



Echinoderm Collections of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, as Information Base for Fundamental Biological Investigation

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Abstract

At the Zoological Institute of the Russian Academy of Sciences (RAS), St. Petersburg, in 1914 the V invertebrates branch has been created, which includes the echinoderm collections. Unique material has been received for 160 years by researches, conducted in various parts of the World Ocean, and serves as the data source for an information retrieval system of the collections. In addition to scientific, historical and cognitive aspects, the important ecological sounding data receive similar attention. The collections were accumulated over large time intervals ("monitoring collections"), which provides an opportunity to trace changes in sea ecosystems that occur under the influence of global climatic, local hydrological, and anthropogenous influences.

Three years ago, the Zoological Institute (ZIN) of RAS has started to develop algorithms for the digitization of its collections, considering the specificity of the storage for separate systematic groups. Web pages with type specimens on brittle stars, sea stars, sea urchins and sea cucumbers have been prepared (https://www.zin.ru/Collections/index_en.html).

Using available ZIN server infrastructure and a new intelligence system for collection samples, creation of a portal of the Global Information Facility (GBIF) and the subsequent selective publication of ZIN collection data on this portal becomes possible (<https://www.gbif.org/publisher/c14b9ce2-9545-4376-8a3b-6741558c256a>).

Keywords: Echinoderms; Zoological Collections; Information Systems

Abbreviations

RAS: Russian Academy of Sciences; ZIN: Zoological Institute of RAS; GBIF: Global Biodiversity Information Facility; DB: Database; IRS: Information Retrieval System

Introduction

The echinoderm collections at the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, have a long history. Feodor Fyodorovich Brandt (Johann Friedrich von Brandt, 1802 - 1879) - the founder and first director of the Zoological Museum - was the first to process material of echinoderms, collected by A. K. (K.H.) Mertens (1796 - 1830), during a global cruise (1826 - 1829). From 1895 to 1897, the echinoderm collection, alongside sponges,

cnidarians, worms, crustaceans, etc., was registered at the Department of "Other invertebrates". In 1897, the echinoderms were attributed to the department "Mollusk-zoological (III)" [13,14].

In 1914, Alexander Mikhailovich Djakonov (1886 - 1956), created and lead the echinoderm department (V Department of Invertebrate Animals) and remained its chief to the end of his life [13,14,30]. Zoja Ivanovna Baranova (1922 - 2010) worked at the Zoological Institute from 1948 to 1983 and was the head of the echinoderm department in 1960 - 1983. Evgeniy Nikolayevich Gruzov (1933 - 2010) was a zoologist and aquatic biologist, one of the pioneers of underwater research of marine bottom fauna and biosensors of Antarctica by means of scuba-diving technics. From 1960,

he worked in the echinoderm department, and in 1984 - 1998, he managed it [11,12]. Since 1998, Alexey Vladimirovich Smirnov leads the echinoderm department. Other staff in the echinoderm department are senior scientist Igor Sergeevich Smirnov, senior curator Ekaterina Grigorjevna Serkina, and senior laboratory assistant Tatyana Nikolayevna Konina [13,14]. The big collection and large volume of data has hampered the full analysis of the identified material and since 1987, an information system for marine invertebrates began to be developed [7,15,16,22,23,25,26,27,29].

Materials and Methods

Echinoderm collections

The echinoderm collection of the department holds a total of more than 26,000 units of storage (or lots) and is divided into the categories "systematic" and "non-identified". A lot is here defined as a part of a hydrobiological sample with specimens of a certain species. One lot may contain several hundreds of specimens. The systematic part of the collection is stored in taxonomic order (by family, genus and species), while the non-identified part is stored by expeditions. All material is divided into alcoholic and dry. As a rule, alcoholic collections are stored on small trays in cabinets, while dry ones are placed above them on entresols (Figure 1).



Figure 1: Storage facility of the Laboratory of the Marine Research ZIN RAS.

In the echinoderm department, along with the catalogue of type specimens, two more catalogues are managed: a numbered inventory for all lots and a systematic one, where lots with the same

species are numbered. During the reidentification of the material, numbers in the systematic catalogue are changed, while inventory numbers remain permanent.

The echinoderm collections originate mainly from the cold and temperate waters of the World Ocean (polar and middle latitude regions). The main collection originates from the material collected by the famous first Russian research vessel "Andrey Pervozvannyi" (1899). Since that time, many regions of the World Ocean have been sampled and a large amount of material has been collected mainly by Zoological Institute researchers.

A total of 309 species and subspecies of brittle stars are available in the Marine Research Laboratory of the Zoological Institute RAS collection [16]. The systematic collection of brittle stars consists of 9,591 lots, whereas the non-identified part consists of more than 500 lots. The collection of sea stars represents 438 species and subspecies, with 7,731 lots in the systematic collection, and more than 700 lots in the non-identified part. The collection of sea urchins consists of 219 species and subspecies, with 3,564 lots in the systematic part and over 400 non-identified lots. The collection of sea cucumbers represents 263 species and subspecies, with 2,360 lots in the systematic part, and more than 250 unidentified lots [17].

Creation of a collection database system

Representing the biological diversity of the group of taxa classification, including the total consideration of synonyms is the main problem in creating a faunistic and collection data bank [9,10]. For storing the taxonomic information, an approach has been used which consists in creation of an automatic taxonomic classificatory, independent of other databases, and in making up specially organized codes for coordination of different data missives. The classificatory makes it possible to deal with any number of taxonomic categories, including the rarely used ones: Legion, Cahors, etc. Another considerable advantage of the classificatory is that during the changes being made in a group's system and nomenclature, no change of the information stowed in operative databases (on ecology, etc.) is necessary [6].

The creation of electronic databases (DB) on marine invertebrates at the Zoological Institute began in 1987. The appearance in 1989 of personal computers allowed to solve many problems in

a creating zoological DB and information retrieval systems (IRS) more efficiently [22,29]. Designed at the Zoological Institute IRS “OCEAN” consists of 4 basic units: taxonomic (name and nomenclature of taxa), geographical (locality of collecting with coordinates of stations, gear etc.), ecological (biomass, depth, temperature, salinity, oxygen etc.) and bibliographic. The system was added by the new method of data input using the dictionaries developed by A.A. Golikov in FoxPro for Windows (later in MS SQL Server), which minimizes the number of errors [5]. The IRS allows to operate the data on the structure of fauna, its biodiversity, benthic groupings and their distribution more efficiently. Station DB contains now more than 14000 records (more than 130 expeditions) (Figure 2).

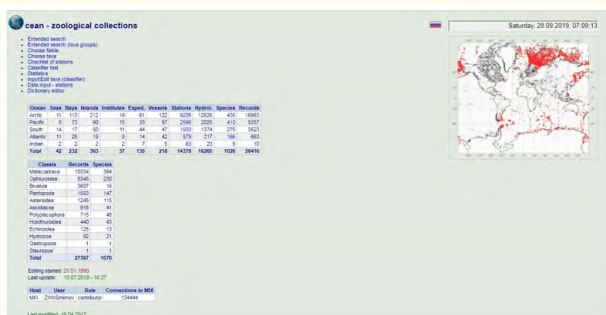


Figure 2: Screen shot of the first web page from IRS “OCEAN”.

Results and Discussion

In the beginning with the use of the created classificatory of the world fauna of Ophiuroids, a data bank was developed consisting of 5 databases: 1) The Classificatory (Ophiuroids system); 2) Database of stations, with data on depth, etc.; 3) Database of findings, i.e. short notes on a given species met at a given station; 4) Collection database; 5) Reference database (bibliography) (Figure 3 and 4) [6,15,22].

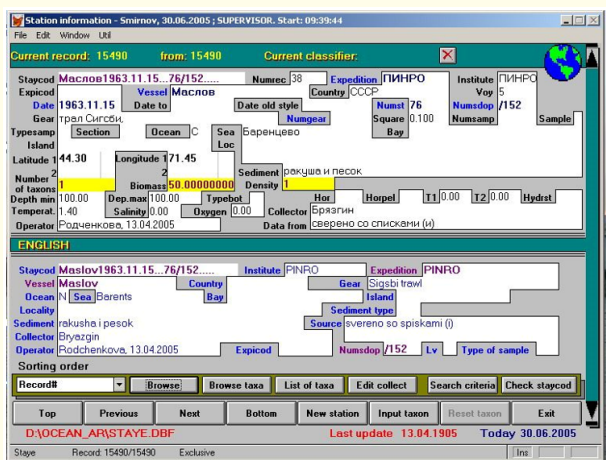


Figure 3: Screen shot of the web page from old version IRS “OCEAN” (2005).



