ANNOTATED REFERENCES TO TECHNIQUES CAPABLE OF ASSESSING THE ROLES OF CEPHALOPODS IN THE EASTERN TROPICAL PACIFIC OCEAN, WITH EMPHASIS ON PELAGIC SQUIDS

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INTRODUCTION

This annotated bibliography presents a list of publications relevant to pelagic cephalopod assessment, especially the assessment of epipelagic squids, in the eastern tropical Pacific Ocean, (ETP). Pelagic cephalopods are important both to commercial fisheries (Voss 1973) and in their influences within oceanic ecosystems. In particular, epipelagic squids are found in stomachs of seabirds, fishes and marine mammals; and, squid are active predators of fishes, crustaceans and other marine organisms.

Two criteria were used for selection of articles. Articles concerning cephalopods were of primary interest. And because many of these animals have a cosmopolitan distribution, articles have been selected from worldwide sources. The second criterion was presentation of assessment techniques applicable to ETP cephalopods. Selection was not confined to methods which have been used solely within the ETP.

I have reviewed each article as thoroughly as time has permitted, and have compiled a summary of the article and a list of key words for each reference. I considered a wide variety of subjects to be relevant to the topic of assessment. Some pertinent subjects were capture gear and techniques, stock differentiation, trophic dynamics, identification of species, population modelling, growth and reproduction, distribution, and other censusing methods.

The references were entered into a microcomputer disk storage, using a format for a database program Superfile (FYI 1982). This program is able to access publications and summarized information by using key words. In the future, as new papers are identified, this database will be updated.

There are about 500 key words which reference approximately 200 entries. Key words were selected to index publications by author, taxon and information type (such as gear type, ocean, etc.). Taxa used were family, genus and species. Species names use only the first initial of the genus. More complete species names are found in the index.

As an aid, in locating articles by subject, each publication was placed into one of seven general categories, which are as follows:

1) Keys to identification
2) Summaries and surveys
3) Squid as prey for marine organisms
4) Commercial fisheries
5) Gear
6) Biology
7) Assessment techniques and population modelling

Accompanying each citation in the annotated bibliography is the number, between one and seven, which refers to one of the above general categories. These number codes follow a "*" at the beginning of the key words section of every citation.

Annotations summarize information relevant to cephalopod assessment in the ETP. As a result, sometimes the annotations are not summaries of the entire publication. In addition, key words may not represent all information mentioned by a publication. However, this annotated bibliography should allow workers in fields which deal with cephalopods to easily identify the relevant articles.

LITERATURE CITED


Comparisons of allellic variation, using the enzyme phosphoglucomutase. There was no conclusive evidence of stock discrimination.


Description of two specimens of Allopsis mollis captured off Southern California. A. mollis is found in tropical and subtropical waters, and has a cosmopolitan distribution. This cephalopod was observed actively avoiding capture.


A tuna feeding habits study from fish supplied by canneries and caught by both bait boats and purse-seiners. Yellowfin prey were by volume: fish (47%), crustaceans (45%) and cephalopods (8%), by occurrence: crustaceans (76%), fish (54%) and cephalopods (33%). Skipjack food items were by volume: crustaceans (59%), fish (37%) and cephalopods (3%), by occurrence: crustaceans (76%), fish (36%) and cephalopods (13%). Onychoteuthids, ommastrephids and unidentified squid were the main squid food of yellowfin. However, skipjack fed primarily on enoploteuthids and cranchids.


An experiment utilizing incandescent lights and mercury vapor lamps to capture longfinned squid, Loligo pealei. Squid congregated in the periphery of illumination but catches by jigging were poor except on one occasion. Netting of squid proved unsuccessful due to the erratic behavior of the squid.

Suggests methods for setting sounder controls, (time varied gain, swept time constant, and pulse duration). Squid aggregations appeared as plumes or stripes, depending on settings and vessel movement.

*7 AMOS D / DEMELLO R / SONAR / TRAWL


A description of squid jigging operations. Lighting, jigging speed, line size, parachute anchoring, vessel construction and other areas discussed.

*5 PACIFIC / FISHING / N SLOAN GOULD / S AUSTRALIS / JIGGING / LIGHTS / TRAWL / Gillnet


Summary of workshop on cephalopod biology and resources, dealing, primarily with Australian applications. Topics included were taxonomy, ecology, biology, fisheries biology and assessment. Report states gill net fishing is three times more efficient than jigging.

*6 PACIFIC / JIGGING / Gillnet / ASSESSMENT / SEPIIDAE / LOLLIGONIDAE / OMMASTREPHIDAE. OCTOPODIDAE.


A summary of six talks on squid fisheries and resources in the Pacific Ocean. Fisheries mentioned were off California, Hawaii, Peru and Japan. Seabird stomach samples, gonad evaluations, jigging, trawling, and gillnetting provided assessment information on Hawaiian squids.


A short description of drift gillnet fishing for Ommastrephes bartramii by Japanese vessels. History, operation and regulation of the fishery are discussed.

*4 PACIFIC / FISHING / GILLNET / JIGGING / DISTRIBUTION / SEASONAL / BARTRAM II


Japanese newspaper account of interactions within the squid drift gillnetting fleet. Gillnetters wanted to move west of a 170°E regulatory limit and into the fishery exploited by squid jiggng vessels. Korean and Taiwanese gillnetters sometimes set nets contrary to the east-west Japanese deployment. Also, non-Japanese vessels were not restricted by the 170°E demarcation.

*4 GILLNET / JIGGING / PACIFIC / FISHING


A summary of squid fisheries and biology with numerous references to pertinent literature. Subjects discussed are systematics, biology, distribution, fisheries, fishing techniques, marketing, management and resource potential.

*2 ARNOLD G P / WORLDWIDE / TRAWL / JIGGING / LIGHTS / PUMP / LAMPARA FISHING / ASSESSMENT / DISTRIBUTION / SEASONAL / GROWTH / VERTICAL / SQUID DIET / FEEDING HABITS / MARINE MAMMALS / PACIFIC / ATLANTIC / EAST PACIFIC / ETP / MEDITERRANEAN / SEABIRDS / FISH


A proposal to show variations in surface fauna by capture and analysis of regurgitations of sea birds. The diet of four species of sea birds consisted mainly of flying fish, juvenile scombrids and ommastrephid squids. Comparisons showed that sea birds sample some food groups more efficiently than do trawls or yellowfin tuna.

*3 ASHMOLE N P / ASHMOLE M J / SEASONAL / SEABIRDS / PACIFIC / ASSESSMENT / OMMASTREPHIDAE / ENOPLOTEUTHIDAE / FISH / FEEDING HABITS / TRAWL


A description of feeding habits of five tern species found on Christmas Island. Differences in prey composition are related to feeding patterns
and anatomical structure of tern species.


Report of 1963-1964 food habits survey of 8 seabird species using 800 samples collected on Christmas Island. Frequency of occurrence of fish varied 45%-97% and of squid 34%-97%. Nearly all squid were ommastrephids, Symplectoteuthis spp. Comparisons were made with stomach contents observations of 191 surface caught yellowfin (from Reintjes and King 1953).


A review of the history of the fishery, population assessment, biology, and research dealing with the Atlantic Ocean ommastrephid squid, Illex illecebrosus. Includes 23 papers.


Extensions of a simple predator-prey model to multispecies approaches: krill-squid-sperm whales, krill-penguins-baleen whales. In the multispecies approach, both krill and sperm whales cannot sustain harvest based on individual maximum sustainable yields.


Article which suggests that Antarctic krill surplus, available after whale stock depletion, has contributed to increases of populations of remaining baleen whales, seals, penguins, sea birds, fishes and squid. Contrasting with smoother patterns of change in whale populations, fishes and squids of the Gulf of Thailand show substantial fluctuations, because fish have high mortality rates and few age classes.

Report of abundances of cephalopod beaks from collections made in the Indian and Pacific Oceans (1954-1961). Because squid beaks are not preserved for very long, rostra represent recent species. Densities (which were up to several thousand beaks per square meter) allow comparative quantification of squid resources. Results show untapped squid resources in coastal areas of the Indian Ocean.


A history and review of fishing with light, with a worldwide coverage. Lighting and fishing gear are described for squid fishing, as well as for other species such as herring, anchovy, mackerel, saury, kilka and sardine.


Review of fishing gear, processing, biology and identification. Exploratory fishing during fall 1979 by two Japanese research vessels, in conjunction with the Canadian government, is reported.


Description of squid gillnet operations for catching Ommastrephes bartramii. Investigative catches by two Japanese vessels, that fished across the northeast Pacific, including off Vancouver Island, are presented.


