

Bulletin

of the Sea Fisheries Institute

3(151) 2000

CONTENTS

Scientific papers

LEONARD EJSYMONT and KENNETH SHERMAN Poland and United States' Cooperation in Fisheries Ecology: A Multidecadal Retrospective	3
MORGAN S. BUSBY, ANN C. MATARESE, DEBORAH M. BLOOD and MALGORZATA KONIECZNA Advancements in Ichthyoplankton Taxonomy in the Northeastern Pacific Ocean and Bering Sea: Research Conducted by the Alaska Fisheries Science Center 1965-1999	11
ARTHUR W. KENDALL, JR. Status of Recruitment Studies of Northeast Pacific Fishes	21
ALLYN B. POWELL, DONALD E. HOSS, MALGORZATA KONIECZNA and LEONARD EJSYMONT Summary of Ichthyoplankton Research by the NOAA Beaufort Laboratory in Florida Bay, Everglades National Park, Florida, USA	43
JOANNE LYCZKOWSKI-SHULTZ, MALGORZATA KONIECZNA and WILLIAM J. RICHARDS Occurrence of the Larvae of Beryciform Fishes in the Gulf of Mexico	55
JACK W. JOSSI and JOSEPH KANE An Atlas of Seasonal Mean Abundances of the Common Zooplankton of the United States Northeast Continental Shelf Ecosystem	67
KENNETH SHERMAN Marine Ecosystem Management of the Baltic and Other Regions	89
BENJAMIN H. SHERMAN Marine Disease, Morbidity and Mortality, Toward a Baltic Sea Ecological Disturbance Information System	101
PIOTR MARGOŃSKI Impact of Hydrological and Meteorological Conditions on the Spatial Distribution of Larval and Juvenile Smelt (<i>Osmerus eperlanus</i>) in the Vistula Lagoon (Southern Baltic Sea)	119

INSTRUCTIONS FOR AUTHORS

GENERAL INFORMATION

The Bulletin of the Sea Fisheries Institute is a scientific journal which accepts papers from all over the world. Foreign authors are requested to submit their papers in English, the research staff of the SFI in Polish and authors not associated with the SFI in Polish and English.

Papers submitted to the *Bulletin* are classified according to the following three categories: 1) scientific papers, 2) short communications, 3) varia.

The Editorial Staff will accept a paper and assign it to one of the above categories. Papers accepted for publication in the *Bulletin* may not be published elsewhere. Publication in the *Bulletin* is free of charge.

TYPESCRIPT FORM

Papers should be submitted in two copies of single-sided, double-spaced typescript on A4 paper and a diskette containing all the material in the article must be included. Words to be set in italic type, i.e. Latin names of species and genera, as well as symbols for the values of variables, should be underlined with a wavy line (~~~~~). No other underlining should be used.

In the papers from categories 1 and 2, the following order is required:

1. **Title:** brief (up to 100 characters).
2. **First and last name of the author and the name of the affiliated institution.**
3. An **abstract** must precede every scientific paper, research report and other paper; length – one typewritten page at the most.
4. **Key words:** a few terms which enable a given paper to be found among computer files.
5. **Text.** The length of the typescript of papers from category 1 should not exceed 40 pages, and papers from category 2 – 15 pages. In papers from categories 1 and 2, the traditional division is used: 1) introduction, 2) materials and methods, 3) results, 4) discussion, 5) references. The results of measurements should be given in metric system units and their abbreviations should comply with the International System of Unit (SI).
6. **Acknowledgments** should be limited to the necessary minimum (the initials and the last name of the person they are addressed to, without listing scientific titles or names of institutions).
7. **References** should be put in alphabetical order, with the year of publication directly after the author's name and should list solely the papers referred to in the text. (e.g. Smith 1990). Titles of journals – in full form. Titles of papers – in the original language. The exception is titles in Russian which are in a non-Latin alphabet, such as Cyrillic, which should be translated into either English or Polish.

8. **Footnotes** should be marked with Arabic numerals in superscript (...¹), and numbered in succession throughout the text, except for tables; footnote content should be on separate sheets of paper.

9. **Tables** should supplement, not duplicate, data contained in the text or figures. Tables should be numbered and each one should be on a separate sheet of paper. All tables must have titles; all references to them should be placed within the text. Each column in a table is supplied with a heading, explaining the content of the column. Footnotes in tables should be marked with letters in italics, in superscript (e. g. Years^a), and their explanation should be placed under the table.

10. **Figures.** Successive numeration with a reference to each number in the text should be used. Captions must be on a separate sheet of paper. Abbreviations, terms and symbols used in figures must correspond to those used in the text. After scaling, each figure, placed on a separate sheet of paper and marked with a successive number and the author's name, must fit into a column of the *Bulletin*; this should be taken into account by using the appropriate thickness of lines and size of legends in the figures. Only computer generated figures are acceptable. Both a printout and a diskette are required. Papers can be illustrated with photographs in black and white or color. The total content of drawings and photographs must not exceed 30% of the paper.

SAVING TEXT ONTO DISKETTE

Files should be saved on diskette in a format which can be opened by our editorial office. The preferred format is Word for Windows. Please save computer generated figures on diskette in the format which they were created.

REVIEWS

Upon receiving a review, the authors is obliged to revise the paper and to explain in writing which of the reviewer's suggestions he or she has taken into account, and what he or she disagrees with and why.

PROOF-READING

A ten day limit is given for proofreading. At this stage no changes in text content are allowed and only technical corrections will be accepted.

PRESENTATION COPIES

Each author published in categories 1, 2 and 3 receives one copy of the *Bulletin*; the authors of the papers from category 1 additionally receive ten offprints of their paper, and from category 2 – five.

Editorial Office Address:
**Center for Scientific Information and Publishing
Sea Fisheries Institute
Kollątajka 1, 81-332 Gdynia, Poland**

WSKAZÓWKI DLA AUTORÓW

INFORMACJE OGÓLNE

The Bulletin of the Sea Fisheries Institute jest czasopi-
smem naukowym, przyjmującym prace z całego świata.
Autorzy obcojęzyczni proszeni są o składanie prac w ję-
zyku angielskim, pracownicy MIR – języku polskim, a
pozostali autorzy – w języku polskim i angielskim.

Prace złożone klasyfikowane są według trzech kate-
gorii: 1) artykuły naukowe, 2) noty, 3) varia.

O przyjęciu pracy i zakwalifikowaniu jej do określo-
nej kategorii decyduje Zespół Redakcyjny. Prace przy-
jęte do druku nie mogą być publikowane w innym cza-
sopiśmie. Publikacja jest bezpłatna.

FORMA MASZYNOPISU

Prace należy składać w 2 egzemplarzach maszynopisu
pisanego jednostronnie, formatu A4, z podwójnym od-
stępem (konieczna jest dyskietka z całością materiału).
Słowa, które powinny być złożone drukiem pochyłym
(kursywą), tzn. łacińskie nazwy gatunków i rodzajów
oraz symbole wielkości zmiennych należy podkreślić
wężykiem (~~~~~). Innych podkreśleń nie należy sto-
sować.

W pracach kategorii 1 i 2 obowiązuje następująca
kolejność:

1. Tytuł: krótki (do 100 znaków).

**2. Imię i nazwisko autora oraz nazwa i adres instytu-
cji macierzystej.**

3. Abstrakt musi poprzedzać każdy artykuł naukowy i
notę; objętość – najwyżej 1 strona maszynopisu.

4. Słowa kluczowe: kilka pojęć pozwalających na od-
szukanie danej pracy w systemach komputerowych.

5. Tekst. Objętość maszynopisu prac kategorii 1 nie
powinna przekraczać 40 stron, a kategorii 2 – 15 stron.
W pracach kategorii 1 i 2 stosuje się tradycyjny podział:
1) wstęp, 2) materiał i metoda badań, 3) wyniki badań,
4) dyskusja, 5) bibliografia. Wyniki pomiarów należy
podawać w jednostkach miar przyjętych w systemie me-
trycznym, a ich skróty – zgodnie z Międzynarodowym
Układem Jednostek Miar (SI).

6. Podziękowania należy ograniczyć do niezbędnego mi-
nimum (inicjały imienia i nazwisko osoby, do której są
adresowane, bez wymieniania tytułów naukowych i nazw
instytucji).

7. Bibliografię należy zestawiać w porządku alfabetycz-
nym, podając bezpośrednio po nazwiskach autorów rok
wydania i wymieniając tylko prace cytowane w tekście
(np. Kowalski 1990). Tytuły czasopism – w pełnym
brzmieniu. Tytuły prac – w językach oryginału (z wyjąt-
kiem tytułów w języku rosyjskim wydrukowanych alfa-
betem niełacińskim, np. cyrylicą, które należy przetłu-
maczyć na język polski lub angielski).

8. Przypisy oznacza się cyfrą arabską we frakcji górnej
(...) i numeruje kolejno w całym tekście, z wyjątkiem
tabel; treść przypisów – na osobnych stronach.

9. Tabele są dodatkowym źródłem informacji; nie nale-
ży powtarzać w nich danych występujących w tekście
lub na rysunkach. Tabele numerowane, każda na osob-
nej stronie, muszą mieć tytuł; powołanie na nie należy
umieścić w tekście. Każdą kolumnę w tabeli opatrzyć
się tzw. „główką” wyjaśniającą zawartość kolumny. Przy-
pisy w tabelach należy oznaczyć literami, kursywą, we
frakcji górnej (np. Lata^a), a ich objaśnienie umieścić pod
tabelą.

10. Ilustracje. Obowiązuje kolejna numeracja z przy-
wołaniem każdego numeru w tekście. Podpisy pod ilu-
stracjami – na osobnej kartce. Stosowane na rysunkach
skrótów, terminy i symbole muszą odpowiadać użytym w
tekście. Każdy rysunek, umieszczony na osobnej kartce
oraz opisany kolejnym numerem i nazwiskiem autora,
po wyskalowaniu musi zmieścić się w kolumnie; trzeba
to uwzględnić stosując odpowiednią grubość linii i wiel-
kość opisów na rysunkach. Redakcja przyjmuje wyłącz-
nie rysunki wykonane techniką komputerową (konieczny
wydruk i dyskietka). Prace można ilustrować foto-
grafiami (mogą być kolorowe). Łączna objętość rysun-
ków i zdjęć nie może przekraczać 30% objętości pracy.

ZAPIS TEKSTU NA DYSKIETCE

Plik powinien być zachowany na dyskietce w takim for-
macie, aby umożliwić odczytanie go w programach przez
nas stosowanych. Preferowanym formatem jest Word for
Windows. Rysunki wykonane techniką komputerową
prosimy zapisywać na dyskietce w formacie wykonania.

RECENZJE

Po otrzymaniu recenzji autor jest zobowiązany do po-
prawienia pracy i wyjaśnienia na piśmie, co uwzględnił
z sugestii recenzenta, a z czym się nie zgadza i dlaczego.

KOREKTA AUTORSKA

Na wykonanie i odesłanie korekty autorskiej przewiduje
się termin 10-dniowy. Na tym etapie nie należy dokony-
wać zmian autorskich w tekście, a jedynie poprawić uster-
ki techniczne.

EGZEMPLARZE AUTORSKIE

Każdy autor opublikowanego artykułu otrzymuje 1 eg-
zemplarz czasopisma, autorzy prac kategorii 1 otrzymu-
ją ponadto 10 nadbitek swej pracy; kategorii 2 – 5 nad-
bitek.

Adres Redakcji:

Ośrodek Informacji Naukowej i Wydawnictw
Morski Instytut Rybacki
ul. Kołłątaja 1, 81-332 Gdynia,
tel.: 058 620 17 28 (centrala).



Advancements in Ichthyoplankton Taxonomy in the Northeastern Pacific Ocean and Bering Sea: Research Conducted by the Alaska Fisheries Science Center 1965-1999

Morgan S. Busby¹, Ann C. Matarese¹, Deborah M. Blood¹,
and Małgorzata Konieczna²

¹Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA

²Sea Fisheries Institute, Plankton Sorting and Identification Center,
K. Królewicza 4, 71-550 Szczecin, Poland

Abstract. Collections of ichthyoplankton samples have become increasingly important in studies of fisheries recruitment, aquatic ecosystems, and systematics of fishes. In these studies, it is of primary importance that researchers have knowledge of taxonomic characters necessary to correctly identify species of interest at all stages of development. In this review, we provide a historical account of ichthyoplankton research programs and studies, processing techniques, and advancements in knowledge of ichthyoplankton taxonomy in the Northeast Pacific Ocean and Bering Sea. Most of this research has been conducted by scientists during the past 35 years (1965-1999) at NOAA's Alaska Fisheries Science Center (AFSC). In 1980, the Plankton Sorting and Identification Center in Szczecin, Poland (PSIC), began processing ichthyoplankton samples collected by the AFSC. At that time, it was possible to identify larvae of only 8.3% (52 of 627) of fish species known in the area. The PSIC has since assisted in identifying larvae of an additional 239 species. Presently, larvae of 291 of 636 species (45.8%) can be identified from ichthyoplankton samples. Taxonomic studies on gadid larvae in the early 1980s were of particular importance in development of fishery oceanography research on commercially important fish stocks in Alaskan waters. Later studies on scorpaeniform families, particularly the Hexagrammidae and Agonidae, contributed significantly to understanding their systematics. Studies are currently underway on larvae of several families including Scorpaenidae, Cottidae, Hemitripterae, Liparidae, Stichaeidae, and Pleuronectidae.

Keywords: Ichthyoplankton, taxonomy, history, advancements, N.E. Pacific Ocean, Bering Sea

INTRODUCTION

The collection of ichthyoplankton samples has become increasingly important in studies of fisheries recruitment, aquatic ecosystems, and the systematics of fishes. In all of these studies, it is of primary importance that researchers have knowledge of the necessary diagnostic taxonomic characters to correctly identify the species of interest throughout its life history at all

stages of development (Kendall and Matarese 1994). Ichthyoplankton studies in the Northeast Pacific Ocean and Bering Sea were initiated and conducted during the latter half of the twentieth century to assess abundance and investigate recruitment of large stocks of commercially important gadoid fishes including Pacific hake, *Merluccius productus* (Waldron 1972; Bailey *et al.* 1982), and walleye pollock, *Theragra chalcogramma* (Picquelle and Megrey 1993; Kendall *et al.* 1996). Studies were also conducted during this period to assess the status of other fishery resources and the influence of the marine environment on the aquatic ecosystem and species composition of the ichthyoplankton community (Kendall and Dunn 1985). Since 1965, most of this research has been conducted by the Recruitment Processes staff at the Northwest and Alaska Fisheries Center (NWAFC), which became the Northwest Fisheries Science Center (NWFSC) and Alaska Fisheries Science Center (AFSC) in 1991. The Plankton Sorting and Identification Center in Szczecin, Poland (PSIC), has had an important role in furthering knowledge on identification of larval and juvenile fishes from the Northeast Pacific Ocean and Bering Sea and in improving the quality of descriptive publications. In this review, we provide a historical account of ichthyoplankton research programs and studies, processing techniques, and advancements in taxonomic knowledge during the past 35 years in the Northeast Pacific Ocean and Bering Sea, most of which have occurred in collaboration with the efforts of PSIC. Important contributions and milestones are discussed, as is currently ongoing research in ichthyoplankton taxonomy.

HISTORICAL ACCOUNT OF ICHTHYOPLANKTON SORTING AND PROCESSING PROTOCOLS

Sample sorting and processing protocols (verification of initial identifications and data processing) evolved as research objectives and technologies changed through time. Ichthyoplankton samples collected for NWAFC Pacific hake studies were sorted and identified at sea from 1965-1970 (Table 1). From 1971-1976, samples collected for the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program were sorted and processed at NWAFC. Staff from the Texas Instruments Corporation sorted ichthyoplankton samples collected for the Outer Continental Shelf Environmental Assessment Program (OCSEAP) from 1977- 1979. Staff from NWAFC processed these samples. Beginning in 1980, samples collected during studies conducted by the NWAFC were sent to the National Plankton Sorting Center in Szczecin, Poland, to be sorted and processed. This continued through the inception of the Fisheries Oceanography Coordinated Investigations (FOCI) program in 1984, the Global Ocean Ecosystem Dynamics (GLOBEC) program in 1998, and to the present.

HISTORY OF IDENTIFICATION PROCEDURES

Larvae of Pacific hake was the only taxon identified in ichthyoplankton samples at NWAFC in 1965 and 1966 (Table 1). In 1967, all larvae were identified to the lowest possible taxon. Egg identification began in 1971. The NWAFC began its association with PSIC in 1980, at which time science staff in Poland identified larvae to the lowest possible taxon. Scientists at NWAFC

Table 1. Historical account and time line of ichthyoplankton sorting and processing protocols and scientific programs for the NWAFC and AFSC 1965 to 1999.

Year	Sorting and Processing	Scientific Programs & Studies		Identification		
1965	At Sea	NWAFC Pacific hake studies		Pacific hake larvae		
1966				All larvae		
1967						
1968						
1969						
1970	NWAFC	MARMAP Program		All larvae and eggs		
1971						
1972						
1973						
1974						
1975						
1976						
1977	Texas Instruments Corp.	OCSEAP Program				
1978						
1979	Plankton Sorting and Identification Center, Szczecin, Poland	FOCI		All larvae		
1980				NWAFC Studies	USSR/US Studies	
1981						
1982				NWAFC → AFSC		All larvae; walleye pollock egg identification and staging
1983						
1984						
1985						
1986						
1987						
1988						
1989						
1990						
1991						
1992	Bering Sea FOCI					
1993						
1994						
1995				All larvae and eggs		
1996						
1997						
1998						
1999		GLOBEC				

identified all eggs and verified identifications of larvae. Eggs of walleye pollock were identified and separated into 21 developmental stages at PSIC beginning in 1981, followed by identification of all other fish eggs in 1998. Identifications of juvenile fishes were added to their responsibilities in 1991. With most of the sample processing being conducted in Poland, AFSC scientists have been able to devote more time to verification and addressing taxonomic problems.

ADVANCEMENTS IN TAXONOMIC KNOWLEDGE

Prior to publication of the Laboratory Guide to Early Life History Stages of Northeast Pacific Fishes (Matarese *et al.* 1989), information on identification of Northeast Pacific fish larvae was a combination of a few published reports and considerably more unpublished descriptions and illustrations. Information on larval identification was given to scientists at PSIC in the form of training sessions in Seattle, copies of published papers, and draft manuscripts. Descriptive sections of the manuscripts were greatly refined after the PSIC scientists were consulted. Even so, the number of species of fish eggs and larvae that could be identified was relatively low. Only 1.6 percent of fish eggs (10 species in 4 families) and 8.3 percent of larvae (52 species in 19 families) could be identified in plankton samples (Kendall and Dunn 1985) (Table 2). These calculations were based on a total of 627 species in 94 families known to occur in the area (Matarese *et al.* 1989).

The number of identifiable taxa rose sharply to 7.0 percent of fish eggs and 41.9 percent of larvae upon publication of the laboratory guide (Kendall and Matarese 1994). Since publication of the laboratory guide, two new scorpaenids (Orr and Baker 1997), one cottid (Yabe 1991), one agonid (B. Sheiko, Department of Ichthyology, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia, unpubl. data), three liparids (Busby and Chernova, submitted; Orr and Busby, unpubl. data, Orr and Busby, submitted), one zoarcid (Anderson 1994), one acropomatid (Busby and Orr, 1999), and one pleuronectid (Orr and Matarese 2000) have been reported in the area (Table 3). Two cyclopterids have been synonymized (Kido and Shinohara 1996) (Table 3), bringing the current total number of species to 636 in 98 families. In addition to reports of new species occurring in the area, several new descriptions of early life history stages (all larvae) have been published, mostly on fishes in the order Scorpaeniformes (Table 4). These include six scorpaenids (genus *Sebastes*) (Moreno 1993; Sakuma and Laidig 1995; Laidig *et al.* 1996; Laidig and Sakuma 1998), one psychrolutid (Ambrose 1996a), 12 agonids (Busby and Ambrose 1993; Ambrose 1996b; Busby 1998), seven liparids (Marliave and Peden 1989; Ambrose 1996c), one pholid (Watson 1996), and one pentacerotid (Mundy and Moser 1997). With these new larval descriptions, it is now possible to identify 45.8 percent of the larvae in the area (291 of 636 species) (Table 2).

Table 2. Advancements in taxonomic knowledge of early life history stages of northeastern Pacific fishes 1985 to 1999.

Source	Number of species	Number of larvae described ¹	% Known
Kendall and Dunn, 1985	627	52	8.3
Matarese <i>et al.</i> , 1989	627	263 ²	41.9
Present study	636	291	45.8

¹Includes only species level identifications.

²As calculated by Kendall and Matarese (1994).

Table 3. Species synonymized, described, or reported in the northeastern Pacific Ocean and Bering Sea since publication of Matarese *et al.* (1989)

Taxon	Investigator(s)
Scorpaenidae	
<i>Adelosebastes latens</i>	Orr and Baker, 1997
<i>Sebastes glaucus</i>	„
Cottidae	
<i>Bolinia euryptera</i>	Yabe, 1991
Agonidae	
<i>Podothecus veterus</i>	Sheiko, unpubl. data
Liparidae	
<i>Liparis marmoratus</i>	Busby and Chernova, submitted
<i>Allocareproctus jordani</i>	Orr and Busby, submitted
genus nov. sp. nov.	„
Cyclopteridae	
<i>Aptocyclus ventricosus</i>	Kido and Shinohara, 1996
<i>Pelagocyclus vitazi</i> ¹	„
Zoarcidae	
<i>Lycodes soldatovi</i>	Anderson, 1994
Acropomatidae	
<i>Howella sherborni</i>	Busby and Orr 1999
Pleuronectidae	
<i>Lepidopsetta polyxystra</i>	Orr and Matareses, 2000

¹According to Kido and Shinohara (1996), *P. vitazi* Lindberg and Legeza 1955, is a junior synonym of *A. ventricosus* (Pallas 1769).

SPECIAL CONTRIBUTIONS

Several authors published work during this period that was of particular significance in terms of taxonomic advancement, usefulness in recruitment process studies, or both (Table 5). The first of these contributions was the paper by Matarese *et al.* (1981) that described the larval development of the gadids *Microgadus proximus*, *Theragra chalcogramma*, and *Gadus macrocephalus*. The ability to identify and distinguish these taxa, particularly *T. chalcogramma*, was paramount in the development and initial research of the FOCI program. Publication of the paper by Dunn and Vinter (1984) on the development of *Eleginus gracilis* with comments on the identification of other Northeast Pacific gadids was another significant milestone. In addition to the description of larval *E. gracilis*, the authors also presented the first partial series of *Boreogadus saida* and presented the diagnostic characters needed to distinguish the larvae of all five species of gadid fishes known from Alaskan waters. Kendall and Vinter (1984) described the early life history stages of all five genera and seven of the nine species of hexagrammid fishes in the northeastern Pacific Ocean. This was the first published study

Table 4. Descriptions of early life history stages of Northeast Pacific fishes published after Matarese *et al.* (1989).

Taxon	Author(s)
Scorpaenidae	
<i>Sebastes atrovirens</i>	Moreno, 1993
<i>S. carnatus</i>	„
<i>S. mystinus</i>	„
<i>S. rastrelliger</i>	„
<i>S. goodei</i>	Sakuma and Laidig, 1995
<i>S. saxicola</i>	Laidig <i>et al.</i> , 1996
<i>S. rastrelliger</i> ¹	Laidig and Sakuma, 1998
Psychrolutidae	
<i>Psychrolutes phricus</i>	Ambrose, 1996a
Agonidae	
<i>Odontopyxis trispinosa</i>	Busby and Ambrose, 1993
<i>Xeneretmus latifrons</i>	„
<i>X. leiops</i>	Ambrose, 1996b
<i>Agonopsis vulsa</i>	Busby, 1998
<i>Anoplagonus inermis</i>	„
<i>Bathylagonus alascanus</i>	„
<i>B. infraspinatus</i>	„
<i>B. nigripinnis</i>	„
<i>B. pentacanthus</i>	„
<i>Leptagonus frenatus</i>	„
<i>Pallasina barbata</i>	„
<i>Podothecus acipenserinus</i>	„
Liparidae	
<i>Liparis fucensis</i>	Marliave and Peden, 1989
<i>L. callyodon</i>	„
<i>Careproctus melanurus</i>	Ambrose, 1996c
<i>Liparis mucosus</i>	„
<i>L. pulchellus</i>	„
<i>Paraliparis cephalus</i>	„
<i>Rhinoliparis attenuatus</i>	„
Pholidae	
<i>Apodichthys fucorum</i>	Watson, 1996
Pentacerotidae	
<i>Pseudopentaceros wheeleri</i>	Mundy and Moser, 1997

¹ Augments description of Moreno (1993) to cover all developmental stages.

containing larval descriptions of an entire family of fishes in the region. Publication of the *Laboratory Guide to Early Life History Stages of Northeast Pacific Fishes* (Matarese *et al.* 1989) was the most significant work on larval fish taxonomy in the region during this time period. In this guide, comparative descriptions of 232 species, including 200 previously

Table 5. Special contributions to advancements in taxonomic knowledge of early life history stages of northeastern Pacific fishes 1981 to 1998.

Author(s)	Family	No. of larval taxa described	Significance
Matarese <i>et al.</i> , 1981	Gadidae	3	1 st N.E. Pacific gadid larvae
Dunn and Vinter, 1984	Gadidae	2	Completes family Gadidae, all taxa compared
Kendall and Vinter, 1984	Hexagrammidae	All 5 genera, 7 spp.	Diagnosis of entire family
Matarese <i>et al.</i> , 1989	All N.E. Pacific	232	200 new illustrations, entire region covered
Busby, 1998	Agonidae	22	9 new descriptions, 13 updated

unpublished illustrations, were presented. Since publication of the laboratory guide, only one major study on larval taxonomy has been completed: Busby (1998) presented the diagnostic taxonomic characters and illustrations of 22 of 25 species of larval and early juvenile agonids occurring in the area. This included new larval descriptions of nine species and augmented or updated descriptions of the remaining 13 taxa.

CURRENT STUDIES

Despite all of the recent advancements in our ability to identify early life history stages of northeastern Pacific fishes, gaps exist in our knowledge of one perciform and three scorpaeniform families (Table 6). At present, we are only able to identify 64 percent of larval scorpaenids, 61 percent of cottids, 17 percent of liparids, and 58 percent of stichaeids (Table 6). Research is currently being conducted by staff at the AFSC on all of these families and others including the genera *Sebastes* (family Scorpaenidae), *Triglops* (family Cottidae), *Hemitripteris* (family Hemitripteridae), *Liparis* and *Paraliparis* (family Liparidae), *Bryozoichthys* (family Stichaeidae), and *Lepidopsetta* (family Pleuronectidae; Orr and Matarese 2000) (Table 7).

Contributions of scientists at PSIC have been very important in taxonomic studies of northeastern Pacific fishes. A recent example of this concerns investigations of *Lepidopsetta* larvae. After AFSC scientists identified a new variety of flatfish larva, similar to what had been identified as *L. bilineata* but not linked to any known adult in the area, PSIC scientists were promptly able to accurately identify this larva in plankton samples. This eventually led to the identification and description of the adults of a new species of flatfish. Collaboration between staff of the Plankton Sorting and Identification Center and AFSC, along with continuing efforts of ZSIOP scientists to separate and identify larvae of the poorly known families, will lead to further advancements in taxonomy and fisheries oceanography in the next century.

Table 6. Gaps in knowledge of early life history stages in four major families of northeastern Pacific fishes

Family	Number of species ¹	Number of larvae described ¹	% Known
Scorpaenidae	45	29 ²	64
Cottidae	110	67	61
Liparidae	78	13	17
Stichaeidae	27	16	59

¹ Includes all new species described or reported from the area since Matarese *et al.* (1989) and presently unpublished larval data from AFSC.

² Includes only taxa with stages other than preflexion and juveniles known.

Table 7. Current AFSC ichthyoplankton taxonomy research

Taxon	Description	Investigator(s)
Scorpaenidae <i>Sebastes</i> spp.	Systematic revision with larval and juvenile characters	Kendall and Orr
Cottidae <i>Triglops</i> spp. <i>Hemitripterus bolini</i>	Identification and development of five species of <i>Triglops</i> larvae Development of eggs and larvae with information on spawning and life history	Blood and Matarese Busby <i>et al.</i>
Liparidae <i>Liparis</i> spp. <i>Paraliparis</i> spp.	Taxonomic study	Busby
Stichaeidae <i>Bryozoichthys</i> spp.	Identification and development of <i>B. lysimus</i> and <i>B. marjorius</i>	Blood and Matarese
Pleuronectidae <i>Lepidopsetta polyxystra</i>	Revision of genus with description of a new species	Orr and Matarese

Acknowledgments. The authors thank Jean Dunn and Michael Fahay for critical review of the manuscript.

REFERENCES

- Ambrose, D.A. 1996a. Psychrolutidae: Fathead sculpins. *In*: H.G. Moser, ed. The early stages of fishes in the California Current Region. CALCOFI Atlas No. 33. 841-843.
- Ambrose, D.A. 1996b. Agonidae: Poachers. *In*: H.G. Moser, ed. The early stages of fishes in the California Current Region. CALCOFI Atlas No. 33. 844-859.

- Ambrose, D.A. 1996c. Cyclopteridae: Snailfishes and lumpsuckers. *In*: H.G. Moser, ed. The early stages of fishes in the California Current. CALCOFI Atlas No. 33. 860-871.
- Anderson, M.E. 1994. Systematics and osteology of the Zoarcidae (Teleostei: Perciformes). *Ichthyol. Bull. J. L.B. Smith Inst. Ichthyol.* No. 60.
- Bailey, K.M., R.C. Francis, and P.R. Stevens. 1982. The life history and fishery of Pacific whiting, *Merluccius productus*. *CalCOFI Reports* 23:81-98.
- Busby, M.S. and D.A. Ambrose. 1993. Development of larval and early juvenile pygmy poacher, *Odontopyxis trispinosa*, and blacktip poacher, *Xeneretmus latifrons*, (Scorpaeniformes: Agonidae). *Fish. Bull.*, U.S. 91:397-413.
- Busby, M.S. 1998. Guide to the identification of larval and early juvenile poachers (Scorpaeniformes: Agonidae) from the northeastern Pacific Ocean and Bering Sea. U.S. Dep. Commer., NOAA Tech. Rep. 137, 88 p.
- Busby, M.S. and J.W. Orr. 1999. A pelagic basslet *Howella sherborni* (Family Acropomatidae) from the Aleutian Islands. *Alaska Fish. Res. Bull.* 6(1) 49-53.
- Busby, M. S. and N. V. Chernova. (Submitted). Redescription of the festive snailfish, *Liparis marmoratus* (Scorpaeniformes: Liparidae), with a new record from the northern Bering Sea. *Ichthyological Research*.
- Dunn, J.R. and B.M. Vinter. 1984. Development of larvae of saffron cod, *Eleginus gracilis*, with criteria for identification of gadid larvae in Pacific and Arctic waters contiguous to Canada and Alaska. *Can. J. Fish. Aquat. Sci.* 41:304-318.
- Kendall, A.W. and J. R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. U.S. Dep. Commer., NOAA Technical Report NMFS 20, 89 p.
- Kendall, A.W. and A.C. Matarese. 1994. Status of early life history descriptions of marine teleosts. *Fish. Bull.*, U.S. 92:725-736.
- Kendall, A.W., J.D. Schumacher, and S. Kim. 1996. Walleye pollock recruitment in Shelikof Strait: applied fisheries oceanography. *Fish. Oceanogr.* 5 (Suppl. 1): 4-18.
- Kendall, A.W. and B.M. Vinter. 1984. Development of hexagrammids (Pisces, Scorpaeniformes) in the northeastern Pacific Ocean. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 2, 44 p.
- Kido, K. and G. Shinohara. 1996. *Pelagocycclus vittazi* Lindberg and Legeza, 1955, a junior synonym of *Aptocycclus ventricosus* (Pallas 1769) (Scorpaeniformes: Cyclopteridae). *Ichthyol. Res.*, 43(2): 175-177.
- Laidig, T.E., K. M. Sakuma, and M. M. Nishimoto. 1996. Description of pelagic larval and juvenile striptetail rockfish, *Sebastes saxicola* (family Scorpaenidae), with an examination of age and growth. *Fish. Bull.*, U.S. 94: 289-299.
- Laidig, T.E. and K.M. Sakuma. 1998. Description of pelagic larval and juvenile grass rockfish, *Sebastes rastrelliger* (family Scorpaenidae), with an examination of age and growth. *Fish. Bull.*, U.S. 96: 788-796.
- Marliave, J.B. and A.E. Peden. 1989. Larvae of *Liparis fucensis* and *Liparis callyodon*: Is the cottoid "bubblemorph" phylogenetically significant? *Fish. Bull.*, U.S. 87:735-743.
- Matarese, A.C., S.L. Richardson, and J.R. Dunn. 1981. Larval development of the Pacific tomcod, *Microgadus proximus*, in the Northeast Pacific Ocean with comparative notes on larvae of walleye pollock, *Theragra chalcogramma*, and Pacific Cod, *Gadus macrocephalus* (Gadidae). *Fish. Bull.*, U. S. 78:923-940.
- Matarese, A.C., A.W. Kendall Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of Northeast Pacific fishes. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 80, 652 p.
- Moreno, G. 1993. Description of early larvae of four northern California species of rockfishes (Scorpaenidae: Sebastes) from rearing studies. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 116, 18 p.
- Mundy, B.C. and H.G. Moser. 1997. Development of early stages of pelagic armorhead *Pseudopentaceros wheeleri* with notes on juvenile *Ps. richardsoni* and larval *Histiopertus typus* (Pisces, Percoidae, Pentaceroptidae). *Bull. Mar. Sci.* 61: 241-269.

- Orr, J.W. and D.C. Baker. 1997. New North American records of the Northeast Pacific scorpaenids *Adelosebastes latens* and *Sebastes glaucus* (Teleostei: Scorpaenidae). Alaska Fish. Res. Bull. 3(2): 94-102.
- Orr, J. W. and M. S. Busby. (Submitted). *Prognatholiparis ptychomandibularis*, a new genus and species of the fish family liparidae (Teleostei: Scorpaeniformes) from the Aleutian Islands, Alaska. Proceedings of the Biological Society of Washington.
- Orr, J.W. and A.C. Matarese. 2000. Revision of the genus *Lepidopsetta* Gill, 1862, (Teleostei: Pleuronectidae) based on adult and larval morphology, with a description of a new species. Fish Bull. U. S. 98: 539-582.
- Picquelle, S.J. and B.A. Megrey. 1993. A preliminary spawning biomass estimate of walleye pollock *Theragra chalcogramma* in the Shelikof Strait, Alaska, based on the annual egg production method. Bull. Mar. Sci. 53: 728-749.
- Sakuma, K.M. and T.E. Laidig. 1995. Description of pelagic larval and juvenile chilipepper, *Sebastes goodei* (family Scorpaenidae), with an examination of age and growth. Fish. Bull., U.S. 93: 721-731.
- Waldron, K.D. 1972. Fish larvae collected from the Northeastern Pacific Ocean and Puget Sound During April and May 1967. U.S. Dep. Commer., NOAA Tech. Rep., NMFS SSRF-663. 16 p.
- Watson, W. 1996. Pholidae: Gunnels. In: H.G. Moser, ed. The early stages of fishes in the California Current Region. CALCOFI Atlas No. 33. 1120-1125.
- Yabe, M. 1991. *Bolinia euryptera*, a new genus and species of sculpin (Scorpaeniformes: Cottidae) from the Bering Sea. Copeia 1991:329-339.

The Bulletin of the Sea Fisheries Institute *was first issued in 1970.*
Since 1992, three issues of the Bulletin have been published annually.
Papers concerned with fishery-related sciences, i. e., fishery biology,
ichthyology, physical and biological oceanography, sea-food technology and processing,
fishing gear technology and marine environment conservation issues
will be considered for publication in the Bulletin.
Prior to publication, articles are reviewed by recognized authorities in the field.

The Bulletin of the Sea Fisheries Institute *is indexed and abstracted in ASFA and FSTA.*

EDITORIAL STAFF

Editor in Chief – Tomasz B. Linkowski (Director)
Guest Editor – Kenneth Sherman
(Northeast Fisheries Science Center, Narragansett, RI, USA)
Senior Publication Officer – Elżbieta Stawska
Translators and Proof-readers – Jennifer & Tymon Zieliński
Technical Editor – Lucyna Jachimowska

SCIENTIFIC ADVISERS

E. Aro – Finnish Game and Fisheries Research Institute, Helsinki, FINLAND
P. Gasjukov – AtlantNIRO, Kaliningrad, RUSSIA
L. Hernroth – Institute of Marine Research, Lysekil, SWEDEN
E. Ojaveer – Estonian Marine Institute, Tallinn, ESTONIA
A. I. L. Payne – CEFAS, Lowestoft Laboratory, Lowestoft, UK
T. Penczak – University of Łódź, Łódź, POLAND
J. Piechura – Institute of Oceanology PAN, Sopot, POLAND
M. Protasowicki – Agricultural Academy of Szczecin, Szczecin, POLAND
K. Sherman – Northeast Fisheries Science Center, Narragansett Laboratory, Narragansett, RI, USA
J. Świniarski – Agricultural Academy of Szczecin, Szczecin, POLAND
W. Załachowski – Agricultural Academy of Szczecin, Szczecin, POLAND

EDITORIAL OFFICE ADDRESS

Sea Fisheries Institute. Scientific Information and Publishing Center
Kołłątaja 1, 81-332 Gdynia, POLAND
<http://www.mir.gdynia.pl>
e-mail: bulletin@mir.gdynia.pl

THIS JOURNAL IS SUPPORTED FINANCIALLY
by
THE STATE COMMITTEE FOR SCIENTIFIC RESEARCH, POLAND