Figure 4: Screen shot of the web page from IRS “OCEAN” with information on ophiuroids species Ophiura sarsii.

Species/subspecies	Number of lots	Type material
<i>Acanthaster planci</i>	2	
<i>Acodontaster capitatus</i>	3	
<i>Acodontaster conspicuus</i>	1	
<i>Acodontaster elongatus</i>	4	
<i>Acodontaster hodgsoni</i>	1	
<i>Acodontaster stellatus</i>	2	
<i>Allostichaster insignis</i>	2	
<i>Allostichaster polyplax</i>	1	
<i>Anseropoda membranacea</i>	5	
<i>Anseropoda placenta</i>	1	
<i>Anthenea affinis</i>	2	
<i>Anthenea flavescens v. nuda</i>	1	
<i>Anthenoides rugulosus</i>	2	
<i>Anthosticte sp.</i>	1	
<i>Aphelasterias changfengyingi</i>	3	Paratype
<i>Aphelasterias japonica</i>	100	
<i>Archaster angulatus</i>	2	
<i>Archaster typicus</i>	6	
<i>Asterias amurensis</i>	101	
<i>Asterias amurensis acervispina</i>	13	
<i>Asterias amurensis flabellifera</i>	33	Holotype
<i>Asterias amurensis gracilispinis</i>	6	Holotype
<i>Asterias amurensis latissima</i>	5	
<i>Asterias amurensis robusta</i>	4	Holotype
<i>Asterias argonauta</i>	21	Holotype
<i>Asterias forbesi</i>	1	
<i>Asterias microdiscus</i>	22	Syntype
<i>Asterias pectinata</i>	10	
<i>Asterias rathbuni</i>	42	
<i>Asterias rathbuni alveolata</i>	8	Holotype

<i>Asterias rathbuni anomala</i>	13	
<i>Asterias rollestoni</i>	47	
<i>Asterias rubens</i>	134	
<i>Asterias rubens brachybrachia</i>	1	
<i>Asterias rubens violacea</i>	4	
<i>Asterias sp</i>	4	
<i>Asterias versicolor</i>	8	
<i>Asterias vulgaris</i>	2	
<i>Asterina calcarea</i>	1	
<i>Asterina cepheus</i>	1	
<i>Asterina coronata</i>	3	
<i>Asterina gibbosa</i>	7	
<i>Asterina pancerii</i>	1	
<i>Asterina variolata</i>	1	
<i>Asterina verruculata</i>	2	
<i>Asterinides folium</i>	2	
<i>Asterinides miniata</i>	2	
<i>Asterinopsis penicillaris</i>	3	
<i>Asterodon miliaris</i>	1	
<i>Asterope carinifera</i>	3	
<i>Astrocles actinodetus</i>	3	
<i>Astrocles djakonovi</i>	2	Holotype
<i>Astrometis sertulifera</i>	1	
<i>Astropecten americanus</i>	2	
<i>Astropecten andersoni</i>	1	
<i>Astropecten aranciacus</i>	12	
<i>Astropecten bispinosus</i>	9	
<i>Astropecten brasiliensis</i>	1	
<i>Astropecten hupferi</i>	1	
<i>Astropecten irregularis</i>	3	
<i>Astropecten irregularis var pentacanthus</i>	5	
<i>Astropecten jonstoni</i>	10	
<i>Astropecten ludwigi</i>	1	
<i>Astropecten mauritianus</i>	1	
<i>Astropecten michaelsoni</i>	1	
<i>Astropecten muelleri</i>	2	
<i>Astropecten mauritianus</i>	2	
<i>Astropecten platyacanthus</i>	7	
<i>Astropecten scoparius</i>	8	

<i>Astropecten serratus</i>	1	
<i>Astropecten spinulosus</i>	3	
<i>Astropecten stellatus</i>	1	
<i>Bathybeaster loripes obesus</i>	7	
<i>Bathybeaster vexillifer</i>	12	
<i>Benthopecten claviger</i>	2	
<i>Benthopecten rhopalophorus</i>	1	Holotype
<i>Benthopecten spinosus</i>	1	
<i>Benthopecten sp</i>	2	
<i>Brisingella ochotensis</i>	2	Holotype
<i>Calvasterias suteri</i>	2	
<i>Ceramaster articus</i>	27	
<i>Ceramaster granularis</i>	29	
<i>Ceramaster japonicus</i>	4	
<i>Ceramaster patagonicus</i>	2	
<i>Ceramaster patagonicus productus</i>	13	Holotype
<i>Ceramaster sp</i>	1	
<i>Ceramaster stellatus</i>	3	Holotype
<i>Chaetaster logipes</i>	2	
<i>Choriaster granulatus</i>	1	
<i>Cladaster validus</i>	7	
<i>Coronaster sp</i>	1	
<i>Coscinasterias calamaria</i>	3	
<i>Coscinasterias sp</i>	1	
<i>Coscinasterias tenuispinus</i>	14	
<i>Craspidaster hesperus</i>	1	
<i>Crossaster borealis</i>	4	
<i>Crossaster borealis ochotensis</i>	3	Holotype
<i>Crossaster diamesus</i>	14	
<i>Crossaster japonicus</i>	4	
<i>Crossaster papposus</i>	489	
<i>Crossaster penicillatus</i>	1	
<i>Crossaster squamatus</i>	3	
<i>Cryptopeltaster lepidonotus</i>	1	
<i>Ctenodiscus australis</i>	2	
<i>Ctenodiscus crispatus</i>	627	
<i>Ctenophoraster diploctenus</i>	1	
<i>Culcita coriacea</i>	1	
<i>Culcita novaeguineae</i>	2	
<i>Culcita schmideliana</i>	1	

<i>Cyathra verrucosa</i>	1	
<i>Dactylaster cylindricus</i>	3	
<i>Dermasterias imbricata</i>	2	
<i>Diplopteraster multipes</i>	8	
<i>Dipsacaster anoplus</i>	10	
<i>Dipsacaster borealis</i>	6	
<i>Dipsacaster sladeni</i>	1	
<i>Distolasterias elegans</i>	17	Holotype
<i>Distolasterias nipon</i>	45	
<i>Echinaster brasiliensis</i>	2	
<i>Echinaster purpureus</i>	5	
<i>Echinaster sepositus</i>	7	
<i>Echinaster sepositus sepositus</i>	1	
<i>Eremicaster pacificus</i>	2	
<i>Eremicaster tenebrarius</i>	5	
<i>Euretaster cribrosus</i>	1	
<i>Evasterias derjugini</i>	5	Holotype
<i>Evasterias echinosoma</i>	81	
<i>Evasterias echinosoma f. troscheliformis</i>	5	Holotype
<i>Evasterias retifera f. retifera</i>	12	Holotype
<i>Evasterias retifera f. retata</i>	2	Holotype
<i>Evasterias retifera f. tabulata</i>	39	Holotype
<i>Evasterias retifera tabulata</i> var. <i>ecylindrica</i>	1	
<i>Evasterias sp.</i>	1	
<i>Evasterias troschelii</i>	18	
<i>Freyella hexactis</i>	1	Holotype
<i>Fromia milleporella</i>	2	
<i>Gephyreaster swifti</i>	11	
<i>Gomophia egyptiaca</i>	1	
<i>Goniaster cuspidatus</i>	1	
<i>Goniodiscaster foraminatus</i>	1	
<i>Goniodiscaster seriatus</i>	1	
<i>Hacelia attenuata</i>	3	
<i>Halityle regularis</i>	2	
<i>Heliaster grandis</i>	1	
<i>Heliaster helianthus</i>	1	
<i>Heliaster kubiniji</i>	3	
<i>Heliaster microbrachia</i>	1	