A survey of cephalopods collected from San Diego to Alaska, which presents species descriptions and notes on distributions. The review includes a key to identification of known regional cephalopods, and 25
plates of illustrations.

*BERRY S. S. EASTPACIFIC / L OPalesCENS / S QUALANI ens / OCTOPODA /
IDENTIFI CATI ON


A key to and descriptions of cephalopods found in the Hawaiian Islands region. Includes illustrations and 11 plates.

*BERRY S. S. PACIFIC / IDENTIFI CATI ON / DISTRIBUTION / O BANKSII /
S QUALANI ens / OCTOPODA


Chapter 12, "Feeding", includes methodology for studying stomach contents and summaries of feeding habits investigations from worldwide areas. Stomach contents from Pacific Ocean sources have yielded 25 cephalopod and 37 fish species, the major portion being squids.

*3 BERZIN A. A. / PACIFIC / ETP / EASTPACIFIC / I ndi a / ATLANTIC / ANA RC TICO
MARINE MAMMALS / FEEDING HABITS / M ROBUSTA / G BOREALIS / G BOREALIS / ONYCHOTEUTHIS / OCTOPUS


A report of volumes of fishes, crustaceans, and cephalopods collected in the eastern tropical Pacific (1958-1961) in standard night hauls, in order to assess possible tuna prey. The study assumed that prey assessment could indicate the presence of yellowfin or skipjack tuna in unfished areas. Dominant cephalopods were Abraliopsis morisi and Leachi a eschscholtzi, but cephalopods amounted to only 5% of the micronekton. Comparisons with stomach contents showed that micronekton surveyed was moderately different.

*3 BLACKBURN M / ASSESSMENT / SEASONAL / FEEDING HABITS / FISH /
DI STRI BUTI ON / NET / ETP / P GI ARDI / PTERYGOTEUTHIS / A MURRI SI I /
ABRALIOPS / ABRALI A / ONYCHOTEUTHIS / O BANKSII / LEACHIA /
LESHCHELOTZI / PYRGOPSIS / L REI NARDI / TEUTHO VENI A / C SI CULUS /
CTENOPTERYX / OCTOPODOTEUTHIS / HISTIOTEUTHIS / OMMASTREPHIDAE


Results of the 1967-1968 Eastropac oceanographic cruises, quantified to identify seasonal changes in chlorophyll a, zooplankton, and micronekton. Only night catches were quantified because daytime catches were one tenth the amount. Significant differences were seen in fish-cephalopod micronekton in the eastern cruise portion, based on latitude and
longitude but not on season.


Areal presentation of concentrations of skipjack tuna forage, in ml per 1000 cubic meters, from data collected during EASTROPAC expeditions, 1967-1968. As reported, tuna forage was the lumped biomasses of species such as epipelagic fishes, crustaceans and cephalopods, collected in micronekton nets.


A 1973 survey of species composition and biomass of pelagic nekton, off Baja California. Since catches were principally galatheid crabs, acoustic data was related to biomass of the crabs.


A description of a squid bottom pair trawl. Mesh size and towing speed are discussed. Report suggests that mesh size should not be greater than 9-10 inches, and towing speed might be 3.5-4 knots.


Results of stomach contents examinations of 40 bigeye and 18 yellowfin tuna caught by longlines in the ETP. Bigeye prey items by volume were: cephalopods 63.2% fish 21.6% and crustaceans 15.1%. Dosidicus gigas represented 50% of the volume of bigeye stomach contents. Food of yellowfin by volume were: crustaceans 50.8% fish 36.3% and cephalopods 12.9% Portunid crabs and Auxis sp. were the main constituents of yellowfin diet. --


A summary of results of studies, of a number of investigators, on
Cephalopod feeding, primarily in laboratory culture.

*6 BOLETZKY S V / SQUID DI ET / SEPIIDAE / OCTOPODIDAE / S LESSONIANA / S SEPIODEA / L VULGARI S / L OPALESCENS / L PEALEI / L PLEI / D BLEEKERI / L BREVIS / I ILLECEBROSUS / T PACIFICUS


Basic principles involved in acoustic surveys of fish stocks. Coverage includes elementary acoustics, target strengths, integration of signals, calibration and quantification.

*7 BURCZYNSKI J / SONAR / ASSESSMENT


Six stages of maturity are presented, with conditions of nidamental glands; ovary development, gonad coefficients, oviducts, and maturation coefficients.

*6 BURUKOVSKI R N / ZOUYEV T V / NIGAMATULLIN CH M / TSYMBAL M A / S PTEROPUS / REPRODUCTION

CADDY, J. F. 1981. Some factors relevant to management of cephalopod resources off West Africa. FAO, CECAF/TECH/81/37 (En). 46 pp.,

History leading to development of present cephalopod fisheries off West Africa, and management conclusions and recommendations. Report indicates that cephalopods are highly opportunistic and have expanded into niches once occupied by sparid fishes.

*7 CADDY J F / TRAWL / O VULGARI S / SEPIA / ATLANTIC / FISHING


An investigation, using recurrent group analysis, of commercial anchovy purse-seine catches and midwater trawls to determine species co-occurrences with Loligo opalescens. Anchovy haul's showed strong association between L. opalescens and Engraulis mordax, while Merluccius productus was the only squid associate in both shallow and deep midwater trawls. No species had significant affinity with squid in winter midwater trawls.

*7 CALLIET G M / KARPOV, K A / AMBROSE D A / L OPALESCENS / TRAWL / PURSE SEINE / DI STRI BUTION / SEASONAL / EASTPACIFIC / ASSESSMENT

An attempt to distinguish subpopulations of L. opalescens by enzyme assay. Data could not verify if subpopulations existed.

*6 CHRISTOFFERSON J P / FOSS A / LAMBERT W E / WEDGE B / STOCK / L OPALESCENS / EASTPACIFIC


Calculations of stratified mean catch per tow and population variance, based on autumn bottom trawl surveys off New England. Although finfishes declined during 1963-1974, squid abundance appeared to increase. Total biomass estimates show declines of 47-51% from 1964-1975; and increases from 1975.

*7 CLARKE S H / BROWN S E / I I LLECEBROSUS / L PEALEI / ASSESSMENT / ATLANTIC / TRAWL


Methods for squid (and octopod) identification and weight estimation, using beak characteristics. Family and species beak descriptions, regressions of total body weight on rostral length, keys to families by upper and lower beak characters, and photographs of beaks are presented.

*1 CLARKE M R / IDENTIFICATION / MORPHOMETRICS / OMMASTREPHIDAE / ONYCHOTEUTHIDAE / HISTIOTEUTHIDAE / ARCHITEUTHIDAE / GONATIDAE / ENOPLOTEUTHIDAE / OCTOPODOTEUTHIDAE / THYSANOTEUTHIDAE / CHIROTEUTHIDAE / CRANCHIDAE / LOLIGINIDAE / SEPIIDAE / SEPIOLIDAE / OCTOPODIDAE / ARGONAUTIDAE


Description of photogenic organs, present in young females and males of Pacific S. oualaniensis were not found to possess a similar organ, while those of the Indian Ocean did. Contrary to previous report, D. gigas did not possess the organ, which may indicate stock differentiation.

*6 CLARKE M R / O PTEROPUS / S OUALANI ENSI S / D GIGAS / STOCK


An extensive review of the distribution, depth, and life history of oceanic squid, presented in taxonomic sequence. Predators; sizes as
presented by mantle length, and depth distribution of families are summarized. Because many oceanic squid are fast swimmers, and are able to evade sampling gear, squid ecology is poorly known.


Report of evidence that male sperm whales larger than about 37 feet migrated from the Antarctic before being caught off Durban. Evidence came from examination of stomach contents of female, young male, and large bull whales. The percentage of Antarctic cephalopod beaks from males increased with the size of the whale. Possible explanations are that larger whales migrate further south, or that smaller whales take longer to travel from the Antarctic.


A number of comparisons of cephalopod assessment results. Sampling techniques included were nets (Engel's midwater trawl, Isaacs-Kidd midwater trawl, rectangular midwater trawl, British Columbia midwater trawl, and ring nets), stomachs (whales, porpoises, birds, seals, sharks, and tuna), and surface observations. Curves of cumulative species composition versus family, by region, show differences due to sampling techniques. Clarke concludes that there are more cephalopods than net sample analysis alone suggests.


A study of sperm whale feeding on cephalopods, from stomach samples collected at South Africa, Australia, South Georgia, and the south Atlantic. Presentation of cephalopod occurrence was by size and sex of whales, by cumulative percentages, by region and by season. Report shows regressions of cephalopod wet weights on beak lengths, and presents systematics and ecology of collected cephalopods, with descriptions and illustrations of flesh remains and lower beaks.
Presentation of the use of stomach contents examinations to provide
information directly relevant to food web studies. Lower trophic
dynamics can be provided by study of stomachs of cephalopods caught in
nets or collected from predator stomachs. Beak identification (with body
weight regressions on beak size) can overcome estimation problems due to
partial digestion. From the study of cephalophages, total cephalopod
population may be estimated.

CLARKE, M. R. and J. D. Stevens. 1974. Cephalopods, blue sharks and

Report of stomach contents of 151 blue sharks caught off Cornwall and in
the Bay of Biscay. Oceanic cephalopod remains in sharks caught off
Cornwall could indicate recent migration of the sharks to that area.
Sharks ate many cephalopod species rarely caught in research nets.

CLARKE, M. R., N. MacLeod, and O. Paliza. 1976. Cephalopod remains from the
stomachs of sperm whales caught off Peru and Chile. J. Zool., Lond. 180:
477-493.

Comparisons with data from Nesis (1973a) showed that sperm whales sampled
larger and different squids than did trawls. The presence of Gonatus and
Mesonychoteuthis may have indicated northward migration from the
Antarctic. Lower beaks of six species are described and lower beak
length frequency distributions are presented for all cephalopods sampled.

Squid lower beaks identified and squid weights estimated in stomachs of two bottlenosed whales stranded off Denmark. Although Gonatus fabricii made up 99% and 74% of the lower beaks found in the two whales, total cephalopod composition may indicate whale movements. Vampyroteuthis remains in one whale may show southward migration.


Examination of cephalopod beaks from the stomach of a stranded 34 ft male sperm whale. Regressions of cephalopod weight on lower rostral lengths allowed comparisons of species by weight. Species composition indicated that the whale had migrated from the Antarctic and had fed along the way on South American cephalopods from the continental slope.


A study of cephalopod beaks collected from 20 sperm whales processed at Vancouver Island, B.C. On, the average, seven beaks were identified per stomach. Food items were predominately gonatids and onychoteuthids, but with a small number of histioteuthids and octopoteuthids. A lower beak identification is given for Gonatus fabricii.


A study of regurgitations, from seven adult fur seals, surveyed the cephalopod portion of stomach contents (squid, fish and nematodes). Out of 275 lower squid beaks, 96% were Onychoteuthis banksi. The distribution of lower rostral lengths of O. banksi presented. Squid which made up diet, by weight, were O. banksi (73%), ommastrephids (26%), and other (1%).

A study of cephalopods from regurgitations of both chick and adult albatrosses. Most likely, birds fed at dusk and dawn, as indicated from the cephalopod species and habits.

*3 CLARKE M R / PRINCE P A / SEABIRDS / FEEDING HABITS


Cephalopod sampling, via 66 sperm whale stomach contents from animals caught commercially. Results indicate that cephalopods make up a larger portion of the standing stock of nekton than net sampling would suggest.

*3 CLARKE M R / MACLEOD N / MARINE MAMMALS / FEEDING HABITS / PACIFIC


A first detailed study of the cephalopod diet of Weddell seals indicated that all squids identified, except one, were also part of sperm whale diets. While many squids found in seal stomachs were also prey of albatrosses, the proportions and diversities of squid species varied considerably.

*3 CLARKE M R / MACLEOD N / BIRDS / MARINE MAMMALS / FEEDING HABITS / ANTARCTIC


General summary of multispecies approaches which use models of predator-prey relations, for Gulf of Maine and Georges Bank fishes. Importance was placed on pre-recruit predation and feeding habits studies.

*7 COHEN E / GROSSLEIN M / SISSENWINE M P / SERCHUK F / BOWMAN R / MODEL / FEEDING HABITS / FISH / ATLANTIC


Food habits survey of commercial fishes showed that arrow squid was not an essential prey item. Investigation followed concern that squid fishing might affect other fisheries.

*3 COLEMAN N / HOBDAY D / PACIFIC / FISH / FEEDING HABITS

Presentation of the background and present state of Japan's squid fisheries. After 1969, with declining CPUE, the Todarodes pacificus fishery was regulated, but resource management has been neglected. Other squid fisheries are concentrated in New Zealand and off the east coast of North and South America. Test fishing ventures have been sent to Equador, Mexico, New Zealand, and Australia. Recently, Japan's quota of imported squid has increased; in 1978, 122,000 tons was imported, of which 1,900 tons was Loligo opalescens.


Review of the preparation of statoliths and interpretation of growth rings, from the literature dealing with Illex illecebrosus, Loligo opalescens and Gonatus fabricii. Back calculation based on growth rings have consistently underestimated mantle lengths. Suggestions to avoid such shortcomings, in this method of aging, are presented.


A general overview of the California fishery for Loligo opalescens; contains annotated bibliography with 27 references.


Description of several types of bottom trawls, with dimensions and mesh sizes. Best type was a medium opening bottom trawl (6 to 7 m vertical opening) with long wings.


Contains section entitled "Diet, diving and feeding behavior", in which
diets of "southern'California continental borderland" dolphins are described. Fall and winter collected animals contained 63% fish and 37% squid (99% Loligo opalescens); while spring and summer collections contained 70% fish, 23% cephalopods (85% onychoteuthids and 15% L. opalescens), and 7% crustaceans. Comparison of food availability-as made with commercial fish catches.

*3 EVANS W E / EASTPACIFIC / MARINE MAMMALS / FEEDING HABITS / L. OPALESCENS ONYCHOTEUTHIDAE


Contains papers which include references to predation upon cephalopods (South American Sea Lion, South American Fur Seal, and California Sea Lion).

*3 FAO / MARINE MAMMALS / FEEDING HABITS / ETP / EASTPACIFIC


Report of cephalopod fisheries off northwest Africa. Production models, catch statistics, length frequency analyses, gear selectivity and biology are discussed. Both Fox and Schaefer models suggest that stocks are overexploited. Appendices are in French and Spanish.

*7 FAO / O. VULGARIS / S OFFICINALIS / L. VULGARIS / MODEL / ASSESSMENT / GROWTH / REPRODUCTION / ATLANTIC / STOCK


Monograph on the common, coastal east Pacific lolignid, Loligo opalescens. Descriptions of growth, reproduction, fisheries and predator-prey relations are included.

*6 FIELDS W G / L. OPALESCENS / GROWTH / REPRODUCTION / SEASONAL / DI STRI GUTON / MORPHOMETRICS / SQUID DIET / FISH / MARINE MAMMALS / FEEDING HABITS / EASTPACIFIC / PARASITE


A survey which collected 17 cephalopods, on the 1968 cruise of the RV Te Vega. Collection methods used were Tucker trawl, bongo net, handline- and regurgitations of a Colombian booby.


Distribution of squids based on 3,000 specimens, collected by research and fishing vessels, 1959-1967, from 272 stations worldwide.


Survey of squid from examination of stomach contents of northern fur seals, Dall's porpoise, Pacific white-sided dolphins, saddleback dolphins, killer whales, and sperm whales, from central California to the Bering Sea. Based on frequent occurrences, Loligo opalescens, Onychoteuthis borealijaponicus, Berryteuthis magister, and Gonatus borealis could probably support northern commercial fisheries.


A report of incidental catches of squids in salmon research gillnets, in latitudes 40 N to 60 N, and longitudes 125 W to 180 W gillnet mesh was between 64 and 133 mm stretch measure, and catches were greatest in 64 and 83 mm meshes. O. borealijaponicus was most abundant and could probably support a jig fishery; and, O. bartramii presented a potential for commercial gillnetting.


A description of squid jigging gear and fishing operations on Japanese vessels.


Review of the use of lights for attracting squid during jigging
operations. Paper discusses incandescent, mercury, halogen, fluorescent, and underwater lighting. Differences in squid response to the various light types probably results from species related reactions.

*5 FLORES E E C / LIGHTS / JIGGING / PUMP / PURSE SEINE / FISHING


Study which suggests the absence of color vision in squid. An extension of these results can be applied to squid line fishing; rather than color, contrast of the jig against the surrounding water would be most important.

*6 FLORES E E C / I GARASHI S / MIKAMI T / JIGGING / T PACIFICUS


Study found that O. bartramii of the South Atlantic was infected by one trematode species, three cestodes and two nematodes, which are described. Probable developmental cycles are presented.

*6 GAEVSKAYA A V / PARASITE / O BARTRAMII / ATLANTIC


Paper states that extent and intensity of infection is significantly higher in oceanic Atlantic Ocean ommastrephids than in neritic species, and that tropical squids have higher infection rates than temperate ones.

*6 GAEVSKAYA A V / PARASITE / ATLANTIC / OMMASTREPHIDAE / SQUID DI ET


Paper reports a correspondence of the trophic and parasitic relationships of Ommastrephes bartramii. Most of the helminthofauna of this squid were similar in the North and South Atlantic although the squid stocks have been separate for 15-20,000 years.

*6 GAEVSKAYA A V / NIGAMATULLIN CH M / O BARTRAMII / ATLANTIC / PARASITE / DISTRIBUTION / SQUID DIET / FISH / MARINE MAMMALS / FEEDING HABITS / STOCK

Identifications of cephalopod lower beaks found in two sperm whales. Beaks were separated into 11 types, and then types were compared to beaks obtained from whole squid.

*3 GASKIN D E / CAWTHORN M W / MARINE MAMMALS / FEEDING HABITS / MORQTEUTHI S N SLOANI / H COOKIANA / ARCHITEUTHIS / S BILINEATA / OCTOPODA / PACIFIC / IDENTIFICATION


Investigation, which utilized three different approaches, to determine sources of backscattering from the oceanic backscattering layer. Although the approaches (one theoretical, two sampling) gave similar results, there were some discrepancies between approaches. Backscattering sources were fish, squid, and large zooplankton. Fish and squid were found early in the evenings, while euphausids appeared later at night.

*7 GREENBLATT P / SONAR / ASSESSMENT / EASTPACIFIC / NET.


Upward and downward migrations of fish, squid, and plankton were measured with a horizontally aimed 87.5 kHz sonar. Resolution was between 17 and 400 m. Scattering strengths of upward migrations were stronger than of downward migrations, and may indicate that organisms were more concentrated during upward migrations.

*7 GREENBLATT P / SONAR / EASTPACIFIC / ASSESSMENT


Report of acoustical estimation of the size distribution and abundance of euphausids, using measurements at several frequencies.

*7 GREENLAW C F / SONAR / ASSESSMENT


Description of male squid reproductive system and maturation, using electron microscopy of testicular tissue or spermatophores. Results suggest that males spawn just once, and then die.

"6 GRIEB T M / BEEMAN R D / L OPALESCE S / REPRODUCTION / EASTPACIFIC

Overview of surumeika (Todarodes pacificus) fishing, including a history leading to the development of present jigging methods, and biological information. Also, Japanese overseas squid fishing operations, such as for Dosidicus gigas, are summarized.


Description of squid jigging gear and its operation. Lighting, jig types, vessel layouts, and squid processing are among the topics discussed.


Three types of lighting were used to attract squids: surface incandescent, surface quartz-iodide and underwater mercury vapor. Four species were collected from the underwater habitat which was operated at depths between 13 and 40 m.


A study of the ecology and biology of waved albatross, from colonies on the Galapagos Islands. A food habit survey, using regurgitations, showed that squid was a major diet item. About 80% of squid beaks were histioteuthids and octopoteuthids; however, ommastrephids comprised the major fraction of biomass, from estimates of mean weights based on beak sizes.

Contains a list of cephalopod genera containing luminous species. Presents illustrations of the positions of light organs on 25 cephalopods.

*6 HERING P J / IDENTIFICATION / SYMPLECTOTEUTHIS / OMMASTREPHES / GONATUS OMYCHOTEUTHIS / HEXISTEUTHIS / OCTOPOTEUTHIS / ABRALIOPSIS / CRANCHIA / LOLIGO / BATHYTHEUTHIS / GALITEUTHIS


Presentation of techniques used to identify 15 cephalopod species, from a feeding habits study of 65 broadbill swordfish caught off Florida. Methods can be applied to other predators and other oceanic areas, because there were a number of cosmopolitan cephalopod species.

*3 HESS S C / TOLL R B / IDENTIFICATION / PACIFIC / INDIAN / MEDITERRANEAN / FI SH / FEEDING HABITS / ATLANTIC / O BANKSII / A LESUEUR / T MASSYAE / ARCHITEUTHIS / H DOFLEI NI / C SICULUS / O PTEROPUS / O ANTI LLARUM / T RHOMBUS / C SCABRA / J DI APHANA / ARGONAUTA


Details of seven specimens collected in the Santa Barbara-Channel from 1967-1974. M. robusta is a major prey of sperm whales.

*2 HOCHBERG F G / EAST PACIFIC / SQUID DI ET


Review of cephalopod biology, followed by descriptions of California species.

*2 HOCHBERG F G / FI ELDS W G / EAST PACIFIC / OCTOPODA / PARASITES


Collection of cephalopods from the 1891 Albatross cruise in the ETP, and a smaller collection from the Albatross 1899-1900 across the tropical Pacific. Contains 12 plates, and descriptions of light organs of two squids.

*2 HOYLE W E / ETP / OCTOPODA / L DI MEDEA / S QUALAN ENSI S / B AYSSI COLA / M DENTATA / O CARRI BAEA / A HOYLEI / ABRALI OPSI S / P GIARDI / C REVERSA / C SCABRA / TACNI


Contains a list of cephalopod genera containing luminous species. Presents illustrations of the positions of light organs on 25 cephalopods.

*6 HERING P J / IDENTIFICATION / SYMPLECTOTEUTHIS / OMMASTREPHES / GONATUS OMYCHOTEUTHIS / HEXISTEUTHIS / OCTOPOTEUTHIS / ABRALIOPSIS / CRANCHIA / LOLIGO / BATHYTHEUTHIS / GALITEUTHIS


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Stomach of a large male elephant seal, harpooned by swordfish fishermen, contained sharks, skates, ratfish and squid.

*3 HUEY L M / MARINE MAMMALS / FEEDING HABITS / EASTPACIFIC / L OPAL ESCENS


Behavioral study of schooling of Loligo opalescens in laboratory experiments. Measurements of angular orientation suggested that larger squid create more cohesive schools than do smaller ones. Vision was the primary sensing system involved in schooling.

*6 HURLEY A C / L OPAL ESCENS / DISTRIBUTION / CAMER A


A summary of population estimates, using three models: areal expansion, Leslie-Delury method and cohort analysis. Leslie and cohort analysis yielded similar estimates, while areal expansion gave a much larger estimate.

*7 HURLEY G V / WALDRON D E / I ILEGCEBROSUS / MODEL / ASSESSMENT / ATLANTIC


An examination of "growth" rings in squid statoliths using both scanning electron microscopy and light microscopy. Study found good prediction of mantle lengths from ring counts, but back calculated lengths were much lower than expected values.

*6 HURLEY G V / BECK P / AT LANTIC / GROWTH / AGING / I ILEGCEBROSUS


Report of study which showed that there was no difference in motion between hand crank and automatic machines, when the latter was operated at medium speed with a jerking motion. In Japanese, with English abstract and figure captions.

*5 IGARASHI S / MIKAMI T / JIGGING

A study of albacore prey from 544 fish collected from 1950 to 1957, by longline, trolling and gillnet. Food items were (by method of capture and volume): longline- fish (47%), squid (41%), and crustaceans (7%); gillnet- fish (34%), squid (62%), and crustaceans (2%); trolling- fish (79%), squid (11%), and crustaceans (6%). Amounts of squid in albacore stomachs, collected in equatorial regions, increased with distance from land.


A survey of albacore stomachs from the 1968 and 1969 seasons, in three areas: southern California, central California, and Oregon-Washington. Digestion of squids obscured their impact in diet, but an index of relative importance showed squid second to fish.


A guide to the identification of 20 species of cephalopods, utilizing upper and lower beaks. Size, and front and side views are provided.


The results of a cooperative survey between Japan and Australia, which utilized a vessel equipped with 28 squid jigging machines and 60 lights of 21 kW total output. Catch of squid over a 120 day period was 120,672 kg Nototodarus sloani gouldi, and 3,608 kg Todarodes filippovae. Mantle length body we-sex, maturity, and stomach contents were sampled. Recapitulated tagged squid, and catches showed limited migration during that fishing period.

**Report of cephalopods, collected during rockfish surveys, in 36 (out of 267 total) bottom trawl hauls. Dominant species were Berryteuthis magister (57%) and Octopus spp. (31%).**

*2 JEFFERTS K / PEARCY W S / EASTPAC Fi C / TRAVL / O CALIF ORN A / OCTOPUS R PACI Fi CA / G BERRYI / M ROBUSTA / G MADOKAI / B MAGI STER*


A description of the present state of squid fisheries in South America. Statistics for all fisheries, including squid, are presented, according to country and from 1970 to 1978. On the Pacific coast, the major squid species landed has been Dosicidicus gigas, with a lesser amount of Loligo. Because of exportation, traditional food preferences, and marketing, there is little demand for squid by South Americans.

*4 JUANI CO M / EASTPAC Fi C / ETP / ATLANTIC C / D GI GAS / L GAHI*


Trawl assessment of two lolignid squids showed that only few of one species type were found with the other, although a non-parametric co-occurrence index indicated high spatial overlap. Both species showed high patchiness.

*7 JUANI CO M / L PLEI / L BRASI LI EN S / TRAVL / ASSESSMENT*


Summary of stomach contents of five bigeye and ten yellowfin tuna caught by longline gear. Prey volumes for the entire sample were 58.7% fish, 27.2% squid, and 15.0% portunid crabs.

*3 JUHL R / ETP / FI SH / FEEDING HABITS / D GI GAS*


Background information and possible use of sonar biomass estimation in power plant applications. Includes 430 references to varied literature
including pelagic studies, equipment, signal processing, statistical analyses, and more.

*KANCI RUK P / SONAR


Similar to Karpov and Calliet (1979). See annotation for content.


Investigation of squid feeding habits, in the Monterey Bay area, from squid collected in bottom trawls during the day, and in midwater trawls both at night and day. Squid fed mainly on crustaceans; size of squid made little difference to prey composition, but depth of capture showed different feeding strategies.


Thirteen measurements of body parts and four sexual maturity codes were used to investigate possible geographic subpopulations of squid. Two measurements clearly indicated sexual dimorphism. Data may indicate three geographic groups: Baja California, northern and central California, and Puget Sound.


Regressions of squid mantle lengths on various squid beak measurements. Comparisons of body size-beak dimension relationships, from squids caught at Monterey and Southern California, revealed no significant differences between areas.

Summary of the Loligo opalescens fishery off California. A short description of t-squid's life history is given, followed by a review of the Southern California and Monterey area fisheries. Fishing methods were by brailing under lights, by hydraulic pumps, by purse seining, and by lampara, a roundhaul net. Fishing regulations prohibit the use of lights or purse seines in the Monterey area. Squid in both areas have been located by associated marine mammals and seabirds.


Examples of echo-traces obtained from 14, 28, 50, 75, and 200 kHz sounders on Japanese research vessels in the Sea of Japan. Report concluded that squid could be recorded throughout the day, whether the ship was underway or stopped.


A collection of five squid species, found in the stomachs of eight sperm whales captured off Japan in 1972.


Review reports that cephalopods predominate in sperm whale diets. Cephalopod species are reported by oceanic region, and consist of 36 genera (31 squid genera) and 19 families.


Of 895 whales, 3.6% were observed to vomit food (16.8% of sperms, 1.1% of seis, and 0.785 of fins). Fin and sperm whales were observed to vomit squid.

Review indicates that squids play a minor role in the diet of some balaenopterid whales. References to the literature are categorized by oceanic region.


An examination of stomachs from 439 yellowfin and 166 bigeye tuna, collected by longline from 1950-1953 in the central Pacific. Food of yellowfin were by volume: fish (62%), squid (29%), other mollusks (7%), and crustaceans (1%). Bigeye prey were: fish (62%), squid (33%), other mollusks (3%), and crustaceans (2%). The diet of yellowfin and bigeye tuna was similar, and the study concludes that both species have the same feeding habits.


Species compositions of 274 hauls, utilizing four types of midwater trawls, in order to monitor juvenile tunas and tuna food resources. Comparisons with yellowfin tuna stomach contents showed that trawls did not sample tuna prey (which included ommastrephid and lolignid squids).
Report of fishing of giant squid, Dosidicus gigas, which has become a prospective major fisheries resource in the Gulf of California. Squid landings, for 1980, are presented according to eight areas, and by season. Landings of squid were 552 tons in 1978, 2,510 tons in 1979, and 8,180 tons in 1980.


A study which found no evidence for single spawning. However, no site for future spawning was found either.


Report of distributional data on ommastrephid species, compiled from several Russian research cruises. Worldwide occurrences are reported for both cosmopolitan and endemic species.


Description of Japanese octopus trawling gear (West Africa) and squid (Loligo, Northwest Atlantic) trawling gear, with dimensions and meshizes.


Relation of concentric growth rings in Gonatus fabricii statoliths to growth and time. Methods of preparation and interpretation are presented. Besides daily increments, fortnightly and monthly bands were seen.

Descriptions of 13 larval cephalopods, and keys to their identification.

KUBODERA T / OKUTANI T / EASTPACIFIC / PACIFIC / IDENTIFICATION / TRAWL / ENOPLOTEUTHIDAE / GONATIDAE / OCTOPUS / JAPETELLA


Report of mesh selectivity, in catching Ommastrephes bartrami, using a salmon research gillnet. Mesh sizes varied from 42 to 157 mm. Gillnets were non-selective for squid having 18-50 cm dorsal mantle lengths. Catching efficiency for squid was higher than for salmon. In Japanese with English abstract.

KUBODERA T / YOSHIDA H / O BARTRAMI / GILLNET / ASSESSMENT / PACIFIC


Description of large scale approach to ecosystem simulation. Model used was a top down (upper end of the food pyramid), biomass based one. Equilibrium biomasses in the Bering Sea are presented for present and natural state conditions, for 20 groups or species, including squid.

LEAVASTU T / LARKINS H A / MODEL / ASSESSMENT / EASTPACIFIC / FISH / MARINE MAMMALS / GONATIDAE / FEEDING HABITS / SQUID DIET / GROWTH / MIGRATION / REPRODUCTION


Simulation of the effects of fishing on Atlantic squid, using a modified Ricker yield-per-recruit model for two cohorts. Mesh size of capture gear and monthly values of growth, spawning, fishing, and natural mortality are incorporated into the model. Yield-per-recruit increased with mesh sizes larger than used in the present fishery.

LANGE A M T / ASSESSMENT / MODEL / ATLANTIC / L PEALEI / I ILLECEBROSUS / GROWTH / REPRODUCTION

LANGE, A. M. T., and M. P. Sissenwine. 1980. Biological considerations relevant to the management of squid (Loligo pealei and Illex illecebrosus) of the northwest Atlantic. Marine Fisheries Review 42(7-
frequency analyses and research cruise abundances (stratified mean weights per tow) are reported. A dynamic pool model (Sissenwine and Tibbetts 1977), to simulate fishing effects on abundances, is presented.


Abundance of an estuarine-tolerant squid, Loliguncula brevis, in relation to salinity, temperature, and food availability. Squid abundance was determined using repetitive otter trawls at speeds of 1.5 m/sec.


Five stages of gonad development were described; and gross characteristics were related to oocyte maturity. Specimens for the study were captured using squid jigs and dipnets, and then frozen or preserved chemically until examination. Relationships between dorsal mantle length and gonad length, nidamental gland length, and body weight were presented.


Observations of four Atlantic Ocean ommastrephid squids made while fishing with hand operated jigging machines. Blue light failed to attract squid, while red light reduced feeding activity; catch was best when no color filters were on white halogen lamps. Buildup, depth and concentration was measured by a 30 kHz sounder. Illex illecebrosus and Martialia-hyadesi formed massive and stationary concentrations. while Ommastrephes spp. remained close to the light/shadow interface in weakly defined groups and then congregated at 350-400 m at dawn.

Description of exploratory squid jiggling for Illex illecebrosus, on two Polish research vessels, during August and September 1979, off Cape Cod. Report describes gear and techniques (jigs, line, automatic jiggling machines, lighting, fishing and processing). Average squid catches, per night, were 2850 kg and 2130 kg for the two vessels.


Discussion of the acoustic target strength of fish. Variations of target strength depend on aspect of individual fish. Interference effects and quantification are also discussed.


A guide which features diagnostic characteristics of eight ommastrephid squids. Also included are brief descriptions of some non-ommastrephid squids found in Australian waters.


Comparisons from 50 and 200 kHz soundings taken around the long axis of Loligo and Trachurus japonicus and with the use of polar diagrams. The target strength of squid was less than of fish, while the number of lobes and fluctuations of echo strength were greater for squid.


Presentation of domestic U.S. fisheries for squid and their potential, in the Western Atlantic, Gulf of Mexico, and Eastern Pacific. Much of the U.S. catch has been exported or used for bait due to lack of domestic demand; and, foreign vessels have taken much of the squid caught in U.S. waters. Sources of squid fisheries statistics are given.

Presentation of yield models which incorporate predator-prey interactions: whale-krill, whale-seal-krill, and whale-cephalopod-krill. One outcome of these models is that the MSY for single species approaches is greater than for multispecies.


Scuba diving observations of squid copulation and egg-laying. A higher proportion (63%) of dead and dying adult squid were males. Eggs were reared in the laboratory and required 30-35 days to hatch.


An atlas of Thecosomata, Heteropoda and Cephalopoda, taken by zooplankton tows on six cruises from 25°N to 45°N in the California current region. Distributions are given for nine larval cephalopod species.


Description of A. felis, which was the most abundant squid in a larval cephalopod survey off California. Records of ETP species, A. affinis, are presented.


A food habits survey of 321 Pacific coast albacore, caught during the summers of 1949 and 1950. Food items were, by volume: Pacific saury 50%, squids 12%, Pleuroncodes planipes 11%, euphausids 7%, and northern anchovy 4% by occurrence in stomachs; squids 80% sauries 55%
euphausids 54%, amphipods 43%, P. planipes 27%, and rockfish 22%
Absence of oegopsid squid normally caught near surface was thought to
indicate that albacore may feed at some depth.

*3 McHugh J L / Fish / Feeding Habits / EastPaci fic / Abralia / P. planipes / Pyrgopsis / O. Banksi / Onychoteuthis / Octopoda / Conatus / P. M. Crolamps / Gonatopsis / O. Nielseni / Enoploteuthidae / Branchiidae / Pterygoteuthis / Chiroteleuthidae / Ommastrephidae / Loligo / Octopodoteuthis

McInnis, R. R, and W W Broenkow 1978. Correlations between squid catches

Survey which showed a time lag of 18 months between temperature and squid
catch, which is consistent with life-span estimates.

*7 McInnis R R / Broenkow W W / L Opalescens / EastPaci fic / Di stri bu tion

Mearns, A. J., O. R. Young, R. J. Olson, and H. A. Schafer. 1981. Trophic

Measurements of Cs/K and assignments of trophic levels (based in part on
comparisons of indices of relative importance) showed that Cs/K ratios
increased with trophic level, in two Pacific Ocean ecosystems, one in the
ETP and one in the Southern California Bight. Loligo opalescens ratios
clustered into a primary carnivore group, while Symplectoteuthis
oualaniensis ranked somewhat higher, midway to the next trophic level.

*3 Mearns A J / Young D R / Olson R J / Schafer H A / ETP / EastPaci fic / Oualaniensis / L Opalescens / Squid Diet / Fish / Feeding Habits / Marine Mammals

Mercer, M. C. 1975. Modified Leslie-DeLury population models of the long
finned pilot whale (Globicephala melaena) and annual production of the
short-finned squid (Illex illecebrosus) based upon their interaction at

Population estimations (for years 1947, 1952, and 1955) of long finned
pilot whales in the North Atlantic, derived by methods of Leslie and
DeLury, and assuming the catchability of whales was proportional to the
catch of squid. Based on whale stock sizes, their consumption of squid
is calculated. A conclusion drawn is that the depletion of whales has
released squid to fisheries and other predators.

*7 Mercer M C / Marine Mammals / Feeding Habits / Trawl / Jigging / Assessment / Model / Illecebrosus / Atlantic

Mercer, R. W 1981. Proceedings of the squid workshop, sponsored by the
Resource Assessment and Conservation Division Northwest and Alaska

Presentation of papers by several persons, dealing with squid resources.
Pearcy suggested large midwater trawls for pelagic sampling. Laevastu
treated squid as a general group, part of an ecosystem model in which he estimated 400 million tons based on sperm whale consumption. Other topics covered were trophic relations with fur seals, seabirds, and cetaceans, food consumption and growth of Todarodes pacificus, and larval assessment.


Squid assessment by trawl surveys on the Scotian Shelf, Georges Bank and adjacent areas. Mean lengths, after separating sexes, were used to estimate growth and reproductive cycles.


Based on length frequency distributions, four modal classes were found. Winter and spring migrations corresponded to different developmental patterns. In Japanese with English Abstract and Figure captions.


Report of the distribution and biology of Dosidicus gigas, from collections made by a Soviet research vessel during 1968. Concentrations of giant squid were densest from the equator to 18°S and up to 250 miles...
offshore. This paper presents regressions of mantle length on upper beak
length, diet, fecundities, reproductive structures, mating and growth.
Squids ate mainly myctophids. Sizes at age were: 20-35 cm (one year), and
30-50 cm (two years), while larger squid were three to four years old.

NESI, K. N. 1971. The family Gonatidae—abundant squids of the North
Pacific (their distribution, systematics and phylogeny, pp 63-69. In I.
M Likharev ed. Molluscs; Trends, Methods and Some Results of Their
Investigation. Academy of Sciences USSR. Translated from Russian.
Provided by F. G. Hochberg, Museum of Natural History, Santa Barbara, Cal.

Description of gonatid morphologies, which suggests diphyletic taxonomic
structure.

NESI, K. N. 1972. Oceanic cephalopods of the Peru current: horizontal and

Zoogeography of 41 cephalopod species collected off South and Central
America on two Soviet research cruises during 1967 and 1968. Only three
of 37 oceanic cephalopods were not tropical species. Based on
collections and other published works, the report delineated 13
epipelagic, epimesopelagic and mesopelagic species, and 22
mesobathypelagic, bathypelagic and bathyabyssal species.

NESI, K. N. 1973a. Cephalopods of the eastern equatorial and southeastern

Collection of 41 cephalopod species during two Soviet research cruises.
Of 37 oceanic species, 27 were tropical or tropical-subtropical, two were
cosmopolitan and two were known from the Atlantic. Zoogeography,
vertical distribution, reproduction, fecundity and larval development are
discussed. In Russian with English abstract. (See Nesis (1972) for
English presentation of similar, but reduced, content.)

Systematics and diversity of gonatid squids. Diversity is highest in boreal Pacific waters. Gonatids are found in the tropics only in relatively cold waters off western America.


Investigation of the population structure of S. oualaniensis to test the hypothesis that two forms live in the central Indo-Pacific. Gear used in the 1975 research cruises were lights, jigs, cast nets, Isaacs-Kidd trawls (for larvae), and otter trawls. Report concluded that there exists a large late-maturing form and a smaller early-maturing form (not found in the eastern Pacific). Mantle lengths, sex, maturity, stomach contents and morphology (spinal photophore) were measured. Principal food were myctophids and their own juveniles.


Report of collections of squids from the western tropical Pacific, using Isaacs-Kidd midwater trawls (for meso- and bathypelagic species), and nets, jigs and trawls (for epipelagic squids). Zoogeographical complexes were widely tropical, strictly tropical (equatorial and central), equatorial central and non-tropical. Differences with ETP fauna were attributed to species impoverishment in the eastern Pacific.


Caribbean and Gulf of Mexico, and ETP cephalopod fauna were found to have a high degree of similarity (28 common species). However, ETP nektobenthic and nerito-oceanic fauna were depauperate compared with Atlantic areas. Full lists of fauna were published in Tr. Inst. Okeanol. Akad. Nauk SSSR, 1975, 100:274-280, 285-286.

Title translates: Short Identification Keys to Cephalopods of the World's Oceans. Book is a cephalopod monograph which contains many illustrations useful in identifying squids. In Russian.


Report of the effectiveness of color, material and size of jigs, and diameter and condition of monofilament line on jigging for squid. Red and orange jigs worked best, while green and fluorescent ones were poorest. 1.17 mm diameter line fished less efficiently than 0.84 mm line (in a catch ratio of 1:2), and chafing of lines reduced fishing efficiency to half after four days.


Review of the use of light attraction for fishing, with jigging gear, for Todarodes pacificus. Results showed that squid congregated 20-25 m below the vessel in a dark zone, and attacked jigs in the boundary between light and dark. Comparisons showed mercury vapor lamps to have better performance than incandescent lights. Squid lower limit of light sensitivity was reported to be 0.1 lux.


Survey of 28 species of oegopsid cephalopods, sampled by 5' X 5' micronekton net tows', from Mexico to Chile as far west as 126°W. Numbers of specimens, descriptions, and distribution of species are discussed.


Worldwide geographic survey of cephalopods fished by Japan, as well as promising catchable stocks. Report reviews population assessments of most commonly fished species.

Comprehensive information of cephalopod resources, from worldwide sources. Contains color plates useful for identification purposes and 104 species are illustrated. In Japanese.


Survey of squid larvae collected during CalCOFI cruises of 1954-1957, captured using a one meter diameter net. Techniques used may not have accurately estimated species abundance and diversity. Report gives the systematics, description and distribution of 13 squid species.


Description of larval forms, growth, reproduction, food habits, parasites and commercial fishing of S. oualaniensis.


A survey of Pacific bonito stomach contents, collected during 1968 and 1969 at San Pedro, California. In order of abundance, principal prey were northern anchovy, other fish and Loligo opalescens.


Two methods of estimating food consumption are presented, one which
utilizes an energy budget model and the other which estimates daily food intake based on instantaneous gastric evacuation rates. In 1972, a major food source of ETP yellowfin tuna was frigate tunas (Auxis sp.), and cephalopods ranked second, according to an index of relative importance using volumes, occurrences and numerical abundances. However, in terms of mean prey biomass based on daily food intake, cephalopods ranked fourth, after scombrids, nomeids and gonostomatids.

*3 OLSON R J / ETP / FISH / FEEDING HABITS / PURSE SEINE


Examination of 15 cephalopod species showed infections of digenetic trematodes. Paper reviews literature and includes a list of cephalopods which have been reported to have infections.

*6 OVERSTREET R M / HOCHBERG F G / PARASITE / S OFFICIALIS / A FALCO / A FELLS / L CH ROCTES / P GEMMATA / P GIARDI / J HEATH / D GI GAS / L BREVIS / ROSSI A / O BRI AREUS / O MACRUM


Comparisons of similarities between cephalopods and fish. Description and review of cephalopod biology (habitat, locomotion, feeding, growth, sensory organs, and paleontology).


Report of pelagic cephalopods caught in nighttime trawl surveys, during 1961-1963 off the Oregon coast. Gonatus spp., Abraliopsis sp. and Chiroteuthis sp. were most abundant numerically. Cephalopod avoidance of trawl gear and comparisons of survey results with albacore food habits were discussed.

*7 PEARCY W G / EASTPACI FI C / DI STRI BUTI ON / VERTI CAL / TRAVIL / FI SH / SEASONAL / L OPALESCENS / R PACI FI CA / O BANKSI I / M ROBUSTA / ABRALIOPSIS / O SI CULA / M HOLYEI / G FABRI CI I / G MAGISTER / NET / G ANONYCHUS / G BOREALIS / C VERANI / G ARMATA / ASSESSMENT / C SCABRA / V INFERNALIS / J HEATH / FEEDING HABITS / T PAVO


Application of the regression equations of Love (1977) to predict acoustic target strengths from body lengths of marine organisms. Data
from four crustaceans and one squid fit the regressions closely.

*7 PENROSE J D / KAYE G T / SONAR


Population dynamics of octopus found off northwest Africa, from four cruises 1967-1978, and based on mantle length frequency distributions. In 1976, the contribution of octopus to the commercial catch of cephalopods from the Saharan Bank was 49%. Growth, length-weight relationships and production models are discussed. In Spanish with English summary.

*7 PEREIRO J A / BRAVO DE LAGUNA J / OCTOPUS / GROWTH / ASSESSMENT / MODEL / ATLANTIC / TRAWL / FISHING


Survey of tuna and porpoise stomach contents from animals captured by tuna purse-seine, in six net hauls in the eastern tropical Pacific, during April 1968. Dosidicus gigas and Symplectoteuthis sp. were the most abundant squids found, and squid were most important in terms of co-occurrences between tuna and porpoise, and as food for porpoise. While porpoise fed on both mesopelagic squid and epipelagic squid, tuna did not eat mesopelagic squid.

*3 PERRIN W F / WARNER R R / FISCUS C H / HOLTS D B / ETP / FISH / ONYKIA / D GIGAS / SYMPLECTOTEUTHIS / A AFFINIS / HISTIOTEUTHIDAE / CHIROTEUTHIDAE / HISTIOTEUTHIS / OCTOPODA / PURSE SEINE / FEEDING HABITS


Investigation of the scattering layer off Southern California to determine euphausiid biomass. Accuracy of acoustic estimation was a function of concentration and size or weight of the organisms, and depth of the layer.

*7 PIEPER R E / SONAR / ASSESSMENT / VERTICAL / EASTPACIFIC


A survey of bluefin stomach contents, from fish sampled at San Pedro canneries, 1968-1969. Fish composed over 90 percent of prey items, followed by crustaceans and squid.

*3 PINKAS L / EASTPACIFIC / FISH / FEEDING HABITS / LOPALESCENS / GONATUS / OBoreal / APONI / CUS / OSIULA / ONYCHOTEUTHIS / A FELIS / C SCABRA / D GIGAS / GONATOPSIS / ENOPLEUTHIDAE / LEACHI / A NOURY / OCTOPODA / OBI MACULATUS / O TUBERCULATA / PURSE SEINE

Experimental jigging for Atlantic Ocean Illex illecebrosus, with one automatic and two hand operated jigging machines. Squid catches varied from 40 to 1,200 pounds per hour of 18-25 cm mantle length squid. Even in full moon conditions catches were 1,000+ pounds per hour.


Analyses of carbon isotopes in two Pacific ocean ecosystems, one in the ETP and the other in the Southern California Bight. Results indicate that the ratio of carbon-13 to carbon-12 increases with increasing trophic level. ETP SympLECToteuthis oualaniensis ratios were above zooplankton, and below those of flying fish, frigate tunas and sharks.


Examination of the stomach contents of 1097 yellowfin tuna caught by, trolling, live bait pole-and-line fishing, and longline, in waters near the Line and Phoenix Islands. Food categories, by volume, were fish (47%), squid (26%) and crustaceans (25%). Unidentified squid, crab larvae and carangid fish were the three most important food items of yellowfin, by volume. Comparisons of stomach contents were made by size of predator and distance to land.


Information of seven cetacean species included cephalopods eaten by 54 sperm whales and seven giant bottlenose whales. Squid occurred in 96% of sperm whale stomachs.

Report of a collection of 30 species of decapods, mainly from the eastern tropical Pacific Ocean, near the Galapagos Islands. The majority were juvenile forms.


Delineation of tentacular club areas (dactylus, manus and carpus) for seven, ommastrephid squids.


A dichotomous key using external body characteristics, with illustrations of representative species in 25 families. Includes notes on each family.


Comparisons of captures between several types of trawls. Trawls used were Isaacs-Kidd midwater trawl (IKMT), rectangular midwater trawl (RMT), and Engel trawl (EMT). Because the IKMT and RMT were closing types, some depth comparisons were also made. Indices of similarity (Jaccard's Community Index and Index of Similarity) indicated dissimilarity in net sampling between types.


A dichotomous key using external body characteristics, with illustrations of representative species in 25 families. Includes notes on each family.

A report on the vertical distribution and vertical migration of pelagic cephalopods, presented by records of representative species in each family and summarized in bar graphs. Scope is worldwide with data from California, Bermuda, Hawaii and other collections.


A report of jigging for Dosidicus gigas (d’Orbigny) off California and Mexico. FAO Fisheries Reports (70):61-67.

A report of jigging for D. gigas off the Baja California coast, near Manzanillo and in the Gulf of California, during October-December 1971, off the Japanese research vessel Ryoun-Maru No. 3. Most of the catch were squid over 300 mm mantle length, and estimated life span was one year. Catches were 23280 kg in October, 728 kg in November and 30 kg in December.

Similar to Sato (1975a). Investigation of the resource potential of Dosidicus gigas, conducted from August 1971 to January 1972, off Baja California, in the Gulf of California and off Manzanillo, from the vessel Gyoun Maru.


Composition of prey (fish and squid) of the Blue-faced Booby, the Red-faced Booby and the Great Frigatebird. Results seem to indicate a partitioning of the food resource by prey size and type.


Study of optical ganglion cholinesterases, which showed little differences between South Atlantic and western Pacific Ommastrephes bartrami. Report suggests that the squid populations are not genetically separated.


A study which suggests that competitive interaction with Dosidicus gigas in the eastern Pacific has split the populations of Ommastrephes bartrami of the North and South Pacific Ocean. Using properties of cholinesterase activity, the investigation found evidence of genetic exchange between North and South Atlantic squids, but isolation in the North and South Pacific.

Echo-sounder recordings of Ommastrephes sloani pacificus, using 28, 50 and 200 kHz sounders, from vessels both underway and stationary. In addition, an underwater camera transmitted videos of squid responses to jiggling lures.

SHIBATA K / FLORES E E C / JIGGING / SONAR / CAMERA / O SLOANI PACIFICUS


Measurements and calculations for measuring squid targets using a 50 kHz sounder. Although echotraces from squids could not be clearly identified, the sounder could detect individual squid at a maximum depth of 20-30 meters.

SHIBATA R / MASTHAWEE P / SONAR


Note on the stomach contents of a male Stenella attenuata captured three miles off Oahu. Pelagic squid were the most abundant food (86% by volume), and second were myctophids (6%).

SHOMURA R S / HIDA T S / MARINE MAMMALS / FEEDING HABITS / A ASTROSTICTA / O HAWAIENSI / PACIFIC


Presentation of simulation of fishing Loligo pealei and Illex illecebrosus of the east coast of the US. The simulation model used modified (for growth and spawning) yield equations and a Beverton-Holt stock recruitment relationship.

SISSENWINE M P / TIBBETTS A M / MODEL / L PEALEI / I ILLECEBROSUS / ASSESSMENT / GROWTH / ATLANTIC


Similar to Spratt (1979). See annotation for content.

SPRATT J D / EASTPACIFIC / GROWTH / AGING / L OPALESCENS


Growth rates of Loligo opalescens were determined from statoliths and compared with model length progressions. Both statolith growth rings and
length composition showed that the squid reach adult size in about 14 lunar months, and that slower growing squid can live through part of a second season.

*6 SPRATT J D / L OPALESCENS / EASTPACIFIC / GROWTH / AGING


Assessment of coastal California fish stocks, from observations by commercial fish spotters, using night (bioluminescence) and day (color and light intensity) sightings. Most common species seen were northern anchovy, jack mackerel, Pacific bonito, Pacific mackerel, Pacific Sardine and bluefin tuna. Squid (Loligo opalescens) were among the less common observations, but distributions of sightings are presented.

*7 SQUIRE J L / L OPALESCENS / AIRPLANE / DISTRIBUTION / EASTPACIFIC / ASSESSMENT


Report of surveys for shrimp, squid, and fish normally taken by shrimp trawls. An estimate of the total shrimp fleet catch of the squid Lolliguncula panamensis was 150,000 kg.

*7 SQUIRES H J / MORA O / BARONA O / L PANAMENSIS / TRAWL / ETP


Growth, reproduction, feeding habits, and estimation of stock potential of the squid Lolliguncula panamensis. Report was based on a survey of commercial shrimps and fishes along the Pacific coast of Columbia, mainly from depths of 5 to 30 m.

*7 SQUIRES H J / BARRAGAN J H / L PANAMENSIS / ETP / TRAWL / SQUID DIET / ASSESSMENT / IDENTIFICATION / GROWTH / REPRODUCTION


Prey were epipelagic and mesopelagic fishes and cephalopods, but most likely mesopelagic prey were eaten near the surface, after vertical migration in response to reduced light at dusk.

*3 STROUD R K / FC SUS C H / KAJIMURA H / EASTPACIFIC / MARINE MAMMALS / FEEDING HABITS / L OPALESCENS / ABRALIOPSIS / OCTOPOTEUTHIS / GONATUS / G BOREALIS / O BOREALIS JAPONICUS / CHI ROTEUTHIS / CRANCHIIDAE / O TUBERCULATA

Report on the abundance of Ommastrephes sloani pacificus in the Hokkaido, Japan area. Optimum temperature and prey availability were considered to be the major controls of squid migration and population density. Indices of abundance were based on catch per unit effort; prey availability was correlated with the deep scattering layer; and, temperature was observed as a function of current zones.

*7 SUZUKI T / O SLOANI PACIFICUS / PACIFIC / ASSESSMENT / JIGGING / DISTRIBUTION / SQUID DIET


A brief summary of echosounding techniques used in locating T. pacificus and a technique for estimating school size by monitoring decreasing CPUE. Squid were located more effectively using 200 kHz than with lower frequencies, and were found between the upper and lower deep scattering layers, formed by thermoclines. The relation of CPUE and cumulative catch allowed estimation of squid numbers, which can then be related to echosounding patterns.

*7 SUZUKI T / SONAR / ASSESSMENT / T PACIFICUS / PACIFIC


Echo-traces of pelagic Todarodes pacificus showed that squid images and the deep scattering layer were more clearly recorded using a 200 kHz sounder than with a 75 kHz one. Squid school images appeared spindle shaped, at a ship’s speed of 9 knots, and were generally distributed between the upper and lower scattering layers.

*7 SUZUKI T / TASHIRO M / YAMAGUCHI Y / SONAR / ASSESSMENT / VERTICAL / JIGGING / PACIFICUS PACIFIC


A useful review of squid pens, for identification purposes.

*6 TOLL R B / IDENTIFICATION

A food habits study in which fish was the primary prey item. Squid and crustaceans were also food items. In Chinese with English abstract.

* TUNG I / PACIFIC / S OUALANI ENSI S / SQUI D DI ET / PARASITE *


A report of fishing grounds locations and CPUEs by month and area for years 1977, 1978 and 1979, and as far east as 173°E. Presents stomach contents, regressions of mantle length on body weight; and morphometrics of reproductive organs. In Chinese with English abstract.

* TUNG I / PACIFIC / O BARTRAMI / SQUI D DI ET / MORPHOMETRICS / FISHING *


Target strengths, from eleven individual squid and using a 200 kHz sounder, showed little relation to the size of squid. Values can be used in integrator systems applicable to population assessment.

* VAUGHAN D L / L OPALESCENS / ASSESSMENT / SONAR *


Similar to Vaughan and Recksiek (1979). See annotation for content.

* VAUGHAN D L / RECKSIEK C W / L OPALESCENS / SONAR / ASSESSMENT / EASTPACIFIC *


Echo-traces of squid, recorded by sounders operating at 38, 50 and 200 kHz, were verified by midwater trawls, jiggling and visual observation. Two behavioral patterns were observed, one from continuous bottom associated traces, and the other from more difficult to assess midwater plume traces.

* VAUGHAN D L / RECKSIEK C W / L OPALESCENS / SONAR / ASSESSMENT / EASTPACIFIC *

Notes on the distribution of baleen and sperm whales in the ETP. Baleen whales were found in areas of richer food bases, connected with zones of vergence, and such distribution was atypical of migrating whales. Report says surface observations of squid, and convergence zones cannot always be associated with sperm whale distributions, since these whales feed on deep water prey.


Depth distribution of major taxa, including specific examples. Zones described are the epipelagic, mesopelagic, bathypelagic, benthopelagic and benthic.


Report of the collection of 18 cephalopod species in the Gulf of Panama, of which eight were squids and four were new octopus species. Records of collection sites and methods (lights, trawls, nets, and dipnets) are included.


A survey of worldwide cephalopod resources, fisheries, and potential. Report is compiled by specific countries or areas.


Contains a food habits section with stomach contents of nine coastal and 17 offshore ETP Tursiops. ETP dolphin prey were, by volume, epipelagic fish (86.7%), and cephalopods (13.3%). Report suggests that mesopelagic fish remains in dolphin stomachs occurred secondarily, because stomach
contents of an intact Doscidicus gigas included otoliths from mesopelagic fishes.


Examination of 707 skipjack 'stomach contents, from tuna obtained by live bait fishing', longline, trolling and purse seine, from 1950 to 1956. Food categories, by volume, were fish (74.6%), squid (19.5%), and crustaceans (3.7%).


Review of hydroacoustic estimation and its application to the assessment of squid abundance. Transmission, noise, computerization, and applications are discussed. Commercial trawling techniques are also presented.


Sampling Loligo sp. and Illex illecebrosus, with groundfish and other bottomtrawls, indicated that squid abundance south of Cape Hatteras is small relative to more northern waters. Length frequency and seasonal data are presented.


Methods for identifying eight common squids of the ETP, by the use of upper and lower beak dimensions. Author presents linear regressions of mantle length and body weight on beak dimensions.

Study of beak characteristics of 18 squid species, and application of resulting beak identification guide to stomach content analysis of Stenella attenuata and Thunnus albacares (same collection as Perrin et al.). Reviews papers on tuna and cetacean feeding habits. Cephalopod beak key was based on ANOVA using 31 ratios of upper and lower beak dimensions. Presents linear regressions of squid body weight on mantle length and upper and lower rostral lengths. Grouping of tuna and dolphin stomach contents was based on discriminant analysis and clustering, and theories of feeding strategies are presented.


Use of discriminant analysis and multiple linear regression to separate two Atlantic squids, Ommastrephes pteropus and O. bartrami, on the basis of ratios of upper and lower beak dimensions. Discriminant analysis classified 42 of 46 samples correctly; multiple linear regression used two and three variables. Regressions of weight and mantle length on rostral length were presented.


Dissertation in which morphological characters and clