeast Pacific. Taurocottus and Trichocottus have also been suggested to have affinities with Myoxocephalus (Schmidt 1929c). At this time, little work of our own or others is available to indicate more definitive affinities of Myoxocephalus. This genus, like most other cottid genera, must await study. The limits of the genus itself are in need of definition also.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fins with a single spine and three rays; scales absent or modified into prickles, plates or tubercles; cirri sometimes present on head; usually 3 preopercular

spines, sometimes 4, uppermost spine usually well developed single spine; lateral line with accessory pores and branches, parallel to or radiating from the central canal.

Myoxocephalus Species in the Northeast Pacific

We do not diagnose the new species; description of this species will be published shortly (N.J. Wilimovsky, pers. comm.). Meristic characters aid in the identification of these species. Synonymies for these species are not given due to the forthcoming work of Cowan and Wilimovsky.

M. jaok (Cuvier and Valenciennes, 1829)

Diagnosis: scales above lateral line stellate, below lateral line spinate, at least posteriorly; tubercles on head without cirri; body very slender with wide, flat head; uppermost preopercular spine about the length of the eye.

This species was illustrated by Andriyashev (1954:376 in Russian edition, 405 in English translation). It has been recorded from shallow waters (i.e. bays). This species is apparently common throughout its range.

M. polyacanthocephalus (Pallas, 1811)

Diagnosis: scales above and below lateral line spinate; tubercles on head without cirri; body not particularly slender; uppermost preopercular spine longer than the length of the eye.

This species was illustrated by Jordan and Gilbert (1899:Pl.63) and Hart (1973:521). It has been recorded from intertidal and subtidal areas. This species is apparently common throughout its range.

M. niger Bean, 1881

Diagnosis: scales absent above and below lateral line; tubercles on head with cirri; body not particularly slender; uppermost preopercular spine smaller than the eye.

This species was illustrated by Jordan and Gilbert (1899:Pl.65). It has been recorded from intertidal and subtidal areas. This species is apparently common in tidepools.

Nautichthys Girard, 1858

Nautiscus Jordan and Evermann, 1898

This genus contains three species which are limited to the North Pacific Ocean, Bering and Chukchi Seas.

In his description of a new species, Peden (1970) briefly reviewed the species within this genus. Prior to Schmidt (1950), some authors had considered N. oculofasciatus and N. pribilovius as the same species; differences had been attributed to sexual dimorphism. Schmidt (1950) corrected this error yet literature records should be suspect because of this confusion. Within the genus, N. pribilovius and N. robustus are quite closely related.

This genus appears to have close affinities with Blepsius and probably Hemitripterus but the degree of affinity must await study. The primary characteristic suggesting affinity is the complex sculpturing (ridges-knobs) of the skull.

Diagnosis: branchiostegal membranes fused to isthmus with no fold; vomerine and palatine teeth present; pelvic fins with a single spine and three rays; most of body covered with embedded single-spine scales which are covered with skin giving the feel and appearance of small dermal papillae

or prickles; cirri developed on head; 3-4 preopercular spines, upper two developed; skull with well-developed complex of ridges and knobs.

Nautichthys Species in the Northeast Pacific

These species are quite similar morphologically; meristics are the most definitive method of identification.

N. oculofasciatus (Girard, 1858)

Diagnosis: height of first dorsal fin in males greater than head length; lateral line pores 41-46; rounded spines on occiput.

Bolin (1947:135) provided an illustration of this species. It has been taken from the intertidal to 110 m in depth. It is moderately uncommon.

N. pribilovius (Jordan and Gilbert) in Jordan and Evermann, 1898

Diagnosis: height of first dorsal fin in males less than head length; lateral line pores 37-42; rounded spines on occiput.

Jordan and Gilbert (1899:Pl.69) provided an illustration of this species. This species has been recorded from 30 to 126 m in depth; Peden (1970) reports two specimens from 2.1 - 4 m in depth. It appears to be moderately uncommon.

N. robustus Peden, 1970

Diagnosis: height of first dorsal fin in males less than head length; lateral line pores 35-38; pointed spines on occiput.

Peden (1970:10) provided an illustration of this species. This species has been recorded from 2-73 m in depth. It is rare.

Oligocottus Girard, 1856

Dialarchus Greeley, 1899

Eximia Greeley, 1899

Rusciculus Greeley, 1899

Stelgidonotus Gilbert and Thompson, 1905

Greeleya Hubbs, 1926b

This genus contains four species all of which are restricted to the northeast Pacific Ocean with one species (O. maculosus) possibly occurring in the Sea of Okhotsk and Bering Sea (discussed below).

This is a relatively well defined group following the work of Hubbs (1926b) and Bolin (1944). Although Bolin (1947) suggested Oligocottus is as closely related to Artedius as it is to Clinocottus, our preliminary studies suggest Oligocottus and Clinocottus are more closely related to each other than either is to Artedius. This does not negate the relatively close relationship that Artedius appears to share with those two genera. The more northern genera, Phallocottus and Sigmistes, also appear related to Oligocottus and Clinocottus. Further discussion of the affinities of Oligocottus must await more detailed study.

Within the genus, the affinities of the four species have been presented by Bolin (1947). Oligocottus rubellio and O. snyderi are the most specialized and the most closely related. Oligocottus maculosus appears less specialized and related to both of the aforementioned species. Oligocottus rimensis is the most primitive type and equally related to all of the other species. Like Clinocottus, Oligocottus species exhibit some interesting variation throughout their range but these two genera are probably among the most well-studied cottid groups - ecologically and taxonomically.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three rays; visable scales absent except in one species in which they are modified into minute prickles; cirri usually well developed on head, lateral line and along sides of body; 4 preopercular spines but lower 2-3 very obscure; anus in posterior third of distance between pelvic fin base and anal fin origin.

Oligocottus Species in the Northeast Pacific

O. maculosus Girard, 1856

O. borealis Jordan and Snyder in Jordan, 1896

O. wosnessenskii Schmidt, 1903

O. alaskanus Miles, 1918 (*lapsus calami*)

According to Bolin (1944), this species occurs in the Sea of Okhotsk and was described as O. wosnessenskii by Schmidt (1903). Bolin indicated that he had examined specimens from Okhotsk. [We have not seen the paper of Schmidt (1903).] Curiously, Schmidt (1950) did not mention this genus or species in his monograph on the Sea of Okhotsk ichthyofauna. In any case, we believe that Oligocottus does not occur in the Sea of Okhotsk nor in the Bering Sea. Wilimovsky (1964) did not record any during his intensive sampling of the Aleutian Islands and Federov (1973) did not record any from the Bering Sea. Although we did not determine the most northern (northwestern) limit of the species, it certainly occurs in the Gulf of Alaska (based on museum specimens).

Diagnosis: visible prickly scales absent; upper preopercular spine bifid, rarely trifid; cirri sparse on head, absent from base of nasal spines and none above lateral line; 1-3

cirri on posterior edge of maxillary but no cirri on suborbital stay.

Illustrations of this species may be found in Bolin (1944:124) and Hart (1973:567). It has been recorded from intertidal and subtidal areas. It is common.

O. rimensis (Greeley, 1899)

Stelgidonotus latifrons Gilbert and Thompson, 1905

Diagnosis: minute prickly scales present; upper preopercular spine simple, rarely bifid; cirri sparse on head, present on nasal spines but none on body above lateral line; 1 cirrus occasionally on posterior edge of maxillary but no cirri on suborbital stay.

Greeley (1899:13), Bolin (1914:123) and Hart (1973:529) illustrated this species. It has been recorded from intertidal areas. It appears to be uncommon throughout its range.

O. rubellio (Greeley, 1899)

Diagnosis: visable prickly scales absent; upper preopercular spine trifid, occasionally bifid or quadrifid; cirri moderately dense on head, present at base of nasal spines and present above lateral line; 1-4 cirri present on posterior edge of maxillary and a tuft of cirri present on suborbital stay.

Greeley (1899:18) and Bolin (1944:126) illustrated these species. It has been recorded from intertidal and subtidal areas. It is less common than maculosus and synderi but not as uncommon as rimensis.

O. snyderi Greeley, 1899

Diagnosis: visable prickly scales absent; upper preopercular spine bifid, occasionally trifid; cirri moderately dense on head, present at base of nasal spines and present above lateral line; no cirri on maxillary or suborbital stay.

Greeley (1899:15), Bolin (1944:125) and Hart (1973:530) illustrated this species. It has been recorded from intertidal and subtidal areas. It is common throughout its range.

Orthonopias Starks and Mann, 1911

This genus contains a single species (O. triacis) restricted to the northeast Pacific.

The affinities of this genus are to Artedius and the relationship is quite close. Two characters separate the two genera; Orthonopias possesses modified pelvic fins, the fin rays are arranged in a longitudinal series rather than an oblique series, and the anus is closer to the pelvic fin base than to the anal fin origin. As mentioned in the Artedius section, these genera are probably related to Oligocottus and Clinocottus.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fins with a single spine and three rays, arranged in a longitudinal series rather than in an oblique series; scales present on body above lateral line arranged in 26-32 oblique rows with 10-14 scales in the longest row; scales dense on head above bottom of eye; cirri present on end of maxillary, base of nasal spines, above posterior portion of orbit, along anterior lateral line pores, on top of head and elsewhere; 4 preopercular spines, uppermost strong, sharp and curved upward, usually multifid; anus closer to pelvic fin base than anal fin origin.

Orthonopias Species in the Northeast Pacific

O. triacis Starks and Mann, 1911

Diagnosis: see generic diagnosis.

This species was illustrated by Bolin (1944:123). It has been recorded from the intertidal to 30 m in depth. It was considered rare by Bolin (1944) and common by Miller and Lea (1973).

Paricelinus Eigenmann and Eigenmann, 1889

Alcidea Jordan and Evermann, 1898

This genus contained one species (P. hopliticus) restricted to the northeast Pacific.

The generic relationships of this genus are obscure. Bolin (1947) suggested that it had affinities to Jordania but our observations suggest only a distant relationship. This genus is most peculiar in the serrations and spines on the head and long the base of the dorsal fins. These resemble the spines found in species of Icelus; other characters also suggest Paricelinus has affinities with Icelus but these interesting genera must await close comparison.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and five rays; scales covering most of body, lateral line scales enlarged and each bearing a spine, body scales smaller and each with a small spine; a series of 32-36 very enlarged, strong spines (scales) along base of dorsal fins; cirri present on head, scattered with a large, fringed postorbital cirrus; 3 preopercular spines, middle spine slightly larger; head with well developed, recurved spines on occiput, postorbital and suborbital stay.

Paricelinus Species in the Northeast Pacific

P. hopliticus Eigenmann and Eigenmann, 1889

Paricelinus throburni Gilbert, 1895

Alcidea throburni Jordan and Evermann, 1898

Diagnosis: see generic diagnosis.

This species was illustrated by Bolin (1944:111) and Hart (1973:532). It has been taken from the surface to 183 m in depth. It is rare throughout its range.

Phallocottus Schultz, 1938

This genus contains a single species (P. obtusus) and is restricted to the Aleutian Island region.

This genus is closely related to the Oligocottus-Clinocottus group of sculpins. The differences involved in generic separation are minor and Phallocottus exhibits affinities to both of the other genera; preliminary study suggests it is closest to Clinocottus.

Diagnosis: branchiostegal membranes united and forming a fold across the isthmus; vomerine teeth present, palatine teeth absent; pelvic fins with single spine and three rays; no scales and papillae; cirri present on anterior lateral line pores, over each concealed nasal spine, on the post-orbital region and on the top of the head; 4 preopercular spines but lower 3 reduced to nubs and uppermost short, blunt and thin; body rather compressed; lateral line arched above pectoral fin.

Phallocottus Species in the Northeast Pacific

P. obtusus Schultz, 1938

Diagnosis: see generic diagnosis.

Schultz (1938:189) provided an illustration of this species. All known specimens have been taken close to shore (intertidal-subtidal). Nothing is known of this species.

Porocottus Gill, 1860

Crossias Jordan and Starks, 1904

This genus contains six species which are restricted to the North Pacific Ocean and the Bering Sea.

This genus was recently reviewed by Neelov (1975, paper in Russian). Discussions of this genus or its allies may be found in Schmidt (1929c, 1929d, 1940, 1950), Taranetz (1935) and Hubbs and Schultz (1941). As pointed out by the aforementioned authors, Porocottus is closely related to Myoxocephalus, a large widespread genus. Other genera also related to Myoxocephalus and Porocottus are Megalocephalus, Microcottus, Taurocottus, Trichocottus and Argyrocottus (aforementioned authors; unpubl. observations). The interrelationships and affinities of this group are in serious need of study. Myoxocephalus is the largest genus of marine sculpins containing 17-18 species, though many more have been described (Cowan and Wilimovsky, pers. comm). Except for Porocottus (6 species) and Megalocottus (2 species), the other genera are monotypic. See discussion of Myoxocephalus.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and three rays; body mostly without scales or papillae; cirri present

above eye and on top of head; 4 preopercular spines, uppermost curved upward; lateral line with accessory pores extending perpendicular to the canal; inner ray of pelvic fin not adnate to abdomen; pectoral fins of males with bony tubercles on fin rays.

Porocottus Species in the Northeast Pacific

P. bradfordi Rutter in Jordan and Evermann 1899

Crossias albomaculatus Schmidt, 1915

Diagnosis: three pairs of cirri on head, first pair above posterior of orbit, each cirrus of every pair usually with three or more filiments (branches).

This species has been illustrated by Schmidt (1915:620). This species has been taken in the intertidal. On the basis of museum lots and the literature, this species is common or locally common within the intertidal.

Psychrolutes Gunther, 1861

This genus contains two species which are restricted to the North Pacific Ocean and Bering Sea.

One of the two species in this genus was only recently described, P. phrictus Stein and Bond, 1978. This genus belongs to the 7 branchiostegal group of sculpins; this group has been termed the psychrolutid group following the practice of many workers of recognizing the family Psychrolutidae. This group includes Cottunculoides, Cottunculus, Dasycottus, Ebanania, Eurymen, Gilbertidia, Malacocottus, Neophrynichthys, Psychrolutes and Thecopterus. This is a very mixed group but has not been studied in any way. It is in need of study. Preliminarily, it appears

that some of these genera can be synonymized. In the present case, Psychrolutes appears to be quite closely related to Gilbertidia; it may also be related to the Cottunculus-Ebanania-Neophrynichthys taxa but we are less aware of that (those) relationship(s). Until the generic relationships are determined, the specific relationships within Psychrolutes cannot be assessed.

Distribution records for the North Pacific (east and west) psychrolutid genera have been found to contain a number of errors, mostly as a result of misidentifications.

Diagnosis: branchiostegal membranes fused to the isthmus, no fold; no vomerine and palatine teeth; pelvic fin with a single spine and three rays; scales present or absent - see specific diagnoses; cirri-papillae present or absent - see specific diagnosis; no preopercular spines; soft body, 7 branchiostegals; dorsal spines completely buried in flesh (gelatinous tissue).

Psychrolutes Species in the Northeast Pacific

P. paradoxus Gunther, 1861

P. zebra Bean, 1890

Diagnosis: maximum size about 2.3 in (5.8 cm); no cirri but stout papillae over head, body and a portion of the fins; prickles few and restricted to two ventrolateral rows.

This species was illustrated by Jordan and Starks (1904:329) and Hart (1973:533). It has been recorded from 33-220 m in depth. It appears to be locally common, at least in some areas.

P. phrictus Stein and Bond, 1978

Diagnosis: maximum size over 20 in (50 cm); cirri present, scattered on head and body; prickles present in individuals less than 50 mm SL; no papillae.

Stein and Bond (1978:4-5) provided an illustration and photograph. It has been recorded from depths of 933-2800 m. NOTE: We have recently identified P. phrictus from the Bering Sea where they are apparently not uncommon.

Radulinus Gilbert, 1890

Radulinopsis Soldatov and Lindberg, 1930

This genus is composed of five species restricted to the North Pacific. Although Bolin (1950) reviewed the genus, two of the species were not seen by him. Although the species are well defined, the species should be reviewed because the two species were not viewed by Bolin and Radulinus and Asemichthys appear closely related, they should, perhaps, be synonymized.

The relationships of Radulinus and Asemichthys are obscure. They share a number of characteristics with Icelinus; this may be a group to which Radulinus is related but our work is too preliminary to offer much more than speculation. These genera also share characteristics with Jordania, Triglops and Artedius but again any relationship statement is speculation.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present or absent, palatine teeth absent; pelvic fin with a single spine and three rays; scales present, large and ctenoid along lateral line, smaller scales on snout, base of opercular flap, region of orbit and a row above lateral line; cirri small and few; 4 preopercular spines, lower two inconspicuous.

Radulinus Species in the Northeast Pacific

R. asprellus Gilbert, 1890

Diagnosis: snout equal to or shorter than eye; vomerine teeth present; nasal spines short; no cirri present on side of body below lateral line.

An illustration of this species may be found in Bolin (1944:118). This species has been recorded from 48-290 m in depth. It is the most common member of this genus in the northeast Pacific.

R. boleoides Gilbert in Jordan and Evermann, 1898

Diagnosis: snout greater than eye length; vomerine teeth present; nasal spines long and needle-like; no cirri present on side of body below lateral line.

Bolin (1944:119) provided an illustration of this species. This species has been recorded from 73-146 m in depth. It appears to be rare as few specimens have been recorded or are available in museum collections.

R. vinculus Bolin, 1950

Diagnosis: snout equal to or shorter than eye; vomerine teeth absent; nasal spines not needle-like; one or more cirri present on side of body below lateral line.

Bolin (1950:199) provided an illustration of this species. It has been recorded from 21-27 m in depth and is considered rare.

Rhamphocottus Gunther, 1874

This genus contains a single species (R. richardsoni) which is restricted to the North Pacific.

This is a bizarre sculpin whose relationships must await osteological and other comparisons. Rhamphocottus is one of the few sculpins whose osteology has been described (Johnson 1918). It does share some characteristics, which may be of systematic value, with Blepsias-Nautichthys-Hemitripterus but no more information may be advanced at this time.

Diagnosis: branchiostegal membranes fused to isthmus, no fold; vomerine and palatine teeth may be present; pelvic fin with a single spine and three rays; most (all) of the body covered with embedded multi-spine scales which are covered with skin giving the feel and appearance of small dermal papillae or prickles; cirri absent but sometimes a flap-like cirrus present on upper lip - in larger individuals; 1 sharp preopercular spine; this species has a long head nearly one-half the body length.

Rhamphocottus Species in the Northeast Pacific

R. richardsoni Gunther, 1874

Diagnosis: see generic synonyms.

Hart (1973:538 and Pl. 1) provided an illustration and photograph of this species. It has been taken from the intertidal to 165 m. Although this species is reported as common in British Columbia (Hart 1973), it is rare or uncommon in Oregon and California.

Scorpaenichthys Girard, 1854a

This genus contains only one species (S. marmoratus) restricted to the northeast Pacific Ocean.

This genus is well defined and is considered by most workers to be the most primitive or most conservative of the cottid fishes (Taranets

1941; Bolin 1947; and others). It differs from all other cottids in a number of aspects including skull osteology and anatomy of the circulatory system (Howe, unpubl. observ.). Some workers have placed it into its own monotypic family. At present, it appears best to retain it within the Cottidae. We can offer no speculation on its affinities; at present, it appears to us to have no close affinities within the family.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fins with a single spine and five rays; scales absent-scales of the lateral line are present but deeply embedded and not visible; cirri present on head including a large, fringed cirri over upper posterior of eye; large flap-like cirrus present on median of snout.

Scorpaenichthys Species in the Northeast Pacific

S. marmorata (Ayres, 1854a)

Diagnosis: see generic diagnosis.

Bolin (1944:110) and Hart (1973:540) provided an illustration of this species. It has been recorded from the intertidal to 76 m in depth. It is moderately common throughout its range.

Sigmistes Rutter in Jordan and Evermann, 1899

This genus contains two species both of which occur in the Aleutian Island-northeast Pacific Ocean area.

This genus is closely related to the Oligocottus-Clinocottus group of sculpins. Sigmistes is also very close to Phallocottus and preliminary study suggests these genera are closest to Clinocottus.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth also present but obscure; pelvic fin with a single spine and three rays; no scales or papillae; cirri present on anterior lateral line pores, at each nasal spine, on the postorbital region and on top of the head; 4 preopercular spines but lower 3 not obvious, uppermost short, thin and hooked; body rather compressed; anus near pelvic fins.

Sigmistes Species in the Northeast Pacific

The two species of Sigmistes may be separated using meristics; due to the small number of S. smithi seen, we cannot diagnose these species.

S. caulias Rutter in Jordan and Evermann, 1899

S. smithi Schultz, 1938

Rutter (1899:191) provided an illustration of S. caulias, no illustration of S. smithi is available. Both species have been taken from intertidal areas, no other information is available.

Stelgistrum Jordan and Gilbert, 1899

Stelgistrops Hubbs, 1926a

This genus contains three species restricted to the North Pacific Ocean and Bering Sea; it has been recorded from the Aleutian Islands.

Aside from a few regional works and the original descriptions, only Andriyashev (1935) has studied Stelgistrum. This genus appears to have affinities with Artedius. Stelgistrum does differ in some aspects from Artedius but in the small specimens seen by us, many characters suggest an affinity between the two genera. The rather poorly known genus Icelus also shares some affinities with the group but this is as yet unstudied.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and three rays; scales present along lateral line, on top of head and in band between lateral line and dorsal fin which ends near posterior portion of dorsal fin; cirri above orbit, on end of maxillary and along anterior portion of lateral line, otherwise absent; 4 preopercular spines, only the uppermost apparent.

Stelgistrum Species in the Northeast Pacific

S. beringianum Gilbert and Burke, 1912

Diagnosis: see generic diagnosis.

This species is illustrated by Gilbert and Burke (1912:53). This species is recorded from 79-95 m in depth, no other information is available for this apparently rare species.

Sternias Jordan and Evermann, 1898

This genus contains a single species (S. xenostethus) which is restricted to the Bering Sea and recorded from the Aleutian Islands.

This genus is quite close to the genus Triglops. It was described as being in Triglops. The primary difference between the two genera is that Sternias has scales on the breast, all Triglops do not have any scales on the breast. It should probably synonymized with Triglops.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fins with a single spine and three rays; scales as in Triglops and, in addition scales on breast; cirri absent; 4 preopercular spines, all poorly developed.

Sternias Species in the Northeast Pacific

S. xenostethus (Gilbert, 1895)

Diagnosis: see generic diagnosis.

Gilbert (1895:428) and Evermann and Goldsborough (1907:302) provided an illustration of this species. It has been recorded from a depth of 62 m. No other information is available for this apparently rare species.

Stlegicottus Bolin, 1936b

This genus contains a single species (S. xenogrammus) restricted to the Bering Sea and has been recorded from the Aleutian Islands.

We have not seen specimens of this monotypic genus. Bolin (1936b) suggested this genus was an early offshoot of the group that gave rise to Artedius. Based on the description, it appears possible but without seeing a specimen, we can only speculate. It was described from a single specimen of 29.1 mm SL.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fin with a single spine and three soft rays; scales present on the head including interorbit and on region above and below the lateral line; cirri few, none on body but present on postorbit, posterior end of opercle and on top of head; 4 preopercular spines, all simple.

Stlegicottus Species in the Northeast Pacific

S. xenogrammus Bolin, 1936b

Diagnosis: see generic diagnosis.

Bolin (1936b:37) presented an illustration of this species. It was taken at a depth of 494 m. No other information is available; it is very rare.

Synchirus Bean, 1889

This genus contains a single species (S. gilli) which is restricted to the northeast Pacific.

The affinities of this genus are obscure. The pectoral fins and the anal papillae in the male are specializations not seen in any other cottids. Jordan and Evermann (1898) and Miller and Erdman (1948) noted a resemblance of Synchirus and Triglops; it appears to us that if these two genera are related, it is a remote relationship.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth present or absent; pelvic fin with a single spine and three rays; scales present along lateral line and a row of scales usually present along base of dorsal fins; cirri present or absent, on preopercle, above posterior portion of orbit and adjacent to nasal spines; 1 preopercular spine, strong and bifid; pectoral fins united on breast.

Synchirus Species in the Northeast Pacific

S. gilli Bean 1889

Diagnosis: see generic diagnosis.

This species is illustrated by Miller and Erdman (1948:87) and Hart (1973:542). It has been recorded from shallow waters. Apparently, it is locally abundant in certain areas.

Thyriscus Gilbert and Burke, 1912

This genus contains a single species (T. anoplus) restricted to the Bering Sea but recorded from the Aleutian Islands.

We have not seen specimens of this apparently rare fish. Gilbert and Burke (1912) stated that its closest affinity was nearest Icelus. We do not definitively concur with this as certain characters suggest affinities to other genera but we can only barely speculate. Our diagnosis follows the original description. Gilbert (1915) and Andriyashev (1937) also discuss this species.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine and palatine teeth present; pelvic fins with a single spine and three rays; scales along lateral line serrated, scales also in axillary patch, body otherwise naked; cirri present on head (3 pairs), on end of maxillary and on tip of opercle; 4 preopercular spines, all simple; lower pectoral rays excised.

Thyriscus Species in the Northeast Pacific.

T. anoplus Gilbert and Burke 1912

Diagnosis: see generic diagnosis.

Gilbert and Burke (1912:43) provided an illustration. The type specimen was taken from a depth of 211 m. No other information is available.

Triglops Reinhardt, 1832

Prionistius Bean, 1883

Elanura Gilbert, 1895

This genus contains nine nominal species distributed in the North Pacific, Arctic and North Atlantic Oceans. Five of these species have

been recorded in the northeast Pacific.

Triglops is a distinctive genus but there has been little speculation and no study of its possible affinities. The genus Sternias is closely related to Triglops and, in fact, the single species within that genus was first described as a Triglops. We believe that Sternias should be placed in synonymy with Triglops; the primary difference between the two genera is the presence (Sternias) or absence (Triglops) of scales on the breast. [This does not constitute a formal synonymy, studies are still underway.] The affinities of this group (Triglops and Sternias) are obscure. Taranets (1941) placed the group in its own subfamily but provided little data for doing so. The group does share some characteristics with Jordania but the relationship appears distant. Radulinus also shares some characteristics with Triglops but again the relationship appears distant.

The species within this genus are in need of review. The species in the North Atlantic and Arctic Oceans (3) have been reviewed or studied by Jensen (1944), Andriyashev (1949, 1954) and McAllister (1963); these appear to be well understood though variation within the species has caused some confusion. Within the North Pacific, some of the component species (5) were reviewed by Schmidt (1929e). Schmidt (1950) also discussed some species in his work on the Sea of Okhotsk ichthyofauna. We have identified problems with the group - it needs review.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fin with a single spine and three rays; scales present, large and spinous along lateral line, small and modified (prickles) on head (sometimes absent) and back; scales below lateral line modified into small serrated

plates lying in oblique dermal folds; folds present or absent on breast but breast not scaled; prickles often extending onto fin rays; cirri absent; 4 preopercular spines, all rather small and blunt.

Triglops Species in the Northeast Pacific.

Meristic characters are useful for separation of some of the species. We recognize four species but, as mentioned, the group needs review; more or less species may exist within the region.

T. forficata (Gilbert, 1895)

Diagnosis: base of dorsal fins with small bony tubercles (scutes); cross folds usually present on breast but reduced or absent; eye diameter less than one-third head length; prickles (scales) absent from maxillary and lower portion of opercle; body folds about 2 per lateral line scale.

Gilbert (1895:Pl.30) and Evermann and Goldsborough (1907:303) provided an illustration of this species. It has been taken from 69-132 m in depth. It appears to be moderately uncommon.

T. macellus (Bean, 1883)

Diagnosis: base of dorsal fins without small bony tubercles (scutes); no cross folds on breast; eye diameter less than one-third head length; prickles (scales) absent from maxillary and lower portion of opercle; body folds between 1 and 2 per lateral line scale.

Hart (1973:543) provided an illustration of this species. It has been taken from 18-102 m in depth. It appears to be uncommon.

T. metopias Gilbert and Burke, 1912

Diagnosis: base of dorsal fins with small bony tubercles (scutes); cross folds usually on breast but few and sometimes absent; eye diameter less than one-third head length; prickles (scales) absent from maxillary and lower portion of opercle; body folds numerous and irregular, smaller folds between larger folds yielding 2 or more folds per lateral line scale.

Gilbert and Burke (1912:50) provided an illustration of this species. It has been taken from 95-99 m in depth. It appears to be uncommon.

T. pingeli Reinhardt, 1832

T. beani Gilbert, 1895 [We follow Andriyashev 1954.]

This species is widespread and apparently quite variable.

Diagnosis: base of dorsal fins with small bony tubercles (scutes); cross folds present on breast; eye diameter about one-third or less head length; prickles (scales) absent from maxillary and lower portion of opercle; body folds about equal in number to lateral line scales (scutes).

Evermann and Goldsborough (1907:301, as T. beani), Andriyashev (1954:351 in Russian edition, 376 in English translation) and Hart (1973:545) provided illustrations of these species - a comparison of the illustrations denotes the need for review. It has been taken from 18-247 m in depth. It appears to be relatively common.

T. scepticus Gilbert, 1895

Diagnosis: base of dorsal fins with small bony tubercles (scutes); cross folds present on breast; eye diameter greater than one third head length; prickles (scales) present on maxillary and lower portion of opercle; body fold 2-4

per lateral line scale (scute).

Gilbert (1895:Pl.28) and Evermann and Goldsborough (1907:302) provided an illustration of this species. It has been taken from 79-252 m in depth. It appears to be moderately uncommon.

Zesticelus Jordan and Evermann, 1896

This genus contains two species which are restricted to the northeast Pacific.

This genus contains species which occur in very deep water. The genus is odd as it combines characters of various groups but these characters are probably due, in part, to its adaptation to deep water. Very few specimens are known and we cannot speculate on its affinities at this time.

Diagnosis: branchiostegal membranes united and forming a fold over the isthmus; vomerine teeth present, palatine teeth absent; pelvic fins with a single spine and two (three) rays; no scales or papillae; no cirri; 4 preopercular spines, uppermost developed; some low ridges and spines developed on top of head; cephalic pores greatly developed into large holes.

Z. profundorum (Gilbert, 1895)

Diagnosis: see generic diagnosis.

Bolin (1944:133) provides an illustration of this species. This species has been recorded from depths of 88-2580 m. It is quite rare, probably a result of its rather deep water distribution.

Summary

The taxonomy and variation of the family Cottidae has not been well studied in the northeast Pacific Ocean except off California. The more northern genera and species have not, in most cases, been studied at all. Certain genera should probably be synoymized with others. Many genera need to be studied because their component species have never been compared and some of these might also be synomymized. Some groups appear preliminarily to contain undescribed species. The genera in need of study include Asemichthys, Gilbertidia, Hemitripterus, Icelinus, Icelus, Leiocottus, Malacocottus, Myoxocephalus, Orthonopias, Phallocottus, Psychrolutes, Sigmistes, Stelgistrum, Sternias, Stlegicottus, Thyriscus, Triglops and Zesticelus. The monotypic genera listed should be studied because at least some of them could be synonymized with other genera. The other genera listed contain species problems.

Table 2. Selected Characteristics of Cottid Genera of the Northeast Pacific Ocean.
Symbols: + = present - = absent () = limited to a single species, [] = limited to a few species
(()) = rarely present
+ Scales: + = along lateral line, ++ = along and above lateral line, +++ = above and below lateral line
+ Cirri: + = few cirri, ++ = moderate cirri, +++ = much cirri
Abbreviations: U = united to each other with fold across isthmus, F = fused to isthmus, no fold Pr = prickles
Preop. sp. = preopercular spine, LL = lateral line

GENUS	Number of Pelvic Rays	Number of Branchiostegals	Branchiostegal Membranes	Scales	Cirri	Papillae	Vomerine Teeth	Palatine Teeth	Other Characteristics
Artediellus	3	6	U	- (Pr)	[+]	-	+	+	Hooked preop. sp.
Artedius	3((2))	6(7)	U	++	++	-	+	+	Anus not advanced
Ascelichthys	0	6	U	-	+	-	+	+	No pelvics
Asemichthys	3	6	U	++	++	-	+	-	Similar to Radulinus
Blepsius	3	6	U	+++ Pr	++	+	+	+	Ridges-spines on head
Chitonotus	3((2))	6	U	++	+	-	+	+	Antler-like preop. sp.
Clinocottus	3	6	U	- (Pr)	+++	-	+	+ or -	Anus advanced
Cottus	4[3]	6[7]	F	- [Pr]	-	-	+	+ or -	Freshwater group
Dasycottus	3	7	U	++	++	-	+	-	Ridges-spines on head
Enophrys	3((2))	6[5]	F	+	+	-	+	-	Skull with tubercles
Eurymen	3	7	U	-	++	-	+ or -	-	No preop. sp.
Gilbertidia	3	7	F	-	-	+	-	-	No preop. sp.
Gymnocanthus	3	6	U	++[+]	+	-	-	-	Barbed preop. sp.
Hemilepidotus	4((3))	6	U or F	+++	++	-	+	+	Stout preop. sp.
Hemitripterus	3	6	U	+++ Pr	+++	+	+	+	Ridges-knobs on head
Icelinus	2	6	U	++	++	-	+	+	Barbed preop. sp.
Icelus	3	6	U	++[+]	+	-	+	+	Hooked preop. sp.
Jordania	5((4))	6	U	+++	+	-	+	+	Curved preop. sp.
Leiocottus	3	6	U	-	+	-	+	-	Similar to Clinocottus
Leptocottus	4	6	F	-	-	-	+	+	Antler-like preop. sp.
Malacocottus	3	7	F	Pr	+	- or +	-	-	Preop. sp. present
Myoxocephalus	3	6	U	Various	+ or ++	-	+	-	LL w/accessory pores
Nautichthys	3	6	F	+++ Pr	++	+	+	+	Ridges-knobs on head
Oligocottus	3	6	U	- (Pr)	+++	-	+	+	Anus not advanced
Orthonopias	3	6	U	++	+++	-	+	+	Similar to Artedius
Paricelinus	5	6	U	+++	+	-	+	+	Spined below dorsal
Phallocottus	3	6	U	-	++	-	+	-	Similar to Clinocottus
Porocottus	3	6	U	-	++	-	+	-	LL w/accessory pores
Psychrolutes	3	7	F	- or Pr	+ or -	- or +	-	-	No preop. sp.
Radulinus	3	6	U	++	+	-	+ or -	-	Slender body
Rhamphocottus	3((4))	6	F	+++ Pr	-	+	+ or -	+ or -	Peculiar
Scorpaenichthys	5	6	U	-	+	-	+	+	Flap on snout
Sigmistes	3	6	U	-	++	-	+	+	Similar to Clinocottus
Stelgistrum	3	6	U	++	++	-	+	-	Similar to Artedius
Sternias	3	6	U	+++	-	-	+	-	Similar to Triglops
Stlegicottus	3	6	U	+++	+	-	+	+	Rare
Synchirus	3	6	U	++	+	-	+	+	Pect. fins united
Thyriscus	3	6	U	+++	+	-	+	+	Rare
Triglops	3	6	U	+++	-	-	+	-	Folds below LL
Zesticelus	2((3?))	6	U	-	-	-	+	=	Large head pores

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APPENDIX I

RANGE

Table 3. Cottid species of the northeast Pacific Ocean and their general distribution[1]. This includes all species recorded from the Aleutian Islands south. B = Baja California, S = Southern California, N = Northern California, O = Oregon, W = Washington, P = Puget Sound, C = British Columbia, E = Southeast Alaska, G = Gulf of Alaska, A = Aleutian Islands.

SPECIES	SOUTHERN RANGE LIMIT	B	S	N	O	W	P	C	E	G	A	NORTHERN RANGE LIMIT
Artediellus pacificus	Auke Bay											Bering Sea
Artedius corallinus	San Martin Isl.											Orcas Isls.
Artedius creaseri	Pt. San Pablo											Pescadero Pt., Monterey Co.
Artedius fenestralis	Diablo Cove											Unalaska Isl.
Artedius harringtoni	San Miguel Isl.											Kodiak Isl.
Artedius lateralis	San Quintin											Kodiak Isl.; ?Bering Sea
Artedius meanyi	Pt. Arena											Fillmore Isl.
Artedius notospilotus	Pt. San Telmo											Puget Sound
Ascelichthys rhodorus	Moss Beach, San Mateo Co.											Sitka
Asemichthys taylori	Strait of Georgia											SE Alaska
Blepsius bilobus	Bella Coola											Bering Sea
Blepsius cirrhosus	San Simeon											Bering Sea
Chitonotus pugetensis	Santa Maria Bay											Work Channel
Clinocottus acuticeps	Big Sur River											Bering Sea
Clinocottus analis	Ascuncion Pt.											Cape Mendocino
Clinocottus embryum	Pt. Banda											Bering Sea
Clinocottus globiceps	Gaviota											Kodiak Isl.
Clinocottus recalvus	Pt. Rompiente											Brookings
[2]*Cottus aleuticus*	San Luis Obispo Co.											Bering Sea
Cottus asper	Ventura River											Seward
Dasycottus setiger	Puget Sound											Bering Sea
Enophrys bison	Monterey											Kodiak Isl.
Enophrys diceraus	Lynn Canal											Arctic
Enophrys lucasi	Port McNeill											Bering Sea
Enophrys taurina	Santa Catalina Isl.											San Francisco
Eurymen gyrinus	Kodiak Isl.											Bering Sea
Gilbertidia sigalutes	Puget Sound											Bering Sea
Gymnocanthus galeatus	near Whales Isl.											Bering Sea
Gymnocanthus pistilliger	Kodiak Isl.											Bering Sea; Arctic(?)
Hemilepidotus hemilepidotus	Monterey Bay											Bering Sea
Hemilepidotus jordani	Sitka Isl.											Bering Sea
Hemilepidotus spinosus	Ventura											Puffin Bay
Hemilepidotus zapus	Aleutian Isls.											Arctic Ocean
Hemitripterus bolini	Hakai Pass											Bering Sea
Hemitripterus villosus	Kodiak Isl.											Bering Sea
Icelinus borealis	Puget Sound											Bering Sea
Icelinus burchami	La Jolla											Behm Canal
Icelinus cavifrons	Santa Maria Bay											Monterey
Icelinus filamentosus	Cortez Bank											N. British Columbia
Icelinus fimbriatus	Manhattan Beach											Monterey
Icelinus oculatus	San Diego											Redondo Isl.
Icelinus quadriseriatus	Cape San Lucas											Russian River
Icelinus sp.	off La Jolla											off La Jolla
Icelinus tenuis	San Benito Isls.											Queen Charlotte Isls.
Icelus canaliculatus	Aleutian Isls.											Bering Sea

SPECIES	Southern Range Limit	B	S	N	O	W	P	C	E	G	A	Northern Range Limit
Icelus euryops	Gulf of Alaska											Bering Sea
Icelus scutiger	Gulf of Alaska											Bering Sea
Icelus spatula	Glacier Bay											Arctic
Icelus spiniger	Queen Charlotte Isl.											Bering Sea
Icelus uncinalis	Gulf of Alaska											Bering Sea
Jordania zonope	Diablo Canyon											Vancouver Isl.
Leiocottus hirundo	Pt. Banda											Gaviota Pier
Leptocottus armatus	San Quintin Bay											Chignik
Malacottus kincaidi	Puget Sound											Bering Sea(?)
Malacottus zonurus	Puget Sound(?)											Bering Sea
Myoxocephalus jaok	SE Alaska											Bering Sea
Myoxocephalus niger	Aleutian Isls.											Bering Sea
Myoxocephalus polyacanthocephalus	Washington Coast											Bering Sea
Myoxocephalus sp.	Welcome Harbour											Aleutian Isl.
Nautichthys oculofasciatus	San Miguel Isl.											Bering Sea
Nautichthys pribilovius	Stevens Passage											Bering Sea
Nautichthys robustus	Washington Coast											Attu Isl.
Oligocottus maculosus	near White Pt., Los Angeles Co.											Sea of Okhotsk; ?Bering Sea
Oligocottus rimensis	San Nicolas Isl.											Welcome Harbour
Oligocottus rubellio	San Martin Isl.											Fort Bragg
Oligocottus snyderi	Rio Socorro											Sitka
Orthonopias triacis	San Geronimo											Monterey
Paricelinus hopliticus	Cortez Bank											Queen Charlotte Sound
Phallocottus obtusus	Aleutian Isls.											Bering Sea
Porocottus bradfordi	Kodiak Isl.;?SE Alaska											Bering Sea
Psychrolutes paradoxus	Puget Sound											Bering Sea
Psychrolutes phrictus	Monterey											N. Oregon
Radulinus asprellus	Los Coronados Isls.											Kodiak Isl.
Radulinus boleoides	Santa Catalina Isl.											Langara Isl.
Radulinus vinculus	Santa Cruz Isl.											Diablo Cove
Rhamphocottus richardsoni	Santa Monica Bay											Bering Sea
Scorpaenichthys marmoratus	Pt. Abreojos											Sitka
Sigmistes caulias	Aleutian Isls.											Bering Sea
Sigmistes smithi	Aleutian Isls.											Bering Sea
Stelgistrum beringianum	Aleutian Isls											Bering Sea
Sternias xenostethus	Aleutian Isls.											Bering Sea
Stlegicottus xenogrammus	Aleutian Isls.											Aleutian Isls.
Synchirus gilli	San Miguel Isl.											Sitka
Thyriscus anoplus	Aleutian Isls.											Bering Sea
Triglops forficata	Gulf of Alaska											Bering Sea
Triglops macellus	Puget Sound											Bering Sea
Triglops metopias	Auke Bay											Bering Sea
Triglops pingeli	Puget Sound											Arctic
Triglops scepticus	Gulf of Alaska											Bering Sea
Zesticelus profundorum	N. Baja California											Bering Sea

[1]Compiled from Evermann and Goldsborough (1907), Gilbert and Burke (1912) Jordan, Evermann and Clark (1930), Schultz and DeLacy (1935-1936), Hubbs and Schultz (1941), Bolin (1944, 1950), Schmidt (1950), Andriashev (1954), Wilimovsky (1954, 1964), McAllister (1960), Peden (1964, 1970, 1972), Grinols (1965), Hubbard and Reeder (1965), Quast (1968), Sandercock and Wilimovsky (1968), Bailey et al. (1970), DeLacy et al. (1972), Miller and Lea (1972), Quast and Hall (1972), Fedorov (1973), Hart (1973), Wilson (1973), Lea (1974), Peden and Wilson (1976), Cowan and Wilimovsky (1978MS), Stein and Bond (1978), and museum records.

[2]The genus *Cottus* is composed of freshwater species but *C. aleuticus* and *C. asper* may be found in nearshore marine waters.

APPENDIX II

Table 4. Range of meristic variation in dorsal fin spines of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.

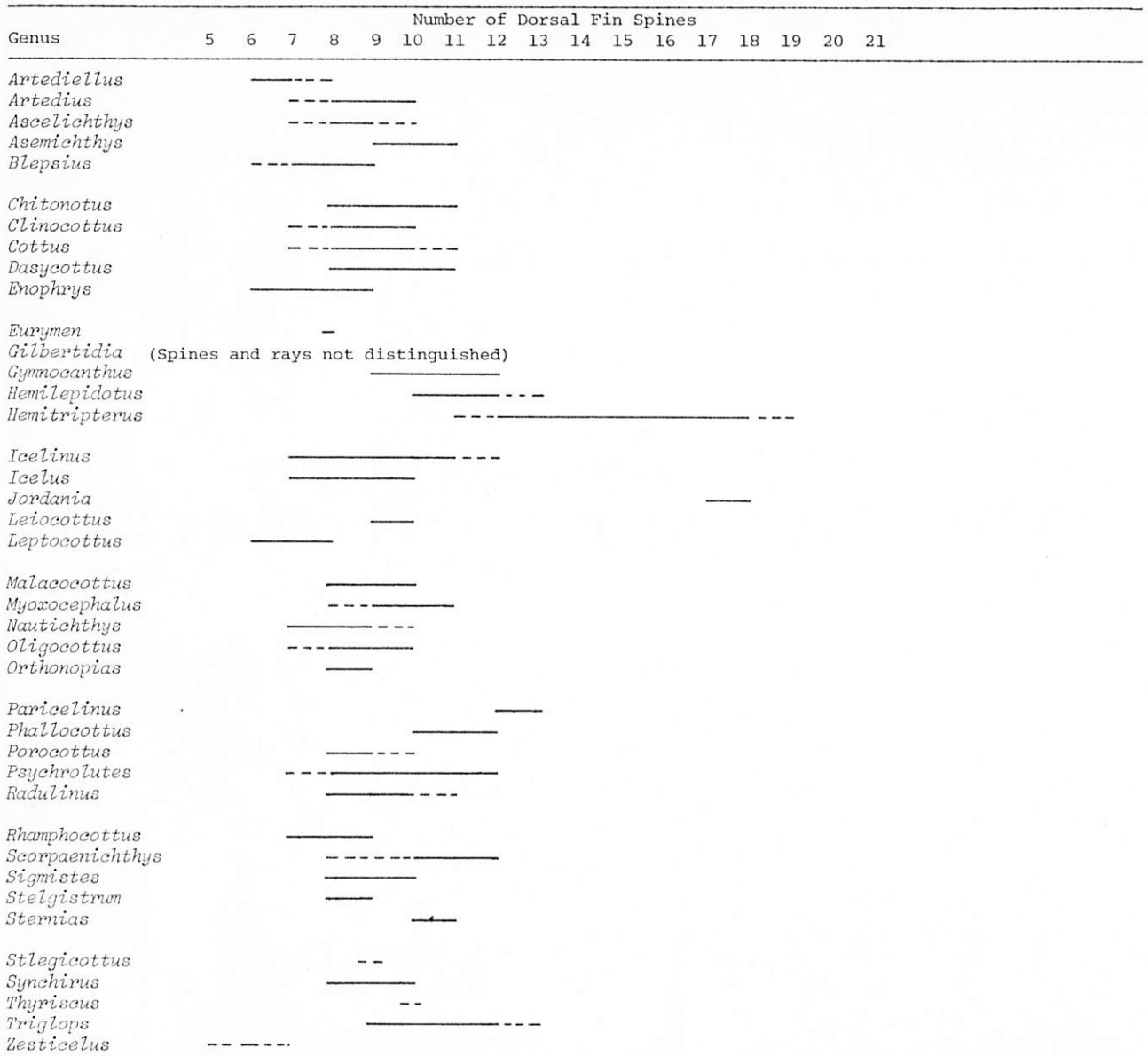


Table 5. Range of meristic variation in dorsal fin rays of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.

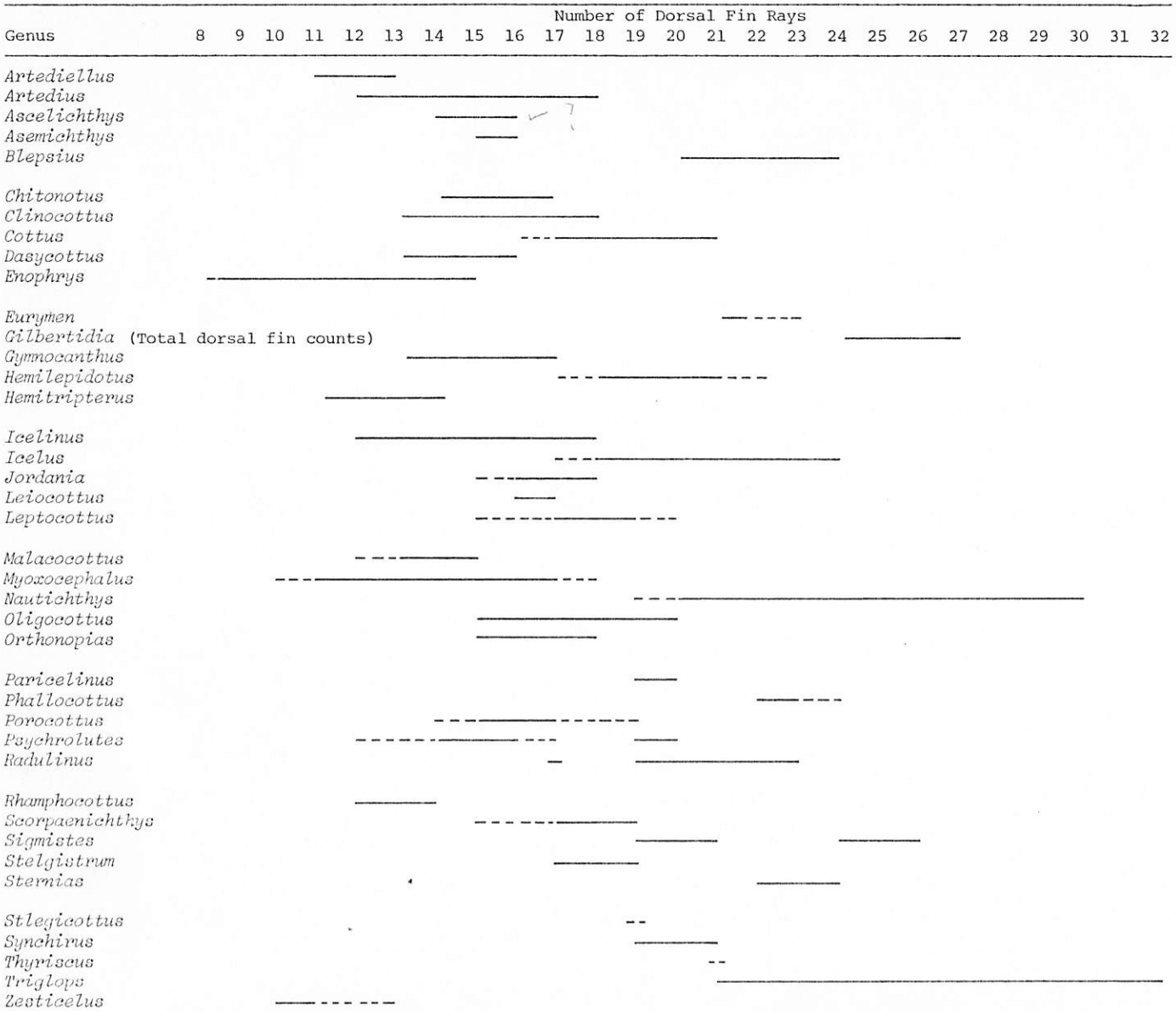


Table 6. Range of meristic variation in anal fin rays of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.

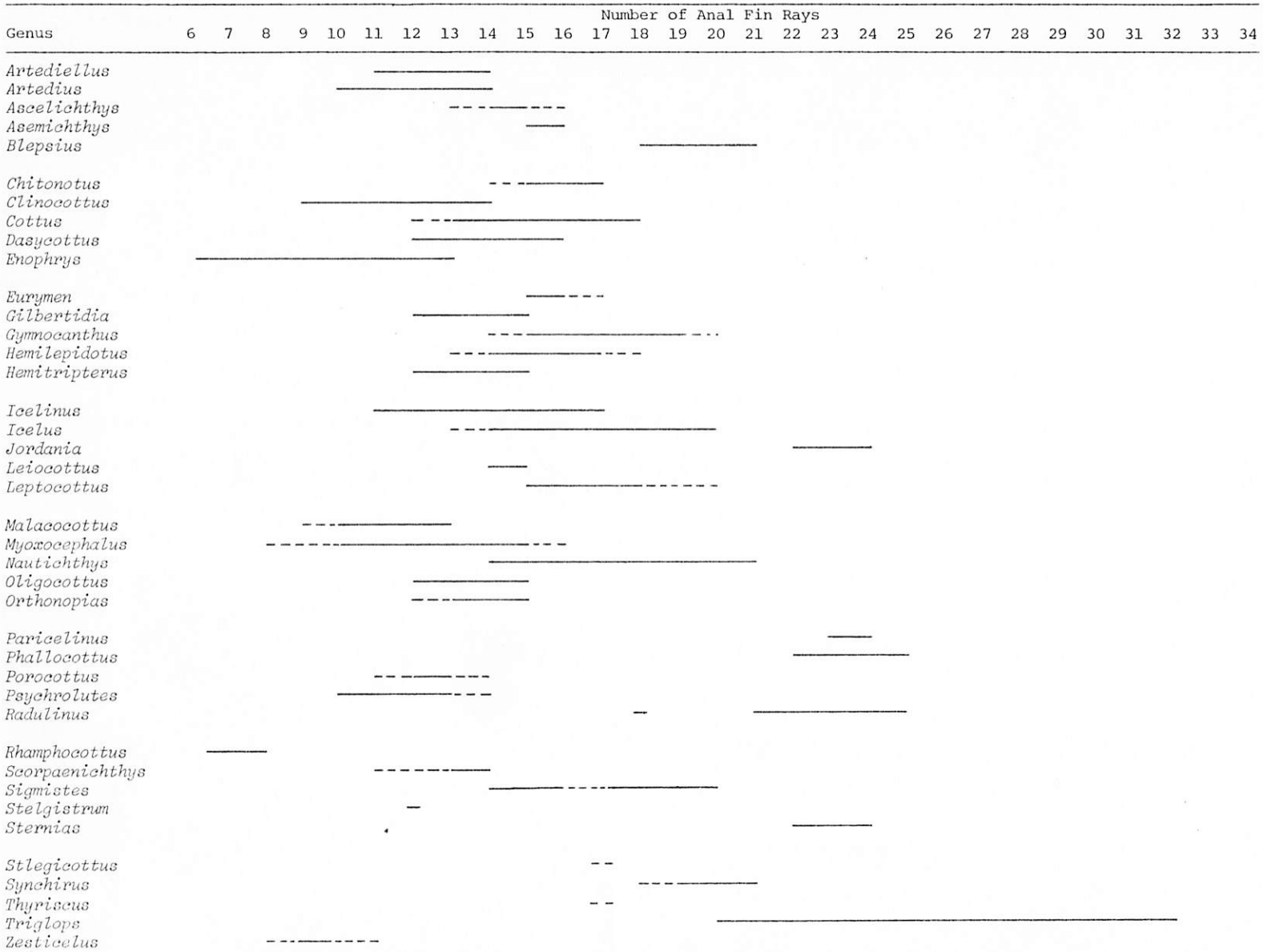


Table 7. Range of meristic variation in pectoral fin rays of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.

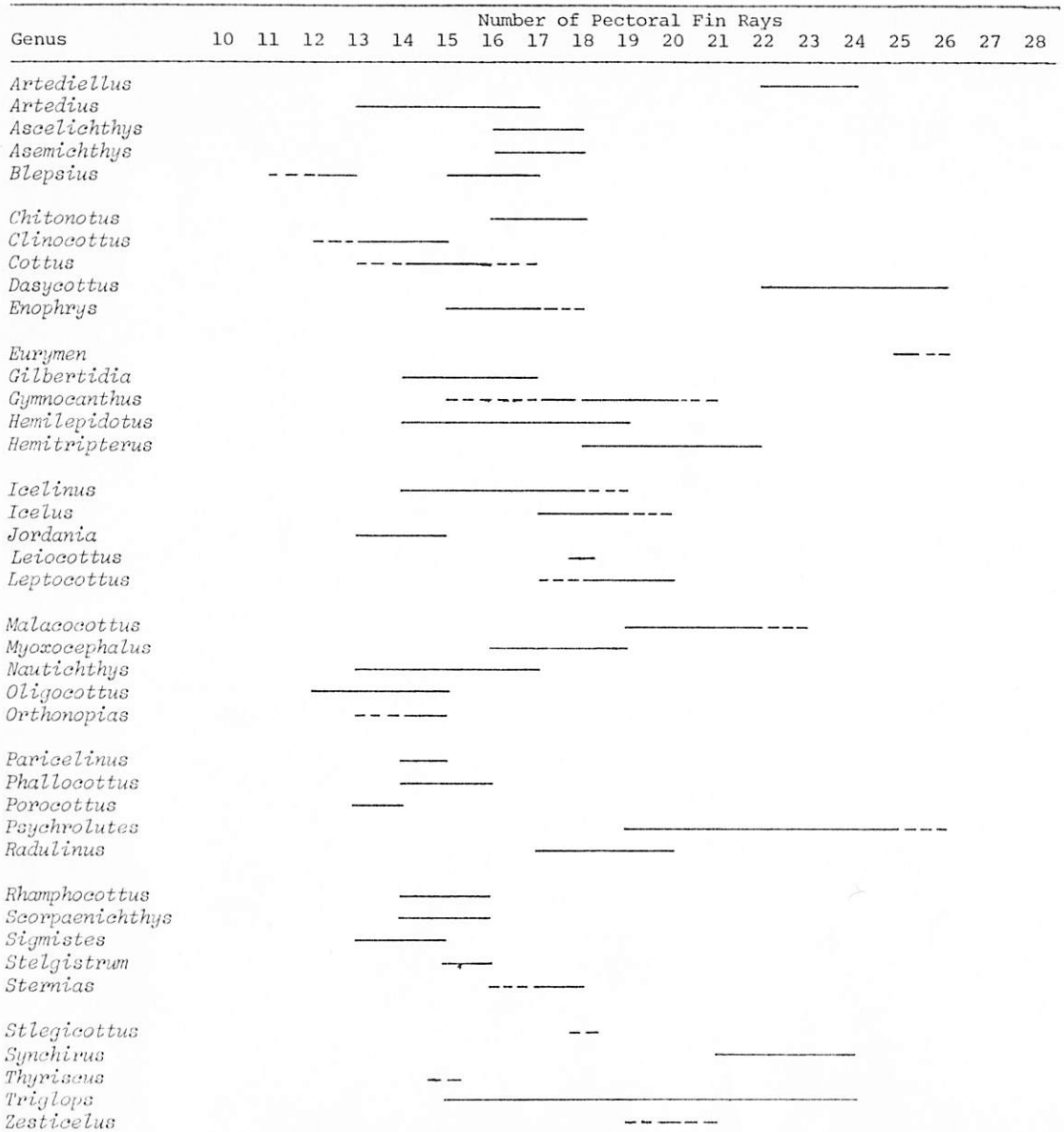
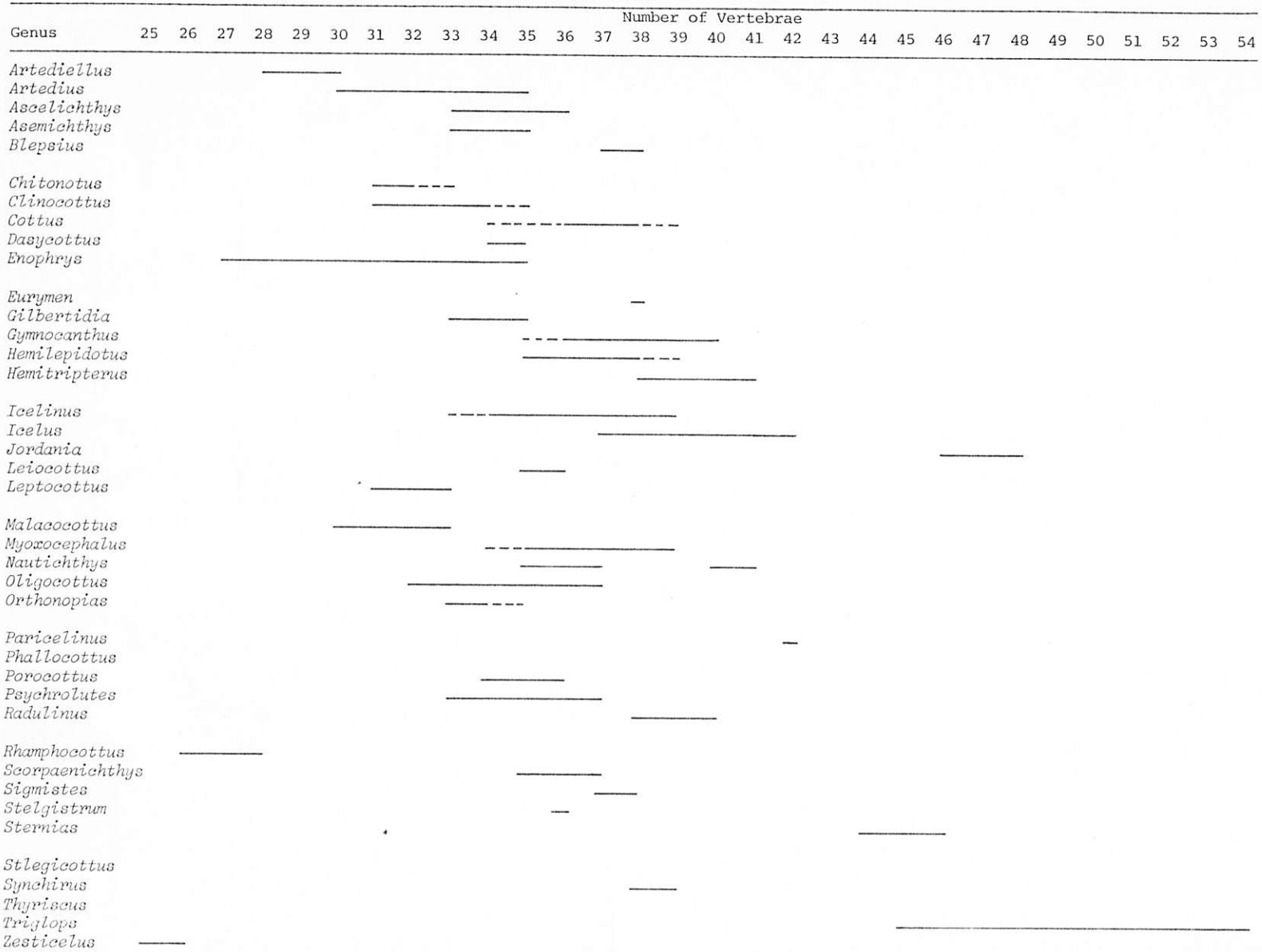


Table 8 . Range of meristic variation in pelvic fin rays of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.

Genus	Number of Pelvic Fin Rays 0	1	2	3	4	5
Artediellus				—		
Artedius			——	——		
Ascelichthys	—					
Asemichthys				—		
Blepsius				—		
Chitonotus			——	——		
Clinocottus				—		
Cottus				--	--	
Dasycottus				—		
Enophrys			——	——		
Eurymen				—		
Gilbertidia				—		
Gymnocanthus				—		
Hemilepidotus				——	——	
Hemitripterus				—		
Icelinus			—			
Icelus				—		
Jordania					——	——
Leiocottus				—		
Leptocottus					—	
Malacocottus				—		
Myoxocephalus				—		
Nautichthys				—		
Oligocottus				—		
Orthonopias				—		
Paricelinus						—
Phallocottus				—		
Porocottus				—		
Psychrolutes				—		
Radulinus				—		
Rhamphocottus				—-·-		
Scorpaenichthys					——	——
Sigmistes				—		
Stelgistrum				—		
Sternias				—		
Stlegicottus				—		
Synchirus				—		
Thyriscus				—		
Triglops				—		
Zesticelus			—	---		

Table 9. Range of meristic variation in vertebrae of cottid genera of the northeast Pacific Ocean. Solid lines indicate data found in this study; broken lines indicate published data.



APPENDIX III

Table 10. Range and distribution of meristic variation in dorsal fin spines of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature.

Species	Number of dorsal fin spines																	N
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Artediellus pacificus		4	26	X														30
Artedius corallinus				2	38													40
Artedius creaseri					6	44												50
Artedius fenestralis				2	47	1												50
Artedius harringtoni					50													50
Artedius lateralis			X	1	97	2												100
Artedius meanyi					4	28												32
Artedius notospilotus					30	1												31
Ascelichthys rhodorus			X	8	42	X												50
Asemichthys taylori					10	18	2											30
Blepsius bilobus			3	32	1													36
Blepsius cirrhosus		X	13	37														50
Chitonotus pugetensis				1	2	46	1											50
Clinocottus acuticeps			X	44	6													50
Clinocottus analis					29	1												30
Clinocottus embryum				3	47	X												50
Clinocottus globiceps				1	28	1												30
Clinocottus recalvus				2	28													30
Cottus aleuticus				X	47	3												50
Cottus asper			X	4	46	X	X											50
Dasycottus setiger				1	24	24	1											50
Enophrys bison			3	30	2													35
Enophrys diceraus			4	36														40
Enophrys lucasi			1	25														26
Enophrys taurina		1	15	X														16
Eurymen gyrinus				1														1
Gilbertidia sigalutes	Spines and rays were not distinguished, see dorsal fin rays for count																	
Gymnocanthus galeatus						12	37	1										50
Gymnocanthus pistilliger					15	35	X											50
Hemilepidotus hemilepidotus						3	46	1	X									50
Hemilepidotus jordani						1	49	X										50
Hemilepidotus spinosus						2	46											50
Hemilepidotus zapus							6	X										6
Hemitripterus bolini							X	1	7	39	3							50
Hemitripterus villosus												1	6	1	X			8
Icelinus borealis					9	27	X											36
Icelinus burchami						5	1											6
Icelinus cavifrons						24	6											30
Icelinus filamentosus						12	18	X										25
Icelinus fimbriatus						1	2											3
Icelinus oculatus							2											2
Icelinus quadriseriatus			2	21	6	1												30
Icelinus sp.			Unknown															
Icelinus tenuis					2	28	X											30
Icelus canaliculatus			2	4														6

Species	Number of Dorsal Fin Spines																	N
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Icelus euryops					X													
Icelus scutiger					6	5												11
Icelus spatula				1	24	3												28
Icelus spiniger				2	21	2												25
Icelus uncinalis					12													12
Jordania zonope													14	36				50
Leiocottus hirundo					4	1												5
Leptocottus armatus		4	34	12														50
Malacottus kincaidi				2	34	4												40
Malacottus zonurus				2	18													20
Myoxocephalus jaok				X	23	26	1											50
Myoxocephalus niger				X	41	9												50
Myoxocephalus polyacanthocephalus					21	29												50
Myoxocephalus sp.				X	X	1												1
Nautichthys oculofasciatus				36	14													50
Nautichthys pribilovius			X	16	3	X												19
Nautichthys robustus			1	4														5
Oligocottus maculosus				33	17													50
Oligocottus rimensis				1	43	6												50
Oligocottus rubellio				26	24													50
Oligocottus snyderi			X	29	21													50
Orthonopias triacis				3	27													50
Paricelinus hopliticus								6	14									50
Phallocottus obtusus						2	7	4										13
Porocottus bradfordi				2	24	X												26
Psychrolutes paradoxus						18	21	11										50
Psychrolutes phrictus			X	7	2													9
Radulinus asprellus				X	46	4												50
Radulinus boleoides				1	4	X	X											5
Radulinus vinculus						2												2
Rhamphocottus richardsoni			9	18	2													29
Scorpaenichthys marmoratus				X	X	14	28	8										50
Sigmistes caulias				7	40	3												50
Sigmistes smithi				1	1	9												11
Stelgistrum beringianum				1	3													4
Stermias xenostethus						1	9											10
Stlegicottus xenogrammus					X													
Synchirus gilli				1	20	29												50
Thyriscus anoplus						X												
Triglops forficata					28	22	X											50
Triglops macellus						1	19											20
Triglops metopias						3	7	1										11
Triglops pingeli					1	21	53	2	X									77
Triglops scepticus						6	23	3										32
Zesticelus profundorum	X	2	X															2

Table 11. Range and distribution of meristic variation in dorsal fin rays of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature.

Species	Number of dorsal fin rays																								
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	N
Artediellus pacificus				7	16	7																				30
Artedius corallinus								10	30																	40
Artedius creaseri					4	38	8																			50
Artedius fenestralis									16	33	1															50
Artedius harringtoni								1	3	38	8															50
Artedius lateralis								1	59	39																99
Artedius meanyi							1	3	21	7																32
Artedius notospilotus							1	22	8																	31
Ascelichthys rhodorus										9	29	12														50
Asemichthys taylori								2	28																	30
Blepsius bilobus													7	21	8											36
Blepsius cirrhosus													X	1	5	23	21									50
Chitonotus pugetensis							1	14	29	6																50
Clinocottus acuticeps						1	4	22	22	1																50
Clinocottus analis							2	0	5	21	2															30
Clinocottus embryum							1	31	17	1																50
Clinocottus globiceps						X	X	2	25	3																30
Clinocottus recalvus							X	11	19																	30
Cottus aleuticus									X	3	X	31	16													50
Cottus asper											X	X	29	21												50
Dasycottus setiger						1	19	26	4																	50
Enophrys bison		X	2	4	27	2																				35
Enophrys diceraus						7	26	7																		40
Enophrys lucasi					2	19	5																			26
Enophrys taurina	1	15	X																							16
Eurymen gyrinus														1		X										1
Gilbertidia sigalutes (Total dorsal fin counts)																	1	20	21	8						50
Gymnocanthus galeatus							X	8	35	7																50
Gymnocanthus pistilliger						4	27	19	X																	50
Hemilepidotus hemilepidotus											12	38	X													50
Hemilepidotus jordani										X	X	3	16	31	X											50
Hemilepidotus spinosus											X	2	46													48
Hemilepidotus zapus											1	0	4	1	X											6
Hemitripterus bolini				14	28	7	1																			50
Hemitripterus villosus				2	6	X																				8
Icelinus borealis							6	15	15	X																36
Icelinus burchami									X	3	3															6
Icelinus cavifrons						11	17	2																		40
Icelinus filamentosus								3	15	12																30
Icelinus fimbriatus									2	1																3
Icelinus oculatus								X	1	1																2
Icelinus quadriseriatus					2	8	18	2																		30
Icelinus sp.									Unknown																	
Icelinus tenuis									12	16	2															30
Icelus canaliculatus																1	5									6

Species	Number of dorsal fin rays																								
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	N
Icelus euryops																X										
Icelus scutiger												7	4													11
Icelus spatula										X	X	1	20	7	X											28
Icelus spiniger												3	10	12												25
Icelus uncinalis											2	6	4													12
Jordania zonope								X	3	35	12															50
Leiocottus hirundo									1	4																5
Leptocottus armatus								X	X	20	28	2	X													50
Malacottus kincaidi						6	26	8																		40
Malacottus zonurus					X	2	12	6																		20
Myoxocephalus jaok						X	8	23	19	X																50
Myoxocephalus niger							X	13	36	1	X															50
Myoxocephalus polyacanthocephalus			X	1	3	4	41	1																		50
Myoxocephalus sp.							X	X	1	X																1
Nautichthys oculofasciatus																				4	18	24	4			50
Nautichthys pribilovius															X	11	5	2	X							18
Nautichthys robustus												X	4	1												5
Oligocottus maculosus								X	X	38	12															50
Oligocottus rimensis									X	3	38	9														50
Oligocottus rubellio								21	23	6																50
Oligocottus snyderi										X	7	34	9													50
Orthonopias triacis								1	4	22	3															30
Paricelinus hopliticus												12	8													20
Phallocottus obtusus															10	3	X									13
Porocottus bradfordi							X	7	18	1	X?	X?														26
Psychrolutes paradoxus					X	X	27	15	8	X																50
Psychrolutes phrictus												3	6													9
Radulinus asprellus													X	13	27	10										50
Radulinus boleoides													3	2	X											5
Radulinus vinculus										2																2
Rhamphocottus richardsoni					22	5	2																			29
Scorpaenichthys marmoratus								X	X	11	31	8														50
Sigmistes caulias												4	32	14												50
Sigmistes smithi																	3	5	3							11
Stelgistrum beringianum										1	2	1														4
Sternias xenostethus															1	6	3									10
Stlegicottus xenogrammus												X														
Synchirus gilli												4	30	16												50
Thyriscus anoplus														X												
Triglops forficata																				3	11	18	12	5	1	50
Triglops macellus																				2	2	6	9	1		20
Triglops metopias																1	3	4	1	2						11
Triglops pingeli															10	39	22	10	X	1	X					82
Triglops scepticus														15	13	4										32
Zesticelus profundorum			1	1	X	X																				2

Table 12. Range and distribution of meristic variation in anal fin rays of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature.

Species	Number of anal fin rays																													N
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
Artediellus pacificus						5	17	7	1																					30
Artedius corallinus							8	32																						40
Artedius creaseri				10	38	2																								50
Artedius fenestralis							12	38	X																					50
Artedius harringtoni					X	X	3	26	21																					50
Artedius lateralis							10	89	1																					100
Artedius meanyi					2	10	20																							32
Artedius notospilotus						5	24	2																						31
Ascelichthys rhodorus								X	4	46	X																			50
Asemichthys taylori										22	8																			30
Blepsius bilobus													1	32	3															36
Blepsius cirrhosus													3	34	11	2														50
Chitonotus pugetensis									X	17	31	2																		50
Clinocottus acuticeps				1	X	13	30	6																						50
Clinocottus analis						1	2	9	18																					30
Clinocottus embryum				1	35	14	X																							50
Clinocottus globiceps						24	5																							30
Clinocottus recalvus				1	X	7	22	X																						30
Cottus aleuticus							X	12	38	X	X																			50
Cottus asper									X	X	4	36	10																	50
Dasycottus setiger							4	13	20	12	1																			50
Enophrys bison			9	25	1																									35
Enophrys diceraus						4	29	7																						40
Enophrys lucasi				1	6	19																								26
Enophrys taurina	4	12																												16
																														2
Eurymen gyrinus										1	1	X																		50
Gilbertidia sigalutes							5	19	21	5																				50
Gymnocanthus galeatus												X	18	32	X															50
Gymnocanthus pistilliger									X	1	45	4	X																	50
Hemilepidotus hemilepidotus								X	8	42	X																			50
Hemilepidotus jordani											13	37	X																	48
Hemilepidotus spinosus									X	24	24																			6
Hemilepidotus zapus											2	4																		50
Hemitripterus bolini							20	29	1																					8
Hemitripterus villosus							1	X	6	1																				
																														36
Icelinus borealis						6	12	9	9																					6
Icelinus burchami							1	1	4																					30
Icelinus cavifrons						3	10	17																						30
Icelinus filamentosus								3	15	10	2																			3
Icelinus fimbriatus							3																							
																														2
Icelinus oculatus								1	1																					30
Icelinus quadriseriatus						8	20	2																						
Icelinus sp.							Unknown																							27
Icelinus tenuis									2	4	18	3																		6
Icelus canaliculatus													1	4	1															

Species	Number of anal fin rays																													
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	N
Icelus euryops													X	X																-
Icelus scutiger													10	1																11
Icelus spatula								X	X	3	23	2	X																	28
Icelus spiniger										X	6	15	4																	25
Icelus uncinalis									2	7	3																			12
Jordania zonope																	X	18	32											50
Leiocottus hirundo									2	3																				5
Leptocottus armatus										1	31	16	2	X	X															50
Malacottus kincaidi					2	16	18	2																						38
Malacottus zonurus				X	X	10	10																							20
Myoxocephalus jaok							X	6	42	2	X																			50
Myoxocephalus niger					9	26	15																							50
Myoxocephalus polyacanthocephalus			X	X	3	10	37	X																						50
Myoxocephalus sp.							X	X	1	X	X																			1
Nautichthys oculofasciatus											1	0	12	28	8	1														50
Nautichthys pribilovius										X	8	9	1	X	X															18
Nautichthys robustus									3	2																				5
Oligocottus maculosus							6	34	10																					50
Oligocottus rimensis								X	46	4																				50
Oligocottus rubellio							17	26	7																					50
Oligocottus snyderi							X	1	41	8																				50
Orthonopias triacis						4	26																							30
Paricelinus hopliticus																		6	14											20
Phallocottus obtusus																	6	4	2	1										13
Porocottus bradfordi						X	23	3	X																					26
Psychrolutes paradoxus					4	2	36	8	X																					50
Psychrolutes phrictus							1	8	X																					9
Radulinus asprellus																X	X	31	18	1										50
Radulinus boleoides																1	4	X												5
Radulinus vinculus													2																	2
Rhamphocottus richardsoni	2	24	3																											29
Scorpaenichthys marmoratus						X	X	42	8																					50
Sigmistes caulias									13	24	13																			50
Sigmistes smithi												X	2	8	1															11
Stelgistrum beringianum							4																							4
Sternias xenostethus																	1	7	2											10
Stlegicottus xenogrammus												X																		-
Synchirus gilli													X	7	39	4														50
Thyriscus anoplus												X																		-
Triglops forficata																						2	3	10	20	13	2			50
Triglops macellus																						3	2	9	5	1				20
Triglops metopias																	2	1	1	4	2	1								11
Triglops pingeli															1	10	35	26	3	X	X	X	X							75
Triglops scepticus																	20	10	2											32
Zesticelus profundorum			X	2	X	X																								2

Table 13. Range and distribution of meristic variation in pectoral fin rays of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature.

Species	Number of pectoral fin rays																			N	Asymmetry L>R	Asymmetry R>L
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
Artediellus pacificus													27	22	11					60	1	1
Artedius corallinus					4	70	6													80		2
Artedius creaseri						6	82	12												100	6	4
Artedius fenestralis					5	95	X													100		3
Artedius harringtoni				4	94	2														100	2	
Artedius lateralis					13	169	18													200	1	1
Artedius meanyi					24	38	X													62	1	1
Artedius notospilotus					4	2	48	8												62	1	1
Ascelichthys rhodorus							8	38	4											100	2	
Asemichthys taylori							8	46	2											60		2
Blepsius bilobus						5	63	4												72		
Blepsius cirrhosus		X	95	5																100	2	1
Chitonotus pugetensis							4	52	44											100		
Clinocottus acuticeps				26	67	7														100	3	6
Clinocottus analis					18	42														60		2
Clinocottus embryum			X	4	94	1														99	3	
Clinocottus globiceps				X	56	4														60	3	1
Clinocottus recalvus				1	55	4														60	3	2
Cottus aleuticus				X	64	36	X													100	2	
Cottus asper					18	56	26	X												100	2	2
Dasycottus setiger													4	20	7	66	3			100	3	5
Enophrys bison						X	62	8												70		
Enophrys diceraus						9	34	37	X											80	3	2
Enophrys lucasi						2	35	15												52	1	2
Enophrys taurina						X	32	X												32		
Eurymen gyrinus																4	X			4		
Gilbertidia sigalutes					1	17	51	31												100	6	4
Gymnocanthus galeatus										6	87	7								100	1	
Gymnocanthus pistilliger						X	X	X	36	64	X									100	3	1
Hemilepidotus hemilepidotus						13	84	3												100	6	2
Hemilepidotus jordani								8	81	10										100	3	3
Hemilepidotus spinosus					6	76	14													96	4	4
Hemilepidotus zapus						10	X	2												12		
Hemitripterus bolini											26	68	6							100		
Hemitripterus villosus									2	13	1									16	1	
Icelinus borealis					9	18	42	3												72	4	4
Icelinus burchami							X	2	10	X										12		
Icelinus cavifrons					6	45	9													60		
Icelinus filamentosus							9	48	3											60	6	
Icelinus fimbriatus								6												6		
Icelinus oculatus								4												4		
Icelinus quadriseriatus						10	40	10												60	2	
Icelinus sp.																						
Icelinus tenuis						8	48	4												60		3
Icelus canaliculatus							5	7												12		

Species	Number of pectoral fin rays																		N	Asymmetry L>R	Asymmetry R>L
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
Icelus euryops									X													
Icelus scutiger								2	16	4										22		2
Icelus spatula								18	34	4	X									56		
Icelus spiniger									42	8										50	2	
Icelus uncinalis								7	17											24	1	
Jordania zonope				1	96	3														100	3	
Leiocottus hirundo									10											10		
Leptocottus armatus								X	32	56	12									100	3	1
Malacottus kincaidi										6	44	26								76	2	2
Malacottus zonurus										2	24	12	2	X						40	1	4
Myoxocephalus jaok								14	76	10										100	2	2
Myoxocephalus niger							6	92	2											100	4	
Myoxocephalus polyacanthocephalus							X	22	62	16										100	5	2
Myoxocephalus sp.								X	1	X										1		
Nautichthys oculofasciatus				5	95															100	1	
Nautichthys pribilovius						18	18	2												38		
Nautichthys robustus					2	6	2													10		
Oligocottus maculosus			1	1	96	2														100	2	1
Oligocottus rimensis				6	86	8														100		1
Oligocottus rubellio				6	92	2														100	1	1
Oligocottus snyderi			2	11	82	5														100	1	2
Orthonopias triacis				X	56	4														60	1	1
Paricelinus hopliticus					4	32														36		
Phallocottus obtusus					15	9	2													26	1	
Porcottus bradfordi				8	44															52	1	1
Psychrolutes paradoxus										7	38	46	9	X						100	5	
Psychrolutes phrictus													X	2	12	4	X			18	1	1
Radulinus asprellus								1	39	10	X									50		
Radulinus boleoides									2	4	4									10	2	
Radulinus vinculus								4												4		
Rhamphocottus richardsoni					6	38	14													58	3	5
Scorpaenichthys marmoratus					6	80	14													100	3	1
Sigmistes caulias				43	57															100	5	2
Sigmistes smithi				1	17	4														22	1	2
Stelgistrum beringianum						2	6													8		
Sternias xenostethus							X	13	7											20		
Stlegicottus xenogrammus									X													
Synchirus gilli												14	62	20	4					100	2	2
Thyriscus anoplus						X																
Triglops forficata											27	62	9							98	2	5
Triglops macellus						7	27	5												39	2	2
Triglops metopias									5	3	8	2	4							22	1	
Triglops pingeli							4	16	101	29										150	2	4
Triglops scepticus								2	32	30										64	2	
Zesticelus profundorum										X	4	X								4		

Table 14. Range and distribution of meristic variation in pelvic fin rays of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature.

Species	Number of pelvic fin rays							Asymmetry	
	0	1	2	3	4	5	N	L>R	R>L
Artediellus pacificus				60			60		
Artedius corallinus				80			80		
Artedius creaseri				100			100		
Artedius fenestralis				100			100		
Artedius harringtoni				100			100		
Artedius lateralis				200			200		
Artedius meanyi			6	58			64	2	
Artedius notospilotus				62			62		
Ascelichthys rhodorus	100						100		
Asemichthys taylori				60			60		
Blepsius bilobus				72			72		
Blepsius cirrhosus				100			100		
Chitonotus pugetensis			4	96			100		2
Clinocottus acuticeps				100			100		
Clinocottus analis				60			60		
Clinocottus embryum				100			100		
Clinocottus globiceps				60			60		
Clinocottus recalvus				60			60		
Cottus aleuticus					100		100		
Cottus asper					100		100		
Dasycottus setiger				100			100		
Enophrys bison				70			70		
Enophrys diceraus			1	79			80		1
Enophrys lucasi			2	50			52		
Enophrys taurina				32			32		
Eurymen gyrinus				4			4		
Gilbertidia sigalutes				93			98		
Gymnocanthus galeatus				100			100		
Gymnocanthus pistilliger				100			100		
Hemilepidotus hemilepidotus				2	98		100		
Hemilepidotus jordani				1	99		100		1
Hemilepidotus spinosus					96		96		
Hemilepidotus zapus					12		12		
Hemitripterus bolini				100			100		
Hemitripterus villosus				16			16		
Icelinus borealis			72				72		
Icelinus burchami			12				12		
Icelinus cavifrons			60				60		
Icelinus filamentosus			60				60		
Icelinus fimbriatus			6				6		
Icelinus oculatus			4				4		
Icelinus quadriseriatus			60				60		
Icelinus sp.			X						
Icelinus tenuis			60				60		
Icelus canaliculatus				12			12		

Species	Number of pelvic fin rays							Asymmetry	
	0	1	2	3	4	5	N	L>R	R>L
Icelus euryops				X					
Icelus scutiger				22			22		
Icelus spatula				56			56		
Icelus spiniger				50			50		
Icelus uncinalis				24			24		
Jordania zonope					2	98	100		
Leiocottus hirundo				10			10		
Leptocottus armatus					100		100		
Malacottus kincaidi				80			80		
Malacottus zonurus				40			40		
Myoxocephalus jaok				100			100		
Myoxocephalus niger				100			100		
Myoxocephalus polyacanthocephalus				100			100		
Myoxocephalus sp.				1			1		
Nautichthys oculofasciatus				100			100		
Nautichthys pribilovius				38			38		
Nautichthys robustus				10			10		
Oligocottus maculosus				100			100		
Oligocottus rimensis				100			100		
Oligocottus rubellio				100			100		
Oligocottus snyderi				100			100		
Orthonopias triacis				60			60		
Paricelinus hopliticus						40	40		
Phallocottus obtusus				26			26		
Porocottus bradfordi				52			52		
Psychrolutes paradoxus				100			100		
Psychrolutes phrictus				18			18		
Radulinus asprellus				100			100		
Radulinus boleoides				10			10		
Radulinus vinculus				4			4		
Rhamphocottus richardsoni				58	X		58		
Scorpaenichthys marmoratus					4	96	100	4	
Sigmistes caulias				100			100		
Sigmistes smithi				22			22		
Stelgistrum beringianum				8			8		
Sternias xenostethus				20			20		
Stlegicottus xenogrammus				X					
Synchirus gilli				100			100		
Thyriscus anoplus				X					
Triglops forficata				100			100		
Triglops macellus				40			40		
Triglops metopias				22			22		
Triglops pingeli				150			150		
Triglops scepticus				64			64		
Zesticelus profundorum			4	X?			4		

Species	Number of Vertebrae																													
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	N
Icelus euryops														Unknown																
Icelus scutiger															3	2	1														6
Icelus spatula															1	4	1														6
Icelus spiniger																1	3	2													6
Icelus uncinalis													1	1	1	1															4
Jordania zonope																						2	5	2							9
Leiocottus hirundo											1	4																			5
Leptocottus armatus											X	1	3	X	1																5
Malacottus kincaidi							3	1	1																						5
Malacottus zonurus						1	2	2	1																						6
Myoxocephalus jaok											1	5	5	1																	12
Myoxocephalus niger												X	1	2	3																6
Myoxocephalus polyacanthocephalus										X	5	3	X																		8
Myoxocephalus sp.											X	X	X																		0
Nautichthys oculofasciatus																2	4														6
Nautichthys pribilovius												1	5																		6
Nautichthys robustus											1																				1
Oligocottus maculosus									6	3																					9
Oligocottus rimensis										1	2	4	1																		8
Oligocottus rubellio								1	4	2	1																				8
Oligocottus snyderi										6	1	X	1																		8
Orthonopias triacis									1	6	X																				7
Paricelinus hopliticus																		3													3
Phallocottus obtusus										Unknown																					
Porocottus bradfordi										2	7	1																			10
Psychrolutes paradoxus												4	2																		6
Psychrolutes phrictus									1	2	1																				5
Radulinus asprellus														2	5																7
Radulinus boleoides															2	2															4
Radulinus vinculus														Unknown																	
Rhamphocottus richardsoni		3	2	1																											6
Scorpaenichthys marmoratus											2	5	1																		8
Sigmistes caulias													1	3																	4
Sigmistes smithi												Unknown																			
Stelgistrum beringianum												1																			1
Sternias xenostethus																				1	5	1									7
Stlegicottus xenogrammus															Unknown																
Synchirus gilli														1	5																6
Thyriscus anoplus												Unknown																			
Triglops forficata																												1	1	2	4
Triglops macellus																											1				1
Triglops metopias																								2	2						4
Triglops pingeli																						2	0	2							4
Triglops scepticus																					1	1									2
Zesticelus profundorum	1	1																													2

Table 15. Range and distribution of meristic variation in vertebrae of cottid species of the northeast Pacific Ocean. Numbers indicate frequency of counts made in this study, X indicates data from the literature. Where possible, literature data have been adjusted to include hypural plate.

Species	Number of vertebrae																													N
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Artediellus pacificus				2	6	2																									10
Artedius corallinus							2	2	1																						5
Artedius creaseri						2	3																								5
Artedius fenestralis								1	3	1	X																				5
Artedius harringtoni								2	3	2																					5
Artedius lateralis								2	3	X																					5
Artedius meanyi									5	2	1																				8
Artedius notospilotus								6	3	1																					10
Ascelichthys rhodorus									1	2	2	2																			7
Asemichthys taylori									5	1	3																				9
Blepsius bilobus													1	2																	3
Blepsius cirrhosus													3	2																	5
Chitonotus pugetensis											3	5																			8
Clinocottus acuticeps							1	4	X																						5
Clinocottus analis							X	4	2	X	X																				6
Clinocottus embryum									3	2																					5
Clinocottus globiceps								2	2	2																					6
Clinocottus recalvus								2	4																						6
Cottus aleuticus										X	X	1	4	2	X																7
Cottus asper										X	X	4	4	X	X																8
Dasycottus setiger										2	3																				5
Enophrys bison					X	3	7																								10
Enophrys diceraus								X	6	4	1																				11
Enophrys lucasi									3	1																					4
Enophrys taurina			X	7	2																										9
Eurymen gyrinus														1																	1
Gilbertidia sigalutes									2	7	1																				10
Gymnocanthus galeatus													X	X	5	5															10
Gymnocanthus pistilliger											X	3	5	X																	8
Hemilepidotus hemilepidotus											1	6	X																		7
Hemilepidotus jordani													4	4	X																8
Hemilepidotus spinosus											X	4	3																		7
Hemilepidotus zapus													X	2																	2
Hemitripterus bolini														1	3	1															5
Hemitripterus villosus															3	2	1														6
Icelinus borealis											4	3																			7
Icelinus burchami											1	2	1																		4
Icelinus cavifrons										3	3	1																			7
Icelinus filamentosus										1	4	3	X																		8
Icelinus fimbriatus											1																				1
Icelinus oculatus													1																		1
Icelinus quadriseriatus									X	7	1																				8
Icelinus sp.									Unknown																						
Icelinus tenuis													1	4	1																6
Icelus canaliculatus																	1														1

APPENDIX IV

ARTIFICIAL KEY TO THE COTTID GENERA OF THE NORTHEAST PACIFIC OCEAN

This key follows the convention of presenting a series of numbered dichotomies. When one alternative is found to apply to the specimen under study, the user is directed further in the key or reaches the terminal point and identifies the taxon.

Two monotypic genera and two other species were not seen but are included in the key using characteristics stated in the original descriptions; these taxa are obviously rare in the Northeast Pacific with one possible exception (Icelinus sp.). The taxa not examined are Stlegicottus xenogrammus, Thyriscus anoplus, Icelus euryops and Icelinus sp.(an undescribed species under study by C.L. Hubbs). The first two taxa are monotypic genera. All other members of Icelinus and Icelus were examined.

For genera containing only a single species in the Northeast Pacific, the specific name is also indicated within the key. The key should be used only for specimens collected in the northeast Pacific Ocean (Baja California to the Aleutian Islands). A more encompassing but preliminary key to north Pacific Ocean and Bering Sea genera is under preparation.

Some individuals of every genus and species exhibit extreme or unusual variation which complicates the construction and use of any taxonomic key. Some of this extreme variation is known and has been taken into account within the key but certainly there are other variable individuals yet to be discovered. In addition, there are known undescribed species (genera?) occurring within the region and probably unknown ones as well. It is assumed that the reader is aware of the text portion accompanying this key; the text gives some idea of the taxonomic state of the art for the taxa within the region.

ARTIFICIAL KEY TO THE COTTID GENERA OF THE NORTHEAST PACIFIC OCEAN

1a. Length of head about one-half standard length .... Rhamphocottus richardsoni
- peculiar body shape for a cottid; strikingly colored; locally common in a variety of nearshore areas though usually only a single individual is found; less than 8 cm in length.

1b. Length of head less than one-half of standard length 2

2a. Pectoral fins united to each other ventrally .... Synchirus gilli
- slender body and less than 8 cm in length; rare to uncommon and lives nearshore in (among) algae.

2b. Pectoral fins normal - well separated and not united 3

3a. Pelvic fins absent .... Ascelichthys rhodorus
- locally common in tidepools sometimes very abundant; less than 16 cm in length; drab color but sometimes with rosy-red lips and red color behind pectorals.

3b. Pelvic fins present 4

4a. Pelvic fins with 4 or 5 rays[1] 5

4b. Pelvic fins with 3 or fewer rays 10

5a. Body above lateral line smooth, without scales 6

5b. Body above lateral line with obvious scales[2] 8

6a. Primary preopercular spine large, strong and antler-like .... Leptocottus armatus
- very common in estuaries and nearshore especially on sandy bottoms; length to about 45 cm but average about 25 cm.

6b. Primary preopercular spine short and curved but not antler-like 7

7a. Cirri present above eye and a triangular flap of skin on snout; usually 5 pelvic rays, rarely 4 .... Scorpaenichthys marmoratus
- moderately common in nearshore areas including tidepools; may reach a meter in length.

7b. No cirri above eye nor flap of skin on snout; usually 4 pelvic rays, rarely only 3 rays ..... Cottus 2+ species
- This is a freshwater group but some species are often found in estuaries or nearshore.

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[1] The pelvic fins of all cottids have a single spine which is small, concealed by thick skin and closely joined to the first ray. Usually it can only be seen through dissection. Also, the last pelvic ray in many species is thin and obscure; therefore it is best to count the rays using light which is reflected through the fin and magnification. Rarely, a taxon characterized by a certain number of pelvic rays will have one more or one less than typical. Some of these cases are known and have been accounted for in the key but other non-typical specimens await to be discovered. As usual with fishes, it is best to have more than one specimen at hand when keying.

[2] The scales of cottids exhibit great modification often giving the appearence of single spines, groups of spines or plates. These may be readily apparent or quite obscure. In the key, when reference is made to scales, these will be apparent though they may be modified and not look like a typical fish scale.

8a. An obvious row of strong, sharp recurved spines along base of dorsal fins and spines on head .... Paricelinus hopliticus
- slender body with the lower pectoral rays not connected by membrane; inhabits nearshore rocky areas and rather rare; length to about 18 cm.

8b. No row of spines along base of dorsal fins and no sharp obvious spines on head; small scales (prickly) present on body 9

9a. Typically 5 pelvic rays, rarely 4; dorsal spines 17-18 and anal rays 22-24 .... Jordania zonope
- long, slender body; length to about 13 cm; inhabits nearshore rocky areas, known to cling to vertical surfaces; moderately rare.

9b. Typically 4 pelvic rays, rarely 3; dorsal spines 10-13 and anal rays 13-18 .... Hemilepidotus 4 species
- Robust body; some species common in tidepools and nearshore rocky areas, others offshore and rare.

10a. Pelvic fins with 2 rays 11

10b. Pelvic fins with 3 rays 15

11a. No scales on lateral line nor above lateral line; primary preopercular spine curved upward; head pores noticably large .... Zesticelus profundorum
- very rare, known from few specimens and taken only in deep water; less than 6 cm in length.

11b. Scales either along lateral line or above lateral line or both; preopercular spine may be curved but only rarely, usually antler-like or straight; head pores not noticably large 12

12a. Scales modified into large plates along lateral line but no scales of any form above lateral line; primary preopercular spine straight and long and sometimes with barbs on dorsal margin .... Enophrys 4 species
- This genus only rarely has 2 pelvic rays, usually it has 3. At least one species is common in rocky areas of estuaries and nearshore areas, others may occur in deeper water offshore.

12b. Scales or plates may be present along lateral line but scales are always present above lateral line (2 or more rows); primary preopercular spine simple, multifid or antler-like but not long and straight..... 13

13a. Scales above lateral line in only two rows, closer to dorsal fin than lateral line; preopercular spine antler-like .... Icelinus 8+ species
- Some of these species are common nearshore, others are in deeper water and relatively rare, some very rare.

13b. Scales above lateral line in more than two rows and often extending between lateral line and dorsal fins;preopercular spine may be antler-like, simple or multifid (both genera keying to this couplet only rarely have two pelvic rays, typically they have three)..... 14

14a. Preopercular spine antler-like; first dorsal spine much longer than second dorsal spine and the first dorsal fin with a notch around the third or fourth spine ..... Chitonotus pugetensis
- Moderately common in some areas nearshore, often over sandy bottoms; maximum length 23 cm.

14b. Preopercular spine simple or multifid; first dorsal fin evenly rounded, no noticably enlongated spines and no notch in the first dorsal ... Artedius
- typically this genus has 3 pelvic rays but at least three species within it may rarely have 2 rays. Mostly a tidepool inhabiting group.

15a. Branchiostegal membranes fused to the isthmus with no fold of skin lying across the isthmus 16

15b. Branchiostegal membranes united to each other and forming a fold across the isthmus, the membranes may be connected (fused) to the isthmus but this is not visible from the exterior 21

16a. Primary preopercular spine long and straight; scales modified into large plates along lateral line but body otherwise naked .... Enophrys 4 species
- these occur in a variety of habitats, at least one species is common in nearshore rocky areas. Some species may have barbs on preoperular spine.

16b. Either no preopercular spine or, if present, short, stout or curved; if scales are present, they are modified into prickles and all over body, not just plates along lateral line 17

17a. No preopercular spine(s)[3] 18

17b. Preopercular spine(s) present 19

18a. Dorsal spines not evident or only barely so because they are embedded in the musculature; pectoral rays 19 or more .... Psychrolutes 2 species
- one species is common to uncommon in nearshore areas, the other is rare and occurs in quite deep water.

18b. Tips of dorsal spines evident as small projections, the rest of the spines covered by skin which appears jelly-filled; pectoral rays 17 or fewer .. .. Gilbertidia sigalutes
- moderately common in local areas; appears to occur over a variety of substrates; less than 9 cm in length.

19a. Body more-or-less completely covered with fleshy papillae which are actually small spines covered by skin; head with ridges, knobs, spines and/or bumps .... Nautichthys 3 species
- One species common in nearshore areas, another common to uncommon and the third species quite rare.

19b. Body smooth or with prickles but prickles are not flesh covered; head smooth or with rounded tubercles but without ridges, spines or knobs.. 20

20a. Dorsal and pectoral rays somewhat obscured by flesh making accurate counting very difficult; pectoral rays greater than 18 .... Malacocottus 2+-species
- This group may occur in nearshore waters.

20b. Dorsal and pectoral rays obvious, not obscured by flesh; pectoral rays fewer than 18 .... Cottus 2+ species
- This is a freshwater group but some species are moderately common in estuaries and sometimes nearshore. Only rarely does this group have 3 pelvic rays, usually there are 4.

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[3] When preopercular spines are not readily discernable, they may still be present but obscured by flesh. The best method of determining their presence is to use a probe or needle and glide it along the preopercle. If a spine or spines are present they will be felt with the needle or probe.

21a. No preopercular spine(s), preopercle smoothly rounded; body without scales .... Eurymen gyrinus
- On the basis of museum records, this species is quite rare, at least in the NE Pacific. Length to at least 15 cm, maybe more.

21b. One or more preopercular spines present although it (they) may be small; body with or without scales 22

22a. Largest preopercular spine antler-like or with barbs on the dorsal margin 23

22b. Largest preopercular spine simple or multifid (forked) but not with barbs nor antler-like 24

23a. Preopercular spine antler-like; head and body above lateral line mostly covered with rough scales .... Chitonotus pugetensis
- Rather common in some nearshore areas; length to 23 cm.

23b. Preopercular spine with barbs on dorsal margin; body without scales above lateral line but head with bony granulations (scales, small plates) .... Gymnocanthus 2 species
- One species appears to be common inshore, the other appears more offshore.

24a. Lateral line with well developed plates (scales); scales present behind pectoral fins - numerous and spiny; lower pectoral rays not connected by membrane and at least some of these rays much longer than other rays, reaching beyond origin of anal fin .... Thyriscus anoplus
- Appears to be very rare, at least in the NE Pacific; length at least 11 cm.

24b. Scales or plates present or absent along lateral line; if scales are present behind pectoral fin, they will usually also be present above lateral line; pectoral fin rays mostly connected by membrane and no rays greatly elongated 25

25a. Body rather deep, laterally compressed; fleshy papillae more-or-less covering entire body, these papillae are actually small spines covered with flesh .... Blepsias 2 species
- At least one species is moderately common is some nearshore-estuarine areas.

25b. Not as above; if prickles-papillae are present, the body is definately not deep but depressed dorso-ventrally; if body appears deep, no prickles-papillae are present 26

26a. Above eye and top of head with apparent spines, ridges and bumps; body covered with prickles or flesh-covered prickles (papillae); mouth very large with maxillary reaching posterior portion of eye; body definately depressed dorso-ventrally 27

26b. Without the combination of characters mentioned above although one or a few of these characters may be present 28

27a. Obvious spines on head sharp; spinous dorsal with less than 11 spines (occassionally 11); no dorsal spines free from membrane although each spine may be topped with a cirrus .... Dasycottus setiger
- Not uncommon in nearshore areas; length to 23 cm.

27b. Spines on head not all sharp, more tubercle-like; spinous dorsal with more than 11 spines (rarely 11); the upper portion of dorsal spines obviously free from membrane .... Hemitripterus 2 species
- One species is rather common in the north; length to 70 cm.

28a. Head and/or body with obvious scales or plates, some may be modified into rough prickles or papillae but most are definately scales sometimes with spinous margins 29

28b. Head and body smooth without obvious scales; a few species have prickles on body but not on head, no other scales or modified scales present 38

29a. Body below lateral line with oblique folds containing serrated plates (modified scales); body usually long and slender 30

29b. Body below lateral line without folds or serrated plates although rows of or scattered scales may be present; body various, it may be slender ... 31

30a. Scales present on breast .... Sternias xenostethus
- Rare in the NE Pacific; length at least 10 cm, more?

30b. Scales absent from breast but folds are sometimes present .... Triglops
- some shallow water species, others deep water. 5 species

31a. Scales present above lateral line, on lateral line and below lateral line, at least in the region above anal fin (only rarely will specimens key here) 32

31b. Scales above and/or on lateral line but rarely below lateral line; a few scales may be present below lateral line in region behind pectoral fin or many prickly scales will be present (one species-Icelus scutiger) but this one species has 40-50 scales (pores) along the lateral line 33

32a. Dorsal spines 10 or more; lateral line scales or pores more than 50 .... Hemilepidotus 4 species, 2 occassionally have 3 pelvic rays.
- Only rarely do specimens in this genus have 3 pelvic rays, usually there are 4.

32b. Dorsal spines 9 or fewer; lateral line scales or pores less than 40 .... Stlegicottus xenogrammus
- Very rare, at least in the NE Pacific; one specimen 3 cm in length.

33a. Body slender; top of head and nape (eye to dorsal fin origin) flat, not arched; lateral line straight, not curved or arched and with plates (scales) which have readily apparent spinous margins posteriorly; 1-4 horizontal rows of plates (scales) above lateral line row but these are much smaller than those on lateral line 34

33b. Body not particularly slender; top of head and nape arching upward, making the depth of the body greater than that of the head, region not flat; lateral line curved and/or arched with scales above lateral line in more than 4 horizontal rows or a single row of enlarged plates often with recurved spines 35

34a. Anal rays 15-16; dorsal rays 15-16 .... Asemichthys taylori
- Inconspicuous but apparently common on clean shell substrates near rocky outcrops; length less than 8 cm. Taken in fairly shallow water.

34b. Anal rays 18-25; dorsal rays 17-23 .... Radulinus 3 species
- One species moderately uncommon at moderate depths, the other two species rare.

35a. Anus closer to pelvic fin base than anal fin origin; 7-14 oblique rows of scales above lateral line in region under posterior portion of spinous dorsal fin; pelvic rays oriented in a longitudinal series with the third ray more-or-less directly behind the first ray (in line with it), rather than the more typical oblique orientation ....Orthonopias triacis
- A moderately common tidepool dweller; length to about 10 cm.

35b. Anus may be advanced but usually closer to the anal fin origin than pelvic fin base; oblique scale rows variable (may fall within the above range) or with a single row of large plates above lateral line (with smaller scales above); pelvic rays oriented in the more typical oblique series 36

36a. Dorsal rays 17 or more; anal rays 13 or more; a series of large plates between lateral line and dorsal fin with much smaller scales sometimes present above large plates or no large dorsal plates but body above and below lateral line with small spinous (prickly) scales, head with spinous scales but these absent from snout and under eye .... Icelus 6 species
- A mixed group of shallow and deep water species, not well studied.

36b. Dorsal rays 18 or fewer; anal rays 14 or fewer; more than one row of scales above lateral line and these not developed into large plates; few, if any, spinous scales below lateral line 37

37a. Palatine teeth present .... Artedius 7 species
- Some species very common tidepool inhabitants, others somewhat rare.

37b. Palatine teeth absent .... Stelgistrum beringianum
- This species rare, at least in the NE Pacific. Length 5 cm, based on a single specimen.

38a. Primary preopercular spine a definate stout hook, curved upward; cirri usually absent, if present, few and not readily discernable 39

38b. Primary preopercular spine straight or multifid or with a slight curve but not a definate hook; cirri readily discernable in most taxa on head and/or body above lateral line 40

39a. Head pores noticably large; pectoral rays 21 or fewer .... Zesticelus profundorum
- A deep water and rare species; known to have 2 pelvic rays but reported to have 3; length less than 6 cm.

39b. Head pores not noticably large; pectoral rays 22 or more ... Artediellus pacificus
- Little is known about this taxon, in need of study; length about 7 cm, at least.

40a. Lateral line with accessory canals and accessory pores yielding the appearance of many pores lying along (on) the lateral line; usually 3 (sometimes 4) preopercular spines which are simple and straight or slightly curved 41

40b. Lateral line without accessory pores and accessory canals though occasionally additional pores may lie along the lateral line, typically there are only one or two pores making up the lateral line; usually 4 preopercular spines though lowermost may be quite obscure; preopercular spine various but in most taxa it is slightly curved or multifid 42

41a. Upper preopercular spine curved and short; pectoral rays 12-14 ....
- Not well known though apparently abundant in (some) tidepools; length at least 7 cm. Porocottus bradfordi

41b. Upper preopercular spine straight and short or long; pectoral rays 16 or more .... Myoxocephalus 4 species
- A least some species common in tidepools and in nearshore waters at least seasonally.

42a. Anus immediately in front of anal fin origin or, if advanced, still in posterior third of the distance from pelvic fin base to anal fin origin (mostly closer to anal fin origin than pelvic fin base).. Oligocottus
- A quite common group of tidepool, shallow water species. 4 species

42b. Anus advanced, in anterior two-thirds of the distance from pelvic fin base to anal fin origin (mostly closer to pelvic fins than anal fin).. 43

43a. Anal fin rays 14 or more; anus usually in anterior third of the distance from pelvic fin base to anal fin origin; lateral line with an arch in region above pectoral fin, yielding a sigmoid shape line 44

43b. Anal fin rays 14 or fewer; anus usually in middle third of the distance from pelvic fin base to anal fin origin; lateral line sloping or curved but not a sigmoid shape 45

44a. Anal rays 22 or more .... Phallocottus obtusus

44b. Anal rays 20 or fewer .... Sigmistes 2 species

Both of these taxa are little known tidepool or shallow water inhabitants; length to 6 or 7 cm.

45a. Upper postorbital cirrus present; no dorsal spines elongated, fin evenly rounded .... Clinocottus 5 species - A common tidepool group.

45b. Upper postorbital cirrus absent; first few dorsal spines elongate, fin higher anteriorly than posteriorly .... Leiocottus hirundo
- Uncommon but found in nearshore waters including tidepools; length to about 25 cm.

APPENDIX V

LIST OF
AND
ARTIFICIAL KEY TO THE COTTID GENERA OF THE NORTHEAST PACIFIC OCEAN

This key was designed to be used separately or in conjunction with the key to cottid genera. If the user is aware of the genus, he or she may proceed directly to the genus; the genera are listed in alphabetical order. As mentioned in the preface to the generic key, this key should only be used within the region for which it was designed - Baja California to the Aleutians. The tables of meristic data as well as the taxonomic diagnoses may be of use in identification.

LIST OF
AND
ARTIFICIAL KEY TO THE COTTID SPECIES OF THE NORTHEAST PACIFIC OCEAN

Artediellus pacificus - only one species in the NE Pacific
- Little is known; length to 7 cm at least; depth 14-112 m.

Artedius

1a. Scales present on head, may be somewhat covered by skin and cirri 2

1b. No scales on head 6

2a. Cirrus present on upper anterior margin of orbit 3

2b. No cirrus on upper anterior margin of orbit 5

3a. Scales present on snout 4

3b. No scales on snout .... A. harringtoni
- moderately common in intertidal and subtidal (to 22 m) areas; length to 10 cm.

4a. Scales apparent on eye; dorsal rays 15-16 (rarely 14) .... A. meanyi
- uncommon to rare, often found on rocks or vertical rock faces; depth 1 to 18 m; length to 6 cm.

4b. Scales not apparent on eye (few small scales may be embedded); dorsal rays 12-14 .... A. creaseri
- uncommon; intertidal to 28 m in depth; length about 8 cm.

5a. Scales present under entire orbit; caudal peduncle covered w th rows of scales .... A. fenestralis
- more common northward from intertidal to 56 m depth; length to 14 cm.

5b. Scales often present under posterior portion of orbit but not anterior portion; caudal peduncle without scales or with a few scattered scales .... A. notospilotus
- moderately common in the central portion of its range; intertidal to 52 m depth; length about 25 cm.

6a. Dorsal scales in 39-49 oblique rows with 10-18 scales in the longest row; 3-10 scales between upper end of pectoral fin base and lateral line .... A. corallinus
- common in California but uncommon to rare northward; intertidal to 22 m depth; length about 13 cm.

6b. Dorsal scales in 18-29 oblique rows with 3-11 scales in longest row; no scales between upper end of pectoral fin base and lateral line .... A. lateralis
- more-or-less common in intertidal to 8 m depth; length to 14 cm

Ascelichthys rhodorus - monotypic genus
- appears to be locally abundant, sometimes very abundant in intertidal and subtidal areas; length to 15 cm.

Asemichthys taylori - monotypic genus
- not common but reported from 6 to 18 m or more depth on clean shell substates near rocky outcroppings; length to about 6 cm.

Blepsius

1a. Dorsal fins separated by a deep notch and spinous dorsal with a notch; usually no scales on dorsum of caudal peduncle, behind pectoral fins and posterior portion of lateral line; pectoral rays 11-13 .. B. cirrhosus
- uncommon and recorded from the intertidal to 37 m; length to 19 cm.

1b. Dorsal fins separated by a deep notch but spinous dorsal without a notch, evenly rounded; body usually completely covered by scales (papillae); pectoral rays 15-17 .... B. bilobus
- appears to be rare; taken in nearshore waters; length to 25 cm.

Chitonotus pugetensis - monotypic genus
- appears to be locally common; from intertidal to 142 m depth; length to 23 cm.

Clinocottus

1a. Inner pelvic ray attached to abdomen by membrane; 1-2 cirri on end of maxillary .... C. acuticeps
- common throughout its range, often taken in areas which have some freshwater influence; intertidal and subtidal areas; length to 6 cm.

1b. Inner pelvic ray not attached to abdomen by membrane; no cirri on maxillary 2

2a. Primary preopercular spine multifid (2-3 points); prickles and cirri present between lateral line and dorsal fin, these minute prickles become obscured by cirri in larger specimens .... C. analis
- common and taken from intertidal to 20 m; length to 17 cm.

2b. Primary preopercular spine simple, only a single point; no prickles or cirri present between lateral line and dorsal fin but cirri may be on head 3

3a. When viewed from above, the middle of the upper lip groove contains a small fleshy tubercle; no cirri between upper pectoral fin base and lateral line .... C. embryum
- uncommon, from intertidal and subtidal areas; length to 7 cm.

3b. No fleshy tubercle as described above; small patch of cirri present between pectoral fin base and lateral line 4

4a. For specimens larger than 4 cm - cirri present in anterior portion of of interorbital space .... C. globiceps - see note below
- common from Oregon northward, uncommon to rare southward; intertidal to subtidal; length to 19 cm.

4b. For specimens larger than 4 cm - no cirri in anterior portion of interorbital space .... C. recalvus
- common in the central portion of its range; intertidal to subtidal; length to 13 cm.

Note: C. globiceps and C. recalvus cannot be distinguished when less than about 4 cm in length unless specimens of both are at hand. Bolin (1944) stated that if the specimen was taken north of San Francisco, it is probably globiceps; if taken south of Santa Cruz (CA), it is probably analis.

Cottus

If a member of this genus is taken in marine waters, it is probably best to utilize a key to freshwater fishes as it is a freshwater genus with about seven species occurring along the Pacific slope. Only two have been (commonly) recorded from marine environments and they are included below.

1a. Palatine teeth absent; posterior nares tubular; prickles, if present, restricted to behind pectoral fins .... C. aleuticus
- uncommon but found in estuaries and nearshore; does not appear to be as common as C. asper in marine environments; has not been reported to breed in estuarine areas; length to 15 cm.

1b. Palatine teeth present; posterior nares not tubular, flat or slightly mound-like; prickles may cover the body, be restricted to behind pectoral fins or be absent .... C. asper
- uncommon but found in estuaries and nearshore; appears to be more common than C. aleuticus in marine environments and has been reported to breed in marine environments (estuaries); length to 30 cm.

Dasycottus setiger - only one species in the NE Pacific.
- moderately common and often taken by shrimp fishermen; depths of 18-122 m; length to 23 cm.

Enophrys - see note below

1a. For specimens larger than 4 cm - primary preopercular spine with barbs (cusps); combined total of second dorsal fin and anal fin 21 or more rays 2

1b. For specimens larger than 4 cm - primary preopercular spine without barbs (cusps); combined total of second dorsal fin and anal fin 23 or fewer rays 3

2a. Primary preopercular spine long, equal to or greater than distance from posterior rim of orbit to posterior edge of nuchal ridge (rarely shorter); interorbital width generally less than 6.5 in head length (ave. 5.7); second dorsal rays 13-15 (mostly 14); anal rays 11-13 (mostly 12) .... E. diceraus
- appears to occur in shallower water than E. lucasi; length to at least 16 cm.

2b. Primary preopercular spine short, generally much less than distance from posterior rim of orbit to posterior edge of nuchal ridge; interorbital width generally greater than 6.6 in head length (ave. 7.6); second dorsal rays 13-14 (mostly 13); anal rays 9-11 (mostly 11) .... E. lucasi
- appears to occur in deeper water than E. diceraus; length to at least 20 cm.

3a. Dorsal rays 9-13 (mostly 12); anal rays 8-10 (mostly 9) .... E. bison
- quite common nearshore in rocky areas and sandy beach areas; length to 30 cm.

3b. Dorsal rays 8-10 (mostly 9); anal rays 6-7 (mostly 7) .... E. taurina
- uncommon and apparently in deeper water than E. bison; depth from 11-255 m; length to 17 cm.

Note: This key was adapted from Sandercock and Wilimovsky (1968). Quast and Hall (1972) have suggested that the differences between E. diceraus and E. lucasi are size-specific, if so, it should be studied and reported.

Eurymen gyrinus - monotypic genus
- Rare, at least in the NE Pacific; length to 15 cm; depth 14-126 m.

Gilbertidia sigalutes - one species in the NE Pacific
- locally common in some areas being found on both rock and mud substrates; recorded from the surface to over 213 m; length less than 9 cm.

Gymnocanthus

1a. Combined total of both dorsal fins, both pectoral fins and anal fin 81 or more rays ..... G. galeatus
- moderately common on the basis of museum material; depths of 0-167m; length to about 35 cm; post-juveniles usually below 50 m.

1b. Combined total of both dorsal fins, both pectoral fins and anal fin 80 or fewer rays ..... G. pistilliger
- moderately common on the basis of museum material; depths of 0-50 m; length to about 22 cm. Post-juveniles usually above 50 m.

Hemilepidotus

1a. Branchiostegal membranes fused to isthmus, no fold (rarely a tiny fold); dorsal scale rows (horizontal) 6-8 (mostly 7) .... H. spinosus
- appears to be more common in south than north, not as rare as H. zapus but not as common as H. hemilepidotus and H. jordani; depths intertidal to 78 m; length to 25 cm.

1b. Branchiostegal membranes united to each other with a fold across isthmus (fused interiorly); dorsal scale rows 4-5 2

2a. Lateral line with 58 or fewer pores; scales always present between dorsal scale band and lateral line on caudal peduncle; row of scales on body above anal fin always present .... H. zapus
- rare, at least in the NE Pacific; depth range 61-107 m; length to 13 cm.

2b. Lateral line with 59 or more pores; scales usually absent between dorsal scale band and lateral line on caudal peduncle (occassionally present in H. hemilepidotus, rarely present in H. jordani); row of scales on body above anal fin usually absent (occassionally present in H. jordani rarely present in H. hemilepidotus) 3

3a. Width of maxillary cirrus less than one-half its length (in specimens over 5 cm); pyloric caeca 4-5; nasal cirri simple .... H. jordani
- appears to be moderately common; apparently occurs in deeper water than H. hemilepidotus; length to 41 cm.

3b. Width of maxillary cirrus more than one-half its length; pyloric caeca 6-7; nasal cirrus multifid (in specimens over 7 cm) .... H. hemilepidotus
- appears to be common ; tidepools to 48 m; apparently occurs in shallower water than H. jordani; length to 51 cm.

Note: Key modified from Peden (1964).

Hemitripterus

1a. Spinous dorsal fin without any notch; dorsal spines 11-15 (mostly 14); pectoral rays 20-22 (mostly 21) ..... H. bolini
- moderately uncommon to common; depths of 30-217 m; length to 69 cm.

1b. Spinous dorsal fin with a deep notch; dorsal spines 16-19 (mostly 17, based on few specimens); pectoral rays 18-20 (mostly 19, based on few specimens) ..... H. villosus
- rare to very rare in the NE Pacific, common in Japan; depths of 27 54 m; length to 42 cm.

Icelinus

1a. Dorsal scale band not extending beyond posterior of second dorsal fin .. 2

1b. Dorsal scale band continuous on caudal peduncle dorsum 5

2a. Two distinct spines at upper posterior of orbit 3

2b. No distinct spines at upper posterior of orbit (bumps may be present) .. 4

3a. Top of head with depression (pit) about the size of the pupil; second dorsal fin 13-15 rays .... I. cavifrons
- uncommon mostly on sandy bottoms; depth from 11-91 m; length to 9 cm.

3b. Top of head more-or-less concave; second dorsal fin with 16-18 rays I. tenuis
- uncommon to common on sandy bottoms; depth 33-373 m; length to 14 cm.

4a. Dorsal scale rows beginning under 3rd or 4th dorsal spine; 2-6 scales present in axil of pectoral fins; pelvic fins extending one-third or more the distance from pelvic fin base to anal fin origin; first two dorsal spines usually elongated .... I. filamentosus
- moderately common on sandy or muddy substrates; depth from 37-373 m length to about 30 cm.

4b. Dorsal scale rows beginning under 5th or 6th dorsal spine; no scales in axil of pectoral fins; pelvic fins extending less than one-third the distance from pelvic fin base to anal fin origin; first two dorsal spines not elongated .... I. burchami
- rare; depths of 244-567 m; length to about 13 cm.

5a. Two pores on tip of ventral surface of lower jaw (chin); pelvic fins extending less than one-third the distance from pelvic fin base to anal fin origin 6

5b. A single pore on tip of ventral surface of lower jaw (chin), this is the fusion of two pores; pelvic fins extending more than one-third the distance from pelvic fin base to anal fin origin 7

6a. A fringe of cirri present on posterior end of maxillary; upper post-orbit with two small spines .... I. fimbriatus
- rare and has been taken on soft substrates; depth 60-265 m; length to about 19 cm.

6b. A single cirri present on posterior end of maxillary; upper postorbit with two small spines or spines absent .... I. oculatus
- very rare and has been taken on soft substrates; depth 82-196 m; length to about 18 cm.

Icelinus (continued)

7a. Dorsal scale band beginning under 4th or 5th dorsal spine; no cirrus at base of nasal spine .... I. quadriseriatus
- uncommon to common on sandy bottoms; depth from 6-101 m; length to about 9cm.

7b. Dorsal scale band beginning under 1st or 2nd dorsal spine; a cirrus present at base of nasal spine .... I. borealis
- common at least in British Columbia; depth 18-247 m; length to about 11 cm.

Note: The key of Bolin (1936) aided in the construction of this key to Icelinus.

Icelus - This key was constructed using very few specimens for some species and the group is in obvious need of review.

1a. Body more-or-less completely covered with small prickles (scales). I. scutiger
- rare; depths of 117-291 m; length to at least 8 cm.

1b. Body with a single series of large plates above lateral line, smaller scales may also be present around these plates 2

2a. Plates above lateral line each with a strong recurved spine; no scales above this lateral row; head without scales .... I. spiniger
- although appearing uncommon, it also appears to be the most common Icelus in the NE Pacific; depth 31-247 m; length to 19 cm.

2b. Plates above lateral line without a strong single spine but with small spines usually present; head usually with scales 3

3a. Two-three rows of scales below lateral line reaching or nearly reaching anal fin .... I. canaliculata
- rare; has been recorded from 525-730 m; length about 13 cm.

3b. Scales absent below lateral line or restricted to region behind pectoral fin 4

4a. Eye diameter 2 times that of snout length and about two-fifths the length of the head .... I. euryops
- apparently very rare; depth unknown but deep water; length at least 7 cm.

4b. Eye diameter 1.5 times that of snout length or less and one third or less the length of head 5

5a. Anal papillae enlarged and spatulate; anterior pair of occipital spines present and well developed ..... I. spatula
- uncommon but in need of study, close to I. uncinalis and Russian workers recognize a number of subspecies of this species and I. uncinalis; depth about 55-150 m; length at least 10 cm.

5b. Anal papillae cylindrical; anterior pair of occipital spines not well developed - tubercles .... I. uncinalis
- see comments in 5a; depth from 10-247 m; length to at least 10 cm.

Jordania zonope - monotypic genus
- moderately rare; nearshore rocky areas, known to cling to vertical surfaces; depth intertidal to 38 m; length to 8 cm.

Leiocottus hirundo - monotypic genus
- uncommon; depth from intertidal to 37 m; length to 26 cm.

Leptocottus armatus - monotypic genus
- common in estuaries and nearshore especially on sandy substrates; depth from intertidal to 91 m; length to about 30 cm.

Malacocottus

This genus contains two species described from the NE Pacific but they present some confusion. The original descriptions are inadequate for separation due to variation; other undescribed species may also be present within the area. The group is under study.

1a. Primary preopercular spine with an accessory spine at its base .... M. zonurus

1b. Primary preopercular spine without accessory spine at its base .... M. kincaidi

Because of the confusion, we do not separate comments for each species. They have been recorded from "shallow" water (27 m) to 275 m. They are not uncommon and may reach 20 cm or more.

Myoxocephalus

A new species is being described by Drs. G.I. McT. Cowan and N.J. Wilimovsky. It is included in the key but its placement is tentative and subject to change because only one specimen was seen.

1a. Scales absent from above and below lateral line; cirri on head; upper preopercular spine smaller than eye .... M. niger
- apparently not uncommon in tidepools and subtidal areas; length at least 15 cm.

1b. Spiny or stellate scales present above and below lateral line; cirri absent from head, though tubercles are present; upper preopercular spine usually the size of the eye or much larger 2

2a. Spinate scales above and below lateral line; anal fin rays 8-13, mostly 12; spinous dorsal rays 8-10,usually 9; soft dorsal fin with 10-15 rays, usually 14 .... M. polyacanthocephalus - comments below

2b. Stellate scales above lateral line & spinate below; counts variable, see below 3

3a. Body rather slender; anal rays 12-16, mostly 14; spinous dorsal rays 8-10, usually 9; soft dorsal fin with 13-15 rays, usually 15 .... M. jaok - comments below

3b. Body various (?); anal rays 10-12, usually 12; spinous dorsal rays 8-10, usually 10; soft dorsal with 14-17 rays, usually 16 .... M. sp.
No comments concerning the new species are available. Both jaok and polyacanthocephalus are common in shallow waters; jaok can be distinguished from polyacanthocephalus by a more slender body and a preopercular spine which is about the same size as the eye rather than much longer.

Nautichthys

1a. Second dorsal fin with 27-30 rays; anal fin with 16-21 rays, usually 19; pectoral fin with 13-14 rays .... N. oculofasciatus
- moderately uncommon; depth from the intertidal to 110 m; length to 20 cm.

1b. Second dorsal fin with 19-26 rays; anal fin with 14-19 rays; pectoral fin with 14-17 rays 2

2a. Second dorsal fin with 22-26 rays, mostly 23; anal fin with 15-20 rays, mostly 16-17; spines on top of head rounded .... N. pribilovius
- moderately uncommon; depth from about 2-126 m; length at least 6 cm.

2b. Second dorsal fin with 19-21 rays, mostly 20; anal fin with 14-15 rays; spines on top of head pointed .... N. robustus
- rare; depth from 2-73 m; length to about 5.5 cm.

Oligocottus

1a. Body prickly, covered with minute spiny scales; preopercular spine with single point .... O. rimensis
- appears to be uncommon throughout its range; known from the intertidal; length to 6cm. This species is probably the most uncommon Oligocottus.

1b. Body not prickly, smooth - no scales; preopercular spines multifid (more than a single point) 2

2a. No cirri on nasal spines; no cirri on body above lateral line nor at base of dorsal fin .... O. maculosus
- common in intertidal and subtidal areas; length to 9 cm.

2b. A single well developed cirrus on nasal spine; base of dorsal fin with tufts of cirri 3

3a. One to four cirri present on end of maxillary; tuft of cirri present on suborbital stay; primary preopercular spine usually trifid, occasionally bifid or quadrifid .... O. rubellio
- moderately common although less so than O. maculosus or O. snyderi; intertidal and subtidal; length to 8 cm.

3b. No cirri on end of maxillary; no tuft of cirri present on suborbital stay; primary preopercular spine usually bifid, occasionally trifid .... O. snyderi
- common in intertidal and subtidal areas; length to 8.5 cm.

Orthonopias triacis - monotypic genus
- a moderately common tidepool inhabitant; depth to 30 m; length to about 10 cm.

Paricelinus hopliticus - monotypic genus
- rather rare, found in nearshore rocky areas; depth from surface to 183 m; length to about 18 cm.

Phallocottus obtusus - monotypic genus
- little is known but has been collected intertidally; may be rare, may be abundant; length to about 6 cm.

Porocottus bradfordi - only one species from the NE Pacific
- little is known but has been reported to be common in tidepools at least in a portion of its range; length at least 7 cm.

Psychrolutes

1a. Stout papillae on head, body and a portion of fins, no cirri; small prickles restricted to two ventrolateral rows; pectoral rays 19-23, mostly 20-21; maximum size 6 cm.... P. paradoxus
- locally common, at least in part of its range; depth from 33-220 m.

1b. Cirri scattered on head and body, papillae absent; prickles present on body including ventrally but not on head or fins, prickles only present on individuals smaller than about 5 cm; pectoral rays 22-26, mostly 24-25; maximum size 50 cm.... P. phrictus
- rare but specimens have recently been identified from the Bering Sea which suggest it is not that rare; depth 933-2800 m.

Radulinus

1a. Second dorsal fin with 17 rays; anal fin with 18 rays; cirri present below lateral line about on vertical of the origin of second dorsal fin .... R. vinculus
- rare; depth from 21-27 m; length to 7 cm.

1b. Second dorsal fin with with 19-23 rays; anal fin with 21-25 rays; no cirri below lateral line on side of body 2

2a. Snout length equal to or less than eye diameter; nasal spines short and stout .... R. asprellus
- uncommon but probably the most common Radulinus, at least the most commonly collected; depth from 48-290 m; length to about 15 cm.

2b. Snout length greater than eye diameter; nasal spines long and needle-like .... R. boleoides
- rare; depth from 73-146 m; length to about 14 cm.

Rhamphocottus richardsoni - monotypic genus
- appears to be locally common in a variety of habitats; depth from the intertidal to 165 m; length to about 8 cm.

Scorpaenichthys marmoratus - monotypic genus
- common in nearshore areas; depth from intertidal to 76 m; length to 1 m.

Sigmistes

1a. Second dorsal fin with 19-21 rays; anal fin with 14-16 rays
.... S. caulias
- Little is known, collected in shallow water - intertidal areas; length to 8 cm.

1b. Second dorsal fin with 24-26 rays; anal fin with 17-21 rays
.... S. smithi
- little is known, collected in shallow water-intertidal areas; length to at least 6 cm.

Stelgistrum beringianum - only one species in the NE Pacific
- little information available, apparently rare at least in the NE Pacific; depth from 79-95 m; length at least (at most ?) 4.5 cm.

Sternias xenostethus - monotypic genus
- rare, at least in the NE Pacific; depth from 60-100 m; length to 10 cm.

Stlegicottus xenogrammus - monotypic genus
- only one specimen known?; taken at a depth of 494 m, rare!; length 3 cm.

Synchirus gilli - monotypic genus
- appears to be locally abundant in some areas; recorded from shallow waters; length to 8 cm; often occurring in algae.

Thyriscus anoplus - monotypic genus
- rare, at least in the NE Pacific; recorded at 210 m; length at least 11 cm.

Triglops

1a. Base of dorsal fin without lateral bony tubercles; body very slender; pectoral fin with 15-17 rays, usually 16 .... T. macellus
uncommon, recorded from depth of 18-102 m; length at least 17 cm.

1b. Base of dorsal fin with lateral bony plates (may be very small); body various including slender; pectoral fin with 16 or more rays, usually 18 or more) 2

2a. Second dorsal fin with 27 or more dorsal rays, usually 28 or more; anal fin with 27 or more rays, usually 28 or more; cross folds on breast not apparent (reduced) or absent .... T. forficata
- moderately uncommon; depth from 69-132 m; length at least 25 cm.

2b. Second dorsal fin with 27 or fewer rays, usually 25 or fewer; anal fin with 28 or fewer rays, usually 25 or fewer; cross folds usually readily apparent on breast..... 3

3a. Eye large, about 2.5 in head length; maxillary and ventral portion of opercle with scales (prickly) .... T. scepticus
- moderately uncommon; depth from 79-252 m; length to 16 cm.

3b. Eye not as large, about 3.5 in head length; maxillary and ventral portion of the opercle without scales (not prickly) 4

4a. Lateral folds sparce and almost correspond to number of lateral line plates; scales along the edges of the folds small and do not overlap .... T. pingeli
- appears to be common but needs study; depth from 18-274 m; length 20 cm.

4b. Lateral folds thick, irregular and and more numerous than plates (2+ times); scales along edges of folds overlapping ... T. metopias
- appears to be uncommon; recorded at 95-99 m depth; length at least 15 cm.

Zesticelus profundorum - only one species in the NE Pacific
- rare; recorded from 88-2580 m; length to 6 cm.

Cottidae

	Dorsal Spines	Dorsal rays	Anal rays	Pect. rays	Vent. Spines	Vent. rays	Br. Gr.		Vert.	Range
Alcidea thoburni	—	—	—	—	—	—	—		—	—
Archaulus biseriatus	—	—	—	—	—	—	6		—	Bering
Artediellus aniacanthus	—	—	—	—	I,	3	6		—	Bering
Artediellus pacificus	VI-VII	11-13	11-14	22-24		3	6		28-30	Bering
Artediellus scaber	—	—	—	—	I,	3	6		—	Bering
Artediellus uncinatus	—	—	—	—	I	3	6		8+22+2+ 30-32	10+21 Circum polar Arc—Alaska
Artedius corallinus	VII-IX	15-16	12-13	14-16	I	3	—		31-33	Baja—Wash
Artedius creaseri	IX-XI	12-14	9-11	15-17		3	—		30-31	Baja—No. Calif.
Artedius delacyi	—	—	—	—	—	—	6		—	Kodiak
Artedius fenestralis	VIII-X	16-18	12-14	14-16	I	3	6	1+4-5 5-6	32-35	So. Calif.—Aleutians
Artedius harringtoni	IX-X	15-18	10-14	13-15	I,	3	6		32-34	So. Calif.-Kodiak
Artedius lateralis	VII-X	15-17	12-14	14-16	I,	3	6	1-2+ 6-9	32-34	Baja-Bering
Artedius meanyi	IX-X	14-17	10-12	14-16	I,	2-3	—		33-35	—
Artedius notospilotus	IX-X	14-16	11-13	14-17	I,	3	—	6-10 10-12	—	Baja—Puget Sound
Oscelichthys rhodorus	VII-X	17-20	13-16	16-18	None		6	3+3 4+4	—	So. Calif.—S.E. Alaska
Psemichthys taylori	IX-XI	15-16	15-16	16-18	I,	3	—		—	—

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. Spines	Vent. rays	Br.	Gr.	Vert.	Range
Blepsius bilobus	VII-IX	20-22	18-20	15-17	I,	3	6		37-38	—
Blepsius cirrhosus	VI-IX	20-25	18-21	11-13	I,	3	6		37-38	So. Calif.—Japan
Chitonotus pugetensis	VIII-XI	14-17	14-17	16-18	I	2-3		0-2+6-9=6-10	34-36	Baja—Br. Colum.
Clinocottus acuticeps	VII-IX	13-17	9-13	13-15	I,	3	6		31-33	Cent. Calif.—Attu Is.
Clinocottus analis	VIII-X	14-18	11-15	14-17	I,	3		0-1+5-6=6-7	31-35	Baja—Cent. Calif.
Clinocottus embryum	VIII-X	14-17	9-12	12-15	I,	3	6		33-34	Baja—Bering
Clinocottus globiceps	VIII-X	13-17	10-12	13-15	I,	3	6		32-34	So. Calif.—Kodiak
Clinocottus recalvus	VIII-IX	14-17	9-13	13-15	I,	3		1+4-7=5-8	32-33	Baja—So. Ore.
Cottus aleuticus	VIII-X	16-20	12-16	13-16		4	6		34-39	Calif.—Bering
Cottus asper	VII-XI	18-22	14-18	14-17		4	6		34-39	Calif.—S.E. Alaska
Cottus cognatus	—	15-17	10-12	—	—		6		—	Arc.,—Alaska
Cottus gulosus	—	—	—	—	—		6		—	Calif.—S.E. Alaska
C. protrusus	—	—	—	—	—		—		—	Bering-Cent. Alaska
Dasycottus setiger	VIII-XI	13-16	12-16	22-26	I,	3	7		34-36	Wash.—Bering
Enophrys bison	VII-IX	9-13	8-10	15-18	I,	3	6	0-1+4-6=5-7	29-31	Cent. Calif.—Kodiak
Enophrys claviger	—	—	—	—	—		6		—	Bering
Enophrys diceraus	VII-VIII	13-15	11-13	15-18	—	2-3	6		32-35	Arc. Alaska—S.E. Alaska
Crossius albomaculatus	—	—	—	—	—		—		—	St. Paul Island

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. spines	Vent. rays	Br.	Gr.	Vert.	Range
Enophrys lucasi	VII-VIII	12-14	9-12	15-17		2-3	6		33-34	Bering
Enophrys taurina	VI-VIII	8-10	6-7	15-18	I,	3	—		27-29	So. Calif.—San Fran.
Eurymen gyrinus	VIII	21-23	15-17	25-26		3	7		38	Bering
Gilbertidia sigalutes	VIII	24-27	12-15	14-17	I,	3	7	ca.13	33-35	Wash.—S.E. Alaska
Gymnocanthus galeatus	X-XII	14-17	17-20	19-21	I,	3	6		37-40	Bering
G. detrisus	—	—	—	—	—	—	—	—	—	Bristol Bay—S. Japan
Gymnocanthus pistilliger	IX-XI	13-16	14-18	15-20	I,	3	6		35-38	Bering
Gymnocanthus tricuspis	—	—	—	—	I,	3	6		13+26-27	Arc. Alaska—Bering
Hemilepidotus hemilepidotus	X-XIII	17-20	13-16	15-17	I	3-4	6		34-37	Calif.—Bering
Hemilepidotus gilberti	—	17-22	14-19	15-17	—		—		37-38	Bering—S. Japan
Hemilepidotus jordani	10-12	17-23	16-18	17-19	I	3-4	6		36-39	S.E. Alaska—Bering
Hemilepidotus papilio	—	19-22	16-18	16-18	—		—		39	Bering—Sea Okhotsk
Hemilepidotus spinosus	X-XI	18-20	14-16	14-16	I,	4	—	0-2+5-8-5-10	35-37	So. Calif.—Alaska
Hemilepidotus zapus	XI-XII	18-22	16-17	15-17		4	6		36-38	Bering
Hemitripterus bolini	XI-XV	11-14	12-14	20-23	I,	3	—		38-40	—
Hemitripterus villosus	XVI-XX	11-13	12-15	18-23	I,	3	6		39-41	Br. Colum.—Bering
Icelinus borealis	IX-XI	14-17	11-14	14-17	I,	2	6		35-36	Wash.—Bering

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. spines	Vent. rays	Br.	Gr.	Vert.	Range
Icelinus burchami	IX-XI	16-18	12-14	16-19	I,	2	6		35-37	So. Calif.— S.E. Alaska
Icelinus cavifrons	IX-XI	12-15	11-13	14-16	I,	2	—		34-36	Baja — Cent. Calif.
Icelinus filamentosus	IX-XII	15-18	13-16	16-18	I,	2	—	rudiment knobs	34-37	So. Calif.— Br. Colum.
Icelinus fimbriatus	X-XI	15-17	12-13	16-18	I,	2	—		35	So. Calif.— Cent. Calif.
Icelinus oculatus	X-XI	15-17	13-14	17	I,	2	—		37	So. Calif.— Br. Colum.
Icelinus quadriseriatus	VII-X	12-16	10-15	15-17	I,	2	—	0+3-6 =3-6	33-35	Baja — No. Calif.
Icelinus sp.	Unknown	Unknown	Unknown	—	—	2	—		Unknown	—
Icelinus tenuis	IX-XI	16-19	13-17	15-17	I,	2	—		37-39	Baja — Br. Colum.
Icelus canaliculatus	VII-VIII	23-24	18-20	16-17	I,	3	6		41	Bering
Icelus euryops	IX	23	18-19	18	I,	3	6		Unknown	Gulf Alaska
Icelus scutiger	IX-X	19-20	18-19	17-19	I,	3	6		39-41	Gulf Alaska— Bering
Icelus spatula	VIII-X	17-22	13-18	17-20	I,	3	6		39-41	Bering
Icelus spiniger	VIII-X	19-21	15-18	18-19	I,	3	6		40-42	S.E. Alaska— Bering
Icelus uncinalis	IX	18-20	14-16	17-18	I,	3	6		37-40	Bering
Icelus vicinalis	—	—	—	—	I,	3	6		—	Bering
I. bicornis	—	—	—	—	—	—	—		—	Circumpolar

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. spines	Vent. rays	Br.	Gr.	Vert.	Range
Jordania zonope	XVII-XVIII	15-18	22-24	13-15	I	4-5	—		46-48	So. Calif. — Br. Colum.
Leiocottus hirundo	IX-X	16-17	14-15	18		3	—		35-36	Baja — So. Calif.
Leptocottus armatus	VI-VIII	15-20	14-20	17-20	I,	4	6	1-3+8-12	35-39	Baja — Kodiak
Malacottus kincaidi	VIII-X	13-15	10-13	19-21	I,	3	7		31-33	Wash. — Bering
Malacottus zonurus	VIII-IX	12-15	9-12	19-23		3	—		30-33	—
Melletes papilio	XI	21	19	17-18	I,	4	6		37-39	Bering
Microcottus sellaris	—	—	—	—	I,	3	6		—	Bering — Japan
Myoxocephalus jaok	VIII-XI	13-17	12-16	17-19	I,	3	6		35-38	Bering — Arc. Alaska.
M. mednius	—	—	—	—	I,	3	6		—	Bering
Myoxocephalus niger	VIII-X	14-18	10-12	16-18	I,	3	6		36-39	Bering
Myoxocephalus polyacanthocephalus	IX-X	10-16	8-13	15-19	I,	3	6		34-37	Wash. — Bering
Myoxocephalus quadricornis	—	—	—	—	I,	3	—		40	Bering — Arc. Alaska
Myoxocephalus sp.	VIII-X	14-17	12-16	17-19	—	3	6		35-37	—
M. groenlandicus	—	—	—	—	—	—	—		13-15+24-25	—
Myoxocephalus scorpioides	—	—	—	15-16	I,	3	6		—	Bering — Arc. Alaska
M. verrucosus	—	—	—	—	—	—	—		—	Chukchi — S. Okhotsk
Myoxocephalus scorpius	—	—	—	17-18	I,	3	6		38-40	Bering — Arc. Alaska
Myoxocephalus stelleri	—	—	—	—	I,	3	6		—	Bering
Megalocottus platycephalus	—	—	—	—	I,	3	6		36-37 (Chukchi — S. Japan)	Bering — Arc. Alaska
M. laticeps	—	—	—	—	—	—	—		—	Bristol Bay

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. spines	Vent. rays	Br.	Gr.	Vert.	Range
Nautichthys oculofasciatus	VIII-IX	27-30	16-21	13-14	I,	3	6	1+7=8	40-41	So. Calif.— Kamchat.
Nautichthys pribilorius	VII-X	22-26	15-20	15-17	—	3	6		36-37	Bering
Nautichthys robustus	VII-VIII	19-21	14-15	14-16	I,	2-3	—		35	Br. Colum.— Aleutian Is.
Oligocottus maculosus	VIII-IX	15-18	11-14	12-15	I,	3	6	0-1+4-5=5-6	33-34	So. Calif.— Okhotsk
Oligocottus rimensis	VIII-X	16-19	13-15	13-15	I,	3	—	1+4-5=5-6	34-37	So. Calif.— Br. Colum.
Oligocottus rubellio	VII-IX	13-17	10-14	13-15	I,	3	—	1+4-6	32-35	Baja — No. Calif.
Oligocottus snyderi	VII-IX	17-20	12-15	12-15	I,	3	—		34-37	Baja — S.E. Alaska
Onocottus hexacornis	—	—	—	—	—	—	—	—	—	Bering — Greenland
Orthonopias triacis	VIII-IX	15-18	11-13	13-15	I,	3	—	1+5=6	33-35	Baja — Cent. Calif.
Oxycottus acuticeps	—	—	—	—	—	—	—	—	—	S.E. Alaska — Aleutian Is.
Paricelinus hopliticus	XII-XIII	19-20	23-24	14-15	I,	5	—		42	So. Calif.— Br. Colum.
Phallocottus obtusus	X-XII	22-24	22-25	14-16	I,	3	6		Unknown	Bering
Porocottus bradfordi	VIII-X	14-19?	11-14	13-14	I,	3	6		34-36	Bering
P. sellaris	—	—	—	—	—	—	—	—	—	Bristol Bay
Porocottus quadrifilis	—	—	—	—	I,	3	6		—	Bering
P. quadratus	—	—	—	—	—	—	—	—	—	Commando Is.
Psychrolutes paradoxus	X-XII	12-17	10-14	19-23	I,	3	7		36-37	wash.— Bering
Psychrolutes phrictus	VII-IX	19-20	12-14	22-26	—	3	—		33-35	—
Pterygiocottus macouni	—	—	—	—	—	—	—	—	—	—
Radulinus asprellus	VIII-XI	20-23	21-25	17-20	I,	3	6	0-1+7-8=7-9	38-39	Baja — Kodiak

Cottidae

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Vent. spines	Vent. rays	Br.	Gr.	Vert.	Range
Radulinus boleoides	VIII-XI	20-22	21-23	18-20	I,	3	—		39-40	So. Calif.— Br. Colum.
Radulinus taylori	X-XI	15-16	15-17	—	I,	3	—		33-35	Wash.— Br. Colum.
Radulinus vinculus	X	17	18	17	—	3	—		Unknown	So. Calif.
Rhamphocottus richardsoni	VII-IX	12-14	6-8	14-16	I,	3-4	—		*24-28*	So. Calif.- Bering
Ruscarius meanyi	—	—	—	—	—		—	—	—	—
Scorpaenichthys marmoratus	VIII-XII	15-19	11-14	14-16	I,	4-5	—	3-6+12 -16	35-37	Baja — S.E. Alaska
Sigmistes caulias	VIII-X	19-21	14-16	13-14	I,	3	6		37-38	Gulf Alaska— Bering
Sigmistes smithi	VIII-X	24-26	17-20	13-15	I,	3	6		Unknown	Aleutians
Sternias xenostethus	X-XI	22-24	22-24	16-18	—	3	6		44-46	Bering
Stelgistrum beringianum	VIII-IX	17-19	12	15-16	I,	3	6		36	Bering
S. concinnum	—	—	—	—	—		—		—	C. Olytorsky
Stlegicottus xenogrammus	IX	19	17	18	I,	3	6		Unknown	Bering
Synchirus gilli	VIII-X	19-21	18-21	21-24	I,	3	—		38-39	Calif. — S.E. Alaska
Thecopterus aleuticus	—	—	—	—	—		7	—	—	Bering
Thyriscus anoplus	X	21	17	15	I,	3	6		Unknown	Bering
Triglops forficata	IX-XI	*24-32*	*27-32*	19-22	—	3	6		52-54	Bering
Triglops macellus	X-XI	27-31	27-31	15-17	I,	3	6		51	Wash.— Bering
Triglops jordani	—	—	—	—	—		—		—	Bering — S. Japan

8.
Cottidae

	Dorsal Spines	Dorsal rays	Anal rays	Pect. rays	Vent. Spines	Vent. rays	Br.	Gr.	Vert.	Range
Triglops pingeli	IX-XIII	22-28	20-28	16-19	I,	3	6		45-50(51)[6]	Wash.—Bering
Triglops metopias	X-XII	23-27	22-27	18-22	I,	3	6		48-49	Bering
Triglops scepticus	X-XII	21-23	22-24	17-19		3	6		45-46[11]	Bering
Ulca bolini	—	—	—	—	—	—	6		—	S.E. Alaska—Bering
Zesticelus profundorum	V-VII	10-13	8-11	19-21	I,	2-3	6		25-26	Baja—Bering