<i>Heliaster multiradiatus</i>	1	
<i>Henricia ambigua</i>	20	Holotype
<i>Henricia angusta</i>	1	Holotype
<i>Henricia aniva</i>	8	Holotype
<i>Henricia annectens</i>	1	
<i>Henricia arctica</i>	5	
<i>Henricia aspera</i>	39	
<i>Henricia aspera annectens</i>	2	
<i>Henricia aspera robusta</i>	20	Holotype
<i>Henricia beringiana</i>	9	Holotype
<i>Henricia curta</i>	1	
<i>Henricia densispina</i>	34	
<i>Henricia derjugini</i>	39	Holotype
<i>Henricia elegans</i>	4	Holotype
<i>Henricia eschrichti</i>	167	
<i>Henricia granulifera</i>	16	Holotype
<i>Henricia hayashii</i>	8	Holotype
<i>Henricia imitatrix</i>	1	Holotype
<i>Henricia inexpectata</i>	18	Holotype
<i>Henricia irregularis</i>	3	
<i>Henricia knipowitschi</i>	28	Holotype
<i>Henricia knipowitschi f. carica</i>	1	Holotype
<i>Henricia kurilensis</i>	2	Holotype
<i>Henricia leviuscula</i>	7	
<i>Henricia leviuscula dyscrita</i>	13	
<i>Henricia longispinqa aleutica</i>	4	
<i>Henricia multispina</i>	2	
<i>Henricia ochotensis</i>	25	Holotype
<i>Henricia orientalis</i>	10	Holotype
<i>Henricia pacifica</i>	7	
<i>Henricia perforata</i>	1	
<i>Henricia pseudoleviuscula</i>	9	Holotype
<i>Henricia ralphae</i>	1	
<i>Henricia reniiosa asiatica</i>	8	Holotype
<i>Henricia reticulata</i>	34	
<i>Henricia sachalinica</i>	9	Holotype
<i>Henricia sanguinolenta</i>	50	
<i>Henricia scabrior</i>	177	
<i>Henricia singularis</i>	1	Holotype
<i>Henricia skorikovi</i>	31	Syntype

<i>Henricia solida</i>	6	Holotype
<i>Henricia spiculifera</i>	63	
<i>Henricia sp</i>	20	
<i>Henricia tacita</i>	5	Holotype
<i>Henricia tumida</i>	129	
<i>Henricia tumida borealis</i>	12	
<i>Hexaster sp.</i>	1	
<i>Hippasteria californica</i>	1	
<i>Hippasteria colossa</i>	1	Holotype
<i>Hippasteria derjugini</i>	1	Holotype
<i>Hippasteria insperialis</i>	1	
<i>Hippasteria kerguelensis</i>	1	
<i>Hippasteria kurilensis</i>	7	
<i>Hippasteria leiopelta</i>	94	
<i>Hippasteria leiopelta f. aculeata</i>	1	Holotype
<i>Hippasteria leiopelta f. longimana</i>	1	Holotype
<i>Hippasteria mammifera</i>	1	Holotype
<i>Hippasteria pedicellaris</i>	1	Holotype
<i>Hippasteria phrigiana</i>	41	
<i>Hippasteria spinosa</i>	1	
<i>Hippasteria spinosa f. armata</i>	3	
<i>Hippasteria spinosa spinosa</i>	1	
<i>Hymenaster pellucidus</i>	7	
<i>Hymenaster perissonotus</i>	4	
<i>Hymenaster quadrispinus</i>	1	
<i>Icasterias panopla</i>	108	
<i>Korethraster hispidus</i>	5	
<i>Labidiaster tridens</i>	2	
<i>Leiaster coriaceus</i>	1	
<i>Leptasterias aequalis</i>	1	
<i>Leptasterias alaskensis</i>	1	
<i>Leptasterias alaskensis asiatica</i>	78	
<i>Leptasterias alaskensis kurilensis</i>	6	
<i>Leptasterias arctica</i>	65	
<i>Leptasterias arctica beringensis</i>	8	
<i>Leptasterias arctica glomerata</i>	3	
<i>Leptasterias calcigera</i>	7	
<i>Leptasterias camtschatica</i>	63	Syntype
<i>Leptasterias camtschatica f. nesiotis</i>	1	
<i>Leptasterias coei schantarica</i>	2	Holotype

<i>Leptasterias danica</i>	1	Syntype?
<i>Leptasterias degerbolli</i>	1	
<i>Leptasterias derbeki</i>	49	Holotype
<i>Leptasterias derbeki f. tatarica</i>	26	Holotype
<i>Leptasterias dispar nitida</i>	2	
<i>Leptasterias djakonovi</i>	7	
<i>Leptasterias fisheri</i>	73	Holotype
<i>Leptasterias fisheri meridionalis</i>	60	Holotype
<i>Leptasterias floccosa</i>	1	Syntype?
<i>Leptasterias floccosa crassa</i>	1	
<i>Leptasterias granulata</i>	5	Holotype
<i>Leptasterias groenlandica</i>	169	
<i>Leptasterias groenlandica cribraria</i>	54	
<i>Leptasterias groenlandica gracilis</i>	7	
<i>Leptasterias groenlandica groenlandica</i>	1	
<i>Leptasterias hexactis</i>	8	
<i>Leptasterias hexactis occidentalis</i>	2	Holotype
<i>Leptasterias hirsuta</i>	23	Holotype
<i>Leptasterias hylodes reticulata</i>	9	
<i>Leptasterias hyperborea</i>	47	
<i>Leptasterias hyperborea floccosoidea</i>	1	Syntype?
<i>Leptasterias hyperborea var. intermedia</i>	1	Paratype
<i>Leptasterias insolens</i>	4	Holotype
<i>Leptasterias islandica</i>	1	
<i>Leptasterias kussakini</i>	23	
<i>Leptasterias leptodoma</i>	8	
<i>Leptasterias muelleri</i>	24	
<i>Leptasterias muelleri nobilis</i>	1	
<i>Leptasterias ochotensis</i>	63	Syntype
<i>Leptasterias orientalis</i>	104	Holotype
<i>Leptasterias orientalis japonica</i>	13	Holotype
<i>Leptasterias polaris</i>	5	
<i>Leptasterias polaris acervata f. acervata</i>	26	
<i>Leptasterias polaris acervata f. intermedia</i>	3	Holotype
<i>Leptasterias polaris acervata f. polythela</i>	68	

<i>Leptasterias polaris polaris</i>	3	
<i>Leptasterias polaris uschakovi</i>	8	Holotype
<i>Leptasterias polymorpha</i>	4	Holotype
<i>Leptasterias schmidti</i>	1	Holotype
<i>Leptasterias sibirica</i>	3	
<i>Leptasterias similispinis</i>	59	
<i>Leptasterias sp</i>	16	
<i>Leptasterias squamulata</i>	4	
<i>Leptasterias subarctica</i>	20	Holotype
<i>Leptasterias tenera</i>	1	
<i>Leptasterias vinogradovi</i>	3	
<i>Leptychaster accrescens</i>	4	
<i>Leptychaster anomalus</i>	19	
<i>Leptychaster arcticus</i>	53	
<i>Leptychaster brevispinus</i>	1	
<i>Leptychaster flexuosus</i>	3	
<i>Leptychaster inermis</i>	1	
<i>Leptychaster kerguelensis</i>	1	
<i>Leptychaster kerguelensis mendosus</i>	1	
<i>Leptychaster magnificus</i>	1	
<i>Leptychaster propinguus</i>	24	
<i>Leptychaster sp.</i>	1	
<i>Lethasterias fusca</i>	44	
<i>Lethasterias nanimensis</i>	1	
<i>Lethasterias nanimensis beringiana</i>	4	Paratype
<i>Lethasterias nanimensis chelifera</i>	120	
<i>Lethmaster rhipidophorus</i>	1	
<i>Linckia guildingii</i>	8	
<i>Linckia laevigata</i>	16	
<i>Linckia multifora</i>	10	
<i>Lophaster furcifer</i>	122	
<i>Lophaster furcilliger</i>	3	
<i>Lophaster furcilliger vexator</i>	4	
<i>Luidia ciliaris</i>	1	
<i>Luidia foliolata</i>	1	
<i>Luidia maculata</i>	2	
<i>Luidia quinaria</i>	14	
<i>Luidia quinaria bispinosa</i>	23	Holotype

<i>Luidia sarsii</i>	1	
<i>Luidia senegalensis</i>	1	
<i>Luidia sp.</i>	2	
<i>Luidiaster dawsoni</i>	8	
<i>Luidiaster dawsoni ochotensis</i>	5	
<i>Luidiaster gerlachei</i>	5	
<i>Luidiaster planetus</i>	2	
<i>Luidiaster tuberculatus</i>	10	
<i>Lysastrosoma anthosticta</i>	143	
<i>Lysastrosoma anthosticta crassispina</i>	3	
<i>Marginaster capreensis</i>	1	
<i>Marthasterias glacialis</i>	25	
<i>Mediaster equalis</i>	2	
<i>Mediaster murrayi</i>	3	
<i>Mithrodia clavigera</i>	2	
<i>Monachaster sanderi</i>	2	
<i>Myxoderma derjuguni</i>	1	Holotype
<i>Narcissia canariensis</i>	3	
<i>Nardoa semiregularis japonica</i>	9	
<i>Nardoa tuberculata</i>	6	
<i>Nardoa variolata</i>	2	
<i>Nearchaster pedicellaris vagans</i>	2	Holotype
<i>Nearchaster scotti</i>	2	
<i>Nearchaster variabilis geminus</i>	3	
<i>Neoferdina intermedia</i>	1	Holotype
<i>Nidorellia armata</i>	3	
<i>Notioceramus anomalus</i>	2	
<i>Odontaster benhami</i>	2	
<i>Odontaster hispidus</i>	1	
<i>Odontaster meridionalis</i>	44	
<i>Odontaster tenuis</i>	1	
<i>Odontaster validus</i>	7	
<i>Ophidiaster granifer</i>	1	
<i>Ophidiaster ophidianus</i>	3	
<i>Ophidiaster sp.</i>	1	
<i>Oreaster clavatus</i>	4	
<i>Oreaster reticulatus</i>	10	
<i>Ortasterias koehleri</i>	2	

<i>Patiria miniata</i>	1	
<i>Patiria pectinifera</i>	128	
<i>Patiria regularis</i>	1	
<i>Patiriella exigua</i>	5	
<i>Patiriella gunni</i>	1	
<i>Patiriella regularis</i>	3	
<i>Pedicellaster eximius</i>	11	Holotype
<i>Pedicellaster indistinctus</i>	3	Holotype
<i>Pedicellaster magister</i>	8	
<i>Pedicellaster magister ochotensis</i>	24	Holotype
<i>Pedicellaster orientalis</i>	7	
<i>Pedicellaster sp.</i>	3	
<i>Pedicellaster typicus</i>	13	
<i>Peltaster nidarosiensis</i>	1	
<i>Pentaceraster alveolatus</i>	2	
<i>Pentaceraster cumingi</i>	2	
<i>Pentaceraster mammillatus</i>	5	
<i>Pentagonaster magnificus</i>	1	
<i>Pentagonaster pulchellus</i>	3	
<i>Pentagonaster semilunatus</i>	1	
<i>Pentaster obtusatus</i>	1	
<i>Pergamaster incertus</i>	3	
<i>Peribolaster biserialis</i>	3	
<i>Persephonaster neozelanicus</i>	1	
<i>Pharia pyramidata</i>	2	
<i>Pisaster brevispinus</i>	2	
<i>Pisaster giganteus</i>	2	
<i>Pisaster ochraceus</i>	5	
<i>Plutonaster agassizi</i>	1	
<i>Plutonaster rigidus</i>	2	
<i>Ponstaster forcipatus</i>	1	
<i>Pontaster mirabilis</i>	1	
<i>Pontaster tenuispinus</i>	357	
<i>Pontaster tenuispinus hebitus</i>	1	
<i>Pontaster venustus</i>	1	
<i>Porania antarctica</i>	32	
<i>Porania insignis</i>	2	
<i>Porania pulvillus</i>	6	
<i>Poraniomorpha bidens</i>	17	
<i>Poraniomorpha hispida</i>	27	

<i>Poraniomorpha sp.</i>	1	
<i>Poraniomorpha tumida</i>	124	
<i>Poraniopsis inflata</i>	2	
<i>Porcellanaster ivanovi</i>	1	
<i>Protoreaster lincki</i>	2	
<i>Protoreaster nodosus</i>	6	
<i>Pseudarchaster discus</i>	1	
<i>Pseudarchaster dissonus</i>	1	
<i>Pseudarchaster ornatus</i>	1	Holotype
<i>Pseudarchaster parelii</i>	50	
<i>Pseudarchaster parelii alaskensis</i>	1	
<i>Psilaster acuminatus</i>	2	
<i>Psilaster andromeda</i>	1	
<i>Psilaster charcoti</i>	8	
<i>Psilaster florum</i>	1	
<i>Psilaster pectinatus</i>	3	
<i>Pteraster educator</i>	4	Holotype
<i>Pteraster hymenasteroides</i>	1	Holotype
<i>Pteraster marsippus</i>	11	
<i>Pteraster militaris</i>	136	
<i>Pteraster minutus</i>	5	Holotype
<i>Pteraster obscurus</i>	63	
<i>Pteraster obscurus ornatus</i>	52	
<i>Pteraster octaster</i>	46	
<i>Pteraster pulvillus</i>	67	
<i>Pteraster sp.</i>	1	
<i>Pteraster temnochiton</i>	1	
<i>Pteraster tessellatus</i>	33	
<i>Pteraster uragaensis</i>	1	
<i>Rathbunaster californicus</i>	1	
<i>Ripaster longispinus</i>	1	
<i>Rosaster symbolicus</i>	1	
<i>Sclerasterias tanneri</i>	1	
<i>Sideriaster sp.</i>	1	
<i>Solaster dawsoni</i>	23	
<i>Solaster earlli</i>	2	
<i>Solaster endeca</i>	68	
<i>Solaster glacialis</i>	44	
<i>Solaster haliplous</i>	2	Holotype

<i>Solaster intermedius</i>	5	
<i>Solaster pacificus</i>	43	
<i>Solaster papillatus</i>	1	
<i>Solaster paxillatus</i>	2	
<i>Solaster sp.</i>	2	
<i>Solaster stimpsoni</i>	10	
<i>Solaster syrtensis</i>		
<i>Stegnaster inflatus</i>	1	
<i>Stegnaster wesseli</i>	1	
<i>Stellaster equestris</i>	5	
<i>Stephanasterias albula</i>	72	
<i>Stichaster aurantiacus</i>	3	
<i>Stichaster suteri</i>	1	
<i>Stichastrella rosea</i>	4	
<i>Stylasterias forreri</i>	1	
<i>Termaster mirabilis</i>	6	
<i>Tethyaster subinermis</i>	3	
<i>Thrissacanthias bispinosus</i>	1	Holotype
<i>Tosia tuberculata</i>	1	
<i>Trophodiscus almus</i>	39	
<i>Trophodiscus sp.</i>	1	
<i>Trophodiscus uber</i>	34	Holotype
<i>Tylaster willei</i>	7	
<i>Uniophora granifera</i>	1	
<i>Uniophora sp.</i>	1	
<i>Urasterias lincki</i>	170	
<i>Urasterias lincki gunneri</i>	6	
<i>Vitiazaster djakonovi</i>	2	

Table 1: List of available identified sea stars from collection of Zoological Institute.

Species/subspecies	Number of lots	Type material
<i>Actinopyda miliaris</i>	1	
<i>Actinopyda nobilis</i>	1	
<i>Amperima naresi</i>	1	
<i>Anapta amurensis</i>	2	Syntype
<i>Anapta ludwigi</i>	4	Syntype
<i>Ankyroderma jeffreysii</i>	1	
<i>Ankyroderma roretzii</i>	5	

<i>Aphelodactyla molpadioides</i>	6	
<i>Bathyplores moseleyi</i>	2	
<i>Caudina arenata</i>	1	
<i>Caudina chilensis</i>	3	
<i>Caudina coriacen</i>	2	
<i>Caudina ranzonnetti</i>	2	
<i>Chiridota albatrossi</i>	1	
<i>Chiridota discolor</i>	13	
<i>Chiridota laevis</i>	10	
<i>Chiridota ochotensis</i>	5	
<i>Chiridota orientalis</i>	33	Holotype
<i>Chiridota pacifica</i>	1	
<i>Chiridota pellucida</i>	19	
<i>Chiridota sp.</i>	1	
<i>Chiridota tauiensis</i>	5	
<i>Chirodota chiaji</i>	1	
<i>Chirodota dunedinensis</i>	1	
<i>Chirodota rufescens</i>	3	
<i>Cladolabes bifurcatus</i>	1	
<i>Colochirus calcareus</i>	1	
<i>Colochirus sp.</i>	1	
<i>Colochirus tuberculosus</i>	1	
<i>Cucumaria abyssorum</i>	4	
<i>Cucumaria alba</i>	1	
<i>Cucumaria albida</i>	2	
<i>Cucumaria calcigera</i>	60	
<i>Cucumaria chronhjelmi</i>	4	
<i>Cucumaria crax</i>	1	
<i>Cucumaria crocea</i>	1	
<i>Cucumaria diligens</i>	1	Holotype
<i>Cucumaria djakonovi</i>	2	Holotype
<i>Cucumaria fallax</i>	12	
<i>Cucumaria fraudatrix</i>	80	Syntype
<i>Cucumaria frondosa</i>	21	
<i>Cucumaria huttoni</i>	1	
<i>Cucumaria hyndemanni</i>	3	
<i>Cucumaria insperata</i>	1	Holotype
<i>Cucumaria japonica</i>	74	

<i>Cucumaria kirchsbergii</i>	14	
<i>Cucumaria koreaensis</i>	1	
<i>Cucumaria lactea</i>	2	
<i>Cucumaria longicauda</i>	9	
<i>Cucumaria miniata</i>	2	
<i>Cucumaria minuta</i>	2	
<i>Cucumaria normani</i>	1	
<i>Cucumaria obunca</i>	1	
<i>Cucumaria ocnoides</i>	2	
<i>Cucumaria pentactes</i>	2	
<i>Cucumaria planci</i>	7	
<i>Cucumaria pusilla</i>	13	
<i>Cucumaria salminii</i>	1	
<i>Cucumaria sarsii</i>	1	
<i>Cucumaria savelijevae</i>	3	Holotype
<i>Cucumaria saxicola</i>	1	
<i>Cucumaria sp</i>	5	
<i>Cucumaria syracusana</i>	3	
<i>Cucumaria vegae</i>	100	
<i>Cucumata calcigera</i>	60	
<i>Echinocucumis hispida</i>	2	
<i>Echinocucumis typica</i>	2	
<i>Ekmania barthii</i>	2	
<i>Elpidia glacialis</i>	58	
<i>Elpidia kurilensis</i>	2	Holotype
<i>Elpidiogone dubia</i>	1	Syntype
<i>Eupyrgus pacificus</i>	15	
<i>Eumolpadia bicornis</i>	1	Holotype
<i>Eupentacta quinguese- mita</i>	3	
<i>Eupentacta sachalinica</i>	8	Syntype
<i>Euphronides depressa</i>	1	
<i>Eupyrgus pacificus</i>	15	
<i>Eupyrgus scaber</i>	113	
<i>Halodeima albiventer</i>	1	
<i>Halodeima atra</i>	5	
<i>Halodeima chilensis</i>	1	
<i>Holothuria arenicola</i>	1	
<i>Holothuria cinerascens</i>	1	

<i>Holothuria farskalia</i>	1	
<i>Holothuria fuscocinerea</i>	2	
<i>Holothuria helleri</i>	1	
<i>Holothuria hilla</i>	1	
<i>Holothuria impatiens</i>	4	
<i>Holothuria integea</i>	1	
<i>Holothuria lubrica</i>	1	
<i>Holothuria maculata</i>	1	
<i>Holothuria marmorata</i>	1	
<i>Holothuria modesta</i>	1	
<i>Holothuria moebii</i>	1	
<i>Holothuria monacaria</i>	1	
<i>Holothuria pardalis</i>	1	
<i>Holothuria poli</i>	2	
<i>Holothuria sanctori</i>	2	
<i>Holothuria scabra</i>	5	
<i>Holothuria sordida</i>	1	
<i>Holothuria squamifera</i>	11	
<i>Holothuria stellati</i>	4	
<i>Holothuria surinamensis</i>	1	
<i>Holothuria tigris</i>	1	
<i>Holothuria tubulosa</i>	4	
<i>Holothuria vagabunda</i>	6	
<i>Kolga hyalina</i>	26	
<i>Labidoplax buskii</i>	3	
<i>Labidoplax digitata</i>	5	
<i>Labidoplax thomsoni</i>	1	
<i>Labidoplax variabilis</i>	2	
<i>Laetmogone sp</i>	1	
<i>Laetmogone violacea</i>	1	
<i>Leptodynapta clarki</i>	1	
<i>Leptopentacta djakonivi</i>	1	Holotype
<i>Leptopentacta imbricata</i>	6	
<i>Leptopentacta taegestina</i>	1	
<i>Leptosynapta ooplax</i>	1	
<i>Mesothuria intestinalis</i>	2	
<i>Mesothuria verrilli</i>	1	
<i>Molpadia arctica</i>	21	

<i>Molpadia intermedia</i>	1	
<i>Myriotrochus angulatus</i>	1	
<i>Myriotrochus bruuni</i>	1	
<i>Myriotrochus eurycyclus</i>	36	
<i>Myriotrochus kurilensis</i>	1	
<i>Myriotrochus longissimus</i>	1	
<i>Myriotrochus minutus</i>	1	
<i>Myriotrochus mitsukurii</i>	9	
<i>Myriotrochus rinkii</i>	209	
<i>Myriotrochus wolfii</i>	1	
<i>Myriotrochus zenkevitchi</i>	1	
<i>Myriotrochus zenkevitchi exiguus</i>	1	
<i>Ocnus/Cucumaria/ glacialis</i>	142	
<i>Orcula limaconopus</i>	1	
<i>Pachythyone rubra</i>	1	
<i>Paelopatides solea</i>	3	Syntype
<i>Pannychia moseleyi</i>	3	
<i>Pannychia moseleyi mollis</i>	2	Holotype
<i>Paracaudina chilensis</i>	4	
<i>Paracaudina chilensis obesa</i>	1	
<i>Parastichopus californicus</i>	1	
<i>Peniagone mus</i>	1	Syntype
<i>Pentamera lissoplaca</i>	1	
<i>Pentamera populifera</i>	1	
<i>Periamma tetramerum</i>	1	
<i>Peristichopus papillatus</i>	1	Syntype
<i>Phyllophorus cylindricus</i>	1	
<i>Phyllophorus drummondii</i>	3	
<i>Phyllophorus fragilis</i>	2	
<i>Phyllophorus pellucidus</i>	21	
<i>Phyllophorus urnor</i>	2	
<i>Polycheira rufescens</i>	3	
<i>Protankyra bankensis</i>	1	
<i>Protankyra bidentata</i>	3	
<i>Protankyra brychia</i>	1	
<i>Pseudocnus californicus</i>	1	
<i>Pseudocnus lubricus</i>	1	

<i>Pseudocnus piperata</i>	1	
<i>Pseudocucumis mixta</i>	1	
<i>Pseudostichopus mollis</i>	1	
<i>Pseudostichopus nudus</i>	2	
<i>Pseudostichopus profundus</i>	1	Syntype
<i>Pseudostichopus sp</i>	2	
<i>Pseudostichopus trachus</i>	5	
<i>Psilothuria bitentaculata</i>	1	
<i>Psolidium bullatum</i>	1	
<i>Psolidium djakonovi</i>	2	
<i>Psolus chitonoides</i>	3	Holotype
<i>Psolus chitonoides ochotensis</i>	6	Syntype
<i>Psolus eximius</i>	5	Holotype
<i>Psolus fabricii</i>	30	
<i>Psolus japonicus</i>	6	
<i>Psolus peronii</i>	26	Syntype
<i>Psolus peronii delongi</i>	2	Syntype
<i>Psolus phantapus</i>	137	
<i>Psolus pourtalesi</i>	1	
<i>Psolus regalis</i>	13	
<i>Psolus sadko</i>	8	Syntype
<i>Psolus sp</i>	2	
<i>Psolus sp fabricii?</i>	2	
<i>Psolus sp sadko? juv</i>	4	
<i>Psolus squamatus</i>	3	
<i>Psolus squamatus segregatus</i>	1	
<i>Psolus valvatus</i>	2	
<i>Psychropotes raripes</i>	1	
<i>Rynkatorpa incinata</i>	1	
<i>Scoliodota lindbergi</i>	14	
<i>Scoliodota theelii</i>	1	
<i>Scotoplanes globosa</i>	3	
<i>Scotoplanes murrayi</i>	3	
<i>Scotoplanes papillosa</i>	1	
<i>Semperrella drozdovi</i>	3	Holotype
<i>Sphaerothuria bitentaculata</i>	7	
<i>Stereoderma miniata</i>	1	

<i>Stichopus ananas</i>	1	
<i>Stichopus chloronotus</i>	2	
<i>Stichopus japonicus</i>	83	
<i>Stichopus kefersteinii</i>	1	
<i>Stichopus regalis</i>	2	
<i>Stichopus sitchaensis</i>	3	
<i>Stichopus sp</i>	1	
<i>Stichopus tremulus</i>	3	
<i>Stichopus variegatus</i>	2	
<i>Synallactes chuni</i>	2	
<i>Synallactes nozawai</i>	30	
<i>Synapta autopista</i>	1	
<i>Synapta beselii</i>	4	
<i>Synapta inhaerens</i>	4	
<i>Synapta mocluta</i>	2	
<i>Synaptula hydriformis</i>	1	
<i>Taeniogyrus australianus</i>	1	
<i>Thelenota ananas</i>	2	
<i>Thelenotaanax</i>	3	
<i>Thelenota rubralineata</i>	1	
<i>Thyone briareus</i>	3	
<i>Thyone fucus</i>	3	
<i>Thyone imbricata</i>	1	
<i>Thyone raphanus</i>	1	
<i>Thyone serrifera</i>	1	
<i>Thyone tubulosa</i>	1	
<i>Thyonidium commune</i>	1	
<i>Thyonidium molle</i>	2	
<i>Thyonidium pellucidus</i> <i>var. barthi</i>	6	
<i>Trachythyone elongata</i>	2	
<i>Trochoderma elegans</i>	36	
<i>Trochodota dunedinensis</i>	1	
<i>Trochodota inexpectata</i>	1	Holotype
<i>Trochostoma boreale</i>	10	
<i>Trochostoma orientale</i>	5	Holotype
<i>Trochostoma boreale</i>	10	

Table 2: List of available identified sea cucumbers from collection of Zoological Institute.

Species/subspecies	Number of lots	Type material
<i>Aeropsis fulva</i>	9	
<i>Agassizia scrobiculata</i>	1	
<i>Alloccentrotus fragilis</i>	1	
<i>Amblypneustes leucoglobus</i>	1	
<i>Amblypneustes ovum</i>	1	
<i>Anthocidaris crassispina</i>	2	
<i>Anthocidaris purpurea</i>	21	
<i>Apatopygus recens</i>	2	
<i>Arachnoides placenta</i>	10	
<i>Araesoma owstoni</i>	1	
<i>Arbacia lixula</i>	28	
<i>Arbacia punctulata</i>	2	
<i>Arbacia spatuligera</i>	2	
<i>Asthenosoma heteractis</i>	1	
<i>Asthenosoma ijimai</i>	5	
<i>Astriclypeus manni</i>	7	
<i>Astropyga radiata</i>	1	
<i>Breynia australasiae</i>	2	
<i>Brisaster fragilis</i>	30	
<i>Brisaster latifrons</i>	19	
<i>Brisaster sp</i>	1	
<i>Brisaster townsendi</i>	4	
<i>Brissopsis alta</i>	1	
<i>Brissopsis lyrifera</i>	2	
<i>Brissopsis oldhomi</i>	1	
<i>Brissus brissus</i>	7	
<i>Brissus latecarinatus</i>	4	
<i>Centrostephanus longispinus</i>	1	
<i>Cidaris abyssicola</i>	1	
<i>Cidaris cidaris</i>	1	
<i>Cidaris metularia</i>	4	
<i>Cidaris thuarsii</i>	11	
<i>Clypeaster fervens</i>	1	
<i>Clypeaster humilis</i>	10	
<i>Clypeaster japonicus</i>	9	
<i>Clypeaster reticulatus</i>	1	
<i>Clypeaster rosaceus</i>	9	
<i>Clypeaster speciosus</i>	1	

<i>Clypeaster sp.</i>	2	
<i>Clypeaster subdepressus</i>	1	
<i>Clypeaster virescens</i>	1	
<i>Coelopleurus maculatus</i>	1	
<i>Coenocentrotus gibbosus</i>	3	
<i>Dendraster excentricus</i>	7	
<i>Dermechnus horridus</i>	1	
<i>Diadema antillarum</i>	4	
<i>Diadema savignyi</i>	5	
<i>Diadema setosum</i>	33	
<i>Dorocidaris papillata</i>	5	
<i>Dorocidaris rugosa</i>	2	
<i>Echinarachnius asiaticus</i>	69	
<i>Echinarachnius juv sp</i>	10	
<i>Echinarachnius mirabilis</i>	7	
<i>Echinarachnius parma</i>	295	
<i>Echinocardium australe</i>	7	
<i>Echinocardium cordatum</i>	33	
<i>Echinocardium flavescens</i>	8	
<i>Echinocardium mediterraneum</i>	1	
<i>Echinocyamus pusillus</i>	10	
<i>Echinodiscus auritus</i>	7	
<i>Echinodiscus bisperforatus</i>	4	
<i>Echinolampas ovata</i>	1	
<i>Echinolampas rangii</i>	1	
<i>Echinometra insularis</i>	4	
<i>Echinometra lucunter</i>	16	
<i>Echinometra mathaei</i>	33	
<i>Echinometra mathaei oblonga</i>	1	
<i>Echinometra picta</i>	2	
<i>Echinometra vanbrunti</i>	6	
<i>Echinometra viridis</i>	1	
<i>Echinoneus cyclostomus</i>	4	
<i>Echinosoma tenue</i>	1	
<i>Echinostrephus molaris</i>	1	
<i>Echinothrix calamaris</i>	3	
<i>Echinothrix diadema</i>	4	
<i>Echinus acutus</i>	2	

<i>Echinus acutus flemingi</i>	1	
<i>Echinus acutus mediterranea</i>	1	
<i>Echinus acutus norvegicus</i>	6	
<i>Echinus affinis</i>	1	
<i>Echinus alexandri</i>	2	
<i>Echinus chlorocentrotus</i>	4	
<i>Echinus elegans</i>	2	
<i>Echinus esculentus</i>	10	
<i>Echinus esculentus fuscus</i>	1	
<i>Echinus gilchristi</i>	1	
<i>Echinus melo</i>	1	
<i>Echinus tenuispinus</i>	1	
<i>Echinarachnius asiaticus</i>	69	
<i>Echinarachnius asiaticus juv.</i>	10	
<i>Echinarachnius griseus</i>	62	
<i>Echinarachnius mirabilis</i>	7	
<i>Echinarachnius parma</i>	295	
<i>Echinarachnius sp</i>	3	
<i>Encope californica</i>	1	
<i>Encope emarginata</i>	8	
<i>Encope grandis</i>	2	
<i>Encope michelini</i>	1	
<i>Encope micropora</i>	5	
<i>Erechinus chloroticus</i>	4	
<i>Eucidaris tribuloides</i>	4	
<i>Fibularia acuta</i>	1	
<i>Glyptocidaris crenularis</i>	1	
<i>Goniocidaris biserialis</i>	1	
<i>Goniocidaris mikado</i>	2	
<i>Goniocidaris tubdaria</i>	1	
<i>Goniocidaris umbraculum</i>	1	
<i>Gymnechinus robillardi</i>	1	
<i>Heliocidaris armigera</i>	1	
<i>Heliocidaris erythrogramma</i>	1	
<i>Heliocidaris tuberculata</i>	1	
<i>Hemicentrotus pulcherrimus</i>	19	
<i>Heterocentrotus mammillatus</i>	17	
<i>Heterocentrotus trigonarius</i>	17	

<i>Laganum decagonale</i>	3	
<i>Laganum depressum</i>	8	
<i>Laganum laganum</i>	3	
<i>Lovenia elongata</i>	8	
<i>Lovenia subcarinata</i>	2	
<i>Loxechinus albus</i>	4	
<i>Lytechinus semituberculatus</i>	4	
<i>Lytechinus variegatus</i>	6	
<i>Lytechinus variegatus atlanticus</i>	1	
<i>Lytechinus variegatus carolinus</i>	2	
<i>Maretia ovata</i>	8	
<i>Mellita quinquiesperforata</i>	3	
<i>Mellita sexesperforata</i>	1	
<i>Meoma grandis</i>	1	
<i>Mespilia globulus</i>	4	
<i>Mespilia sp.</i>	1	
<i>Metalia spatagus</i>	3	
<i>Metalia sternalis</i>	1	
<i>Microcyphus maculatus</i>	1	
<i>Mortensenia oblonga</i>	3	
<i>Notocidarios platyacantha</i>	1	
<i>Nudechinus multicolor</i>	2	
<i>Nudechinus sp.</i>	1	
<i>Paleolampas crassa</i>	1	
<i>Paracentrotus lividus</i>	40	
<i>Parasalenia gratiosa</i>	10	
<i>Parasalenia gratiosa bomnensis</i>	2	
<i>Parechinus angulosus</i>	10	
<i>Peronella lesueurii</i>	15	
<i>Peronella orbicularis</i>	2	
<i>Peronella sp.</i>	2	
<i>Phormosoma placenta</i>	1	
<i>Phormosoma sigsbeii</i>	1	
<i>Phyllacanthus baculosa</i>	7	
<i>Phyllacanthus imperialis</i>	5	
<i>Plococidaris verticillata</i>	1	
<i>Podophora atrata</i>	5	

<i>Podophora pedifera</i>	1	
<i>Pourtalesia heptneri</i>	1	Holotype
<i>Pourtalesia jeffreysi</i>	33	
<i>Pourtalesia jeffreysi gibbosa</i>	4	
<i>Pourtalesia jeffreysi lata</i>	5	Holotype
<i>Pourtalesia laguncula beringiana</i>	1	Holotype
<i>Prionocidaris bispinosa</i>	1	
<i>Psammechinus microtuberculatus</i>	11	
<i>Psammechinus miliaris</i>	29	
<i>Pseudechinus flemingi</i>	1	
<i>Pseudechinus novaezealandiae</i>	1	
<i>Pseudocentrolus depressus</i>	16	
<i>Phyllacanthus baculosa</i>	7	
<i>Rhopalocidaris rosea</i>	1	
<i>Rotula deciesdigitata</i>	3	
<i>Rotula orbiculus</i>	2	
<i>Salmacis dussumieri</i>	4	
<i>Scaphechinus griseus</i>	62	
<i>Schisaster lacunosus</i>	8	
<i>Schizaster canaliferus</i>	7	
<i>Solmacis bicolor</i>	3	
<i>Spatangus multispinus</i>	2	
<i>Spatangus purpureus</i>	12	
<i>Sphaerechinus granularis</i>	22	
<i>Sterechinus magellanicus</i>	1	
<i>Sterechinus neumayeri</i>	1	
<i>Stereocidaris grandis</i>	1	
<i>Stomopneustes variolaris</i>	8	
<i>Strongylocentrotus djakonovi</i>	1	Syntype
<i>Strongylocentrotus droebachiensis</i>	801	
<i>Strongylocentrotus droebachiensis atroviolaceus</i>	130	
<i>Strongylocentrotus droebachiensis humilis</i>	2	
<i>Strongylocentrotus droebachiensis sachalinica</i>	250	Syntype

<i>Strongylocentrotus droebachiensis</i> var <i>ssp</i>	11	
<i>Strongylocentrotus echinoides</i>	88	
<i>Strongylocentrotus franciscanus</i>	7	
<i>Strongylocentrotus golikovi</i>	6	Holotype
<i>Strongylocentrotus intermedius</i>	203	
<i>Strongylocentrotus intermedius longispina</i>	1	
<i>Strongylocentrotus nudus</i>	15	
<i>Strongylocentrotus pallidus</i>	323	
<i>Strongylocentrotus polyanthus</i>	95	
<i>Strongylocentrotus polyanthus apicimagis</i>	6	Syntype
<i>Strongylocentrotus pulchellus</i>	104	
<i>Strongylocentrotus purpuratus</i>	12	
<i>Strongylocentrotus sp</i>	37	
<i>Stylocidaris affinis</i>	2	
<i>Temnopleurus hardwicki</i>	2	
<i>Temnopleurus mortenseni</i>	1	Syntype
<i>Temnopleurus reevesii</i>	26	
<i>Temnopleurus toreumaticus</i>	32	
<i>Temnotrema ruber</i>	1	
<i>Temnotrema sculpta</i>	8	
<i>Tetrypygus niger</i>	7	
<i>Toxopneustes chloracanthus</i>	1	
<i>Toxopneustes elegans</i>	1	
<i>Toxopneustes maculatus</i>	1	
<i>Toxopneustes pileolus</i>	8	
<i>Toxopneustes roseus</i>	1	
<i>Trigonocidaris albida</i>	1	
<i>Tripneustes esculentus</i>	11	
<i>Tripneustes gratilla</i>	17	
<i>Urechinus loveni</i>	2	
<i>Urechinus naresianus</i>	2	
<i>Urechinus sp.</i>	1	

Table 3: List of available identified sea urchins from collection of Zoological Institute.

Climate and distributions of brittle-stars

Collection data have not only scientific and historical aspects. Accumulation of monitoring collections over a broad period made it possible to track changes in marine ecosystems under climatic, hydrologic and anthropogenic influence [18,20,24,28].

In 1995, an attempt was made to determine the impact of climate change on the distribution of ophiuroids. More than 1200 samples from the Barents Sea, collected from 1800 to 1992 by different vessels ("Andrey Pervozvannyi" 1899 - 1915, "Pomor" 1898 and 1992, "Bakan" 1899- 1914, "Naezdnik" 1893 - 1894, "Ermak" 1901, "Persey" 1923 - 1935, "Sedov" 1929-1930, Dal'nie Zelentsy" 1991 and others) were carried out as well in "cold" periods (1898 - 1901, 1905 - 1916, 1951 - 1966), as in "warm" periods (1902 - 1904, 1917 - 1938), according to Yu.I. Galkin [2-4]. For treatments of data computer integrated system "OCEAN" and mapping system "ZOOMAP" were used [24].

We used for analyze of material 9 species of the brittle-stars from 6 genus and 4 families. 6 Arctic species: *Gorgonocephalus arcticus* (Leach, 1819) = [*Gorgonocephalus eucnemis* (Mueller, Troschel, 1842)]; *Ophiopus arcticus* Ljungman, 1866; *Amphiura sundevalli* (Mueller, Troschel, 1842); *Stegophiura nodosa* (Luetken, 1854); *Ophiopleura borealis* (Danielssen, Koren, 1877); *Amphipholis torrelli* (Ljungman, 1871). 2 Boreal species: *Gorgonocephalus lamarcki* (Mueller, Troschel, 1842) and *Amphiura borealis* (Sars, 1871).

Maps of distribution for each species in certain (cooling and warming) periods have been prepared, and it is shown that changes of the distribution (on the given material) for the species *Stegophiura nodosa* are appreciably well explained by the climatological situation [20,24].

Frequently the animals (so-called "species indicators") are more sensitive to hydrologic and climatic changes or processes caused by pollution then super exact hydrologic devices [28].

Global biodiversity information facilities and ZIN

Using available ZIN server infrastructure, a new database system for collection samples has been developed, and a portal on the Global Biodiversity Information Facilities (GBIF) has been created, which allows the subsequent selective publication of ZIN collection data [17,19,21].

Digitization of collections

Three years ago the ZIN has started to work on a concrete fundamental problem, which consists in the development of algorithms for digitization of the collection considering the specific storage of each systematic group [1,8,17,31]. Now web pages with type specimens on brittle stars, sea stars, sea urchins and holothuroids are being prepared (https://www.zin.ru/Collections/index_en.html) (Figure 5). They can be found at the following addresses: https://www.zin.ru/Collections/Asteroidea/index_en.html, https://www.zin.ru/Collections/Echinoidea/index_en.html, https://www.zin.ru/Collections/Holothuroidea/index_en.html.

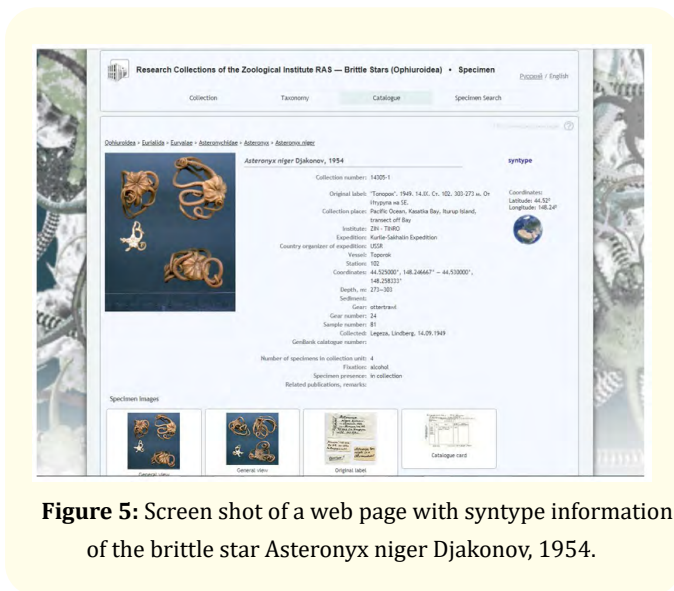


Figure 5: Screen shot of a web page with syntype information of the brittle star *Asteronyx niger* Djakonov, 1954.

Conclusion

The planned integrated intelligence system will allow collecting sufficient information on the biodiversity of echinoderms of the Russian seas, where each component-collections and an information databank about specimens will carry its specific functions, and the system as a whole can adequately serve the needs of biological research and technology, according to modern principles and standards of world zoological collections.

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-54-53028 "Comparative analysis of *Ophiura sarsii* Lütken, 1855 (Echinodermata: Ophiuroidea) populations in the seas of the Arctic and Pacific basins: morphology, genetics, linear growth" and project: "The taxonomic and ecological aspects of the study of diversity of fauna of Russia".

Bibliography

1. Ananjeva NB., et al. "Collections of the Zoological Institute of RAS as information base of fundamental biological investigation". Infrastructure of scientific information resources and systems. Proceedings of the Fifth Symposium". *Dorodnycyn Computing Centre of RAS* (2015): 140-152.
2. Galkin Yu I. "Climate fluctuations and long-term changes in benthos biomass in the Barents Sea" *Biological resources of the Arctic and Antarctic*. M.: Science. (1987): 90-122.
3. Galkin Yu I. "Long-term changes in the bottom fauna in transitional biogeographic areas using the mollusks of the Barents Sea as an example". *Life and the environment of the polar seas*. L., Science. (1989): 157-164.
4. Galkin Yu I. "Long-term changes in the distribution of molluscs in the Barents Sea related to the climate". *Berichte Polarforschung* 287 (1998): 100-143.
5. Golikov AA., et al. "Results of development of information retrieval system on marine invertebrate collection in Zoological Institute (OCEAN)". *Information Retrieval Systems in Biodiversity Research. Proceedings of the Zoological Institute* (1999): 102-103.
6. Lobanov A and Smirnov I. "Principles of arrangement and using of classifiers of animals in the standard ZOOCOD". *Data bases and computer graphics in zoological investigations*, Proceedings of the Zoological Institute, 269, S.-Petersburg (1997): 66-75.
7. Lobanov A., et al. "ZOOINT - an integrated system for zoological data bases". *Proceedings of the International Workshop on Advances in Databases and Information Systems* (1994): 270-271.
8. Pugachev O., et al. "Creation of Information Retrieval System on the Unique Research Collections of the Zoological Institute RAS". In: I. Bychkov and V. Voronin (Eds.): *Information Technologies in the Research of Biodiversity*, Springer Proceedings in Earth and Environmental Sciences. Springer, Cham (SPEES) (2019): 57-65.

9. Skarlato OA., *et al.* "The data bases in zoological systematics and the information concerning higher taxa of animals". *Zoologicheskyy Zhurnal* 73.12. (1994a): 100-116.
10. Skarlato OA., *et al.* "Biodiversity and its analysis on the base computer base data". Biological diversity: The level of taxonomic study. Moscow: Nauka Press. (1994b): 20-41.
11. Smirnov AV. "In memory of Evgeniy Nikolaevich Gruzov" *Biologiya Moria [Russian Journal of Marine Biology]* 37.1 (2011): 75-77.
12. Smirnov AV. "Evgeniy Gruzov – the Pioneer of Antarctic Scuba-Diving Hydrobiological Research" Species diversity on invertebrates and distribution of bottom communities in the Prydz Bay of the Cooperation Sea (Eastern Antarctic) (ed. by B.I.Sirenko, S.Yu.Gagaev, I.S.Smirnov). Chapter 11. Explorations of the fauna of the seas. 76.84, Biological results of the Russian Antarctic Expedition, 10. St. Petersburg (2017): 7-49.
13. Smirnov AV and Smirnov IS. "The history of the collection of echinoderms of the Zoological Institute RAS [talk]" 10th European Conference on Echinoderms. Abstracts. September 16-19th, 2019. Moscow, Borissiak Paleontological Institute RAS (2019a): 92.
14. Smirnov AV and Smirnov IS. "Department of Echinodermata of the Zoological Institute RAS [talk]" 10th European Conference on Echinoderms. Abstracts. September 16-19th, 2019. Moscow, Borissiak (2019b): 93.
15. Smirnov I. "Working out a databank on marine invertebrates" Abstracts of 8th International Echinoderm Conference. Dijon, 6 - 10(1993): 111.
16. Smirnov I., *et al.* "Ophiuroid collection of ZIN as information base of fundamental biological investigation". 9th European Conference on Echinoderms. Ed. Tomasz Borszcz. Abstracts. Sopot, Institute of Oceanology, Polish Academy of Sciences (2016): 66.
17. Smirnov I., *et al.* "Echinoderm collection of the Zoological Institute of RAS as information base of fundamental biological investigation [poster]". 16th International Echinoderm Conference. Program and Abstracts. Nagoya, Nagoya University (2018): 202.
18. Smirnov IS., *et al.* "Influence of climatic changes on distribution of brittle stars (ECHINODERMATA, OPHIUROIDEA) of the Barents Sea". A modern condition plankton and benthos, problems of preservation of a biodiversity of the arctic seas. Abstracts of international conference in Murmansk on April 27-30. Murmansk. (1998): 97-98.
19. Smirnov I., *et al.* "Ophiuroidea collections of the Zoological Institute Russian Academy of Sciences. Version 1.45. Zoological Institute, Russian Academy of Sciences, St. Petersburg. Occurrence dataset" (2019).
20. Smirnov IS., *et al.* "Study of long-term changes of ophiurid fauna (Echinodermata, Ophiuroidea) in the Barents Sea with application of statistical methods". Proceedings of the First International BASIS Research Conference. St. Petersburg, Russia February 22-25, 1998. University of Munster, Germany, (1999): 410-411.
21. Smirnov I and Khalikov R. "Catalogue of the type specimens of sea stars (Asteroidea, Echinodermata) from research collections of the Zoological Institute, Russian Academy of Sciences. Zoological Institute, Russian Academy of Sciences, St. Petersburg. Checklist dataset" (2018).
22. Smirnov I., *et al.* "Information system for Antarctic marine animals". Abstracts of SCAR sixth biology symposium: Antarctic Communities: Species, Structure and Survival. Venice, (1994): 247.
23. Smirnov IS and Lobanov AL. "Antarctic brittle-stars: collections and data bases". The bulletin of the Moscow Society of Naturalists, section of geology, 77.1. (2002): 80-81.
24. Smirnov IS., *et al.* "Long-term changes of ophiuroid's fauna (Echinodermata, Ophiuroidea) of the Barents Sea during the period 1800-1992". 5th Zonenshine conference on plate tectonics, Moscow, Program and Abstracts, (1995): 52.
25. Smirnov IS., *et al.* "Internet-identification keys and web-sites on echinoderms". Russian Conference on echinoderms. February 10 RAS, Moscow, The bulletin of the Moscow Society of Naturalists, section of geology 86.5. (2011): 97.
26. Smirnov IS., *et al.* "Development of an Information Retrieval System on Antarctic benthos ecology (ECOANT) on the basis of a digital collection of invertebrates" «Antarctica and Earth Global Systems: new challenges and outlooks», International Antarctic Conference, Abstracts, Kyiv, Ukraine 17-19 (2011): 244-247.
27. Smirnov IS., *et al.* "Creation of the information retrieval system for collections of the marine animals (fish and invertebrates) at the Zoological Institute of the Russian Academy of Sciences". In: Vanden Berghe, E., W. Appeltans, M.J. Costello, P. Pissierssens (Eds). Proceedings of "Ocean Biodiversity Informatics": an international conference on marine biodiversity data management Hamburg, Germany, Paris, UNESCO/IOC, VLIZ, BSH. (2007): 177-186.

28. Smirnov IS., *et al.* "History of biological oceanology, data bases and global ecology". In History of the national oceanography. Abstracts for the II International Conference, 20.24 (1999): 143-144.
29. Smirnov I and Smirnov A. "OCEAN" - a data bank of marine invertebrate collections of the Zoological Institute, St. Petersburg". Data bases and computer graphics in zoological investigations, Proceedings of the Zoological Institute, 269, S.-Petersburg. (1997): 133-135.
30. Smirnov IS., *et al.* "Alexander Mikhailovich Djakonov (1886-1956) - zoologist, entomologist and founder of the Echinoderm Department of the Zoological Institute of RAS". Accounting of scientific session on results of works 2015". *Zoological Institute* (2016): 30-33.
31. Smirnov IS., *et al.* "Providing of access to natural heritage collections of marine invertebrates of Polar Regions using information technology". Materials of the Sixth International Scientific and Practical Conference "POLAR READINGS ON THE ICEBREAKER KRASSIN – 2018": Technologies and Equipment in Arctic Exploration, Saint-Petersburg, April 27-28, 2018. Moscow: Paulsen. (2019): 353-360.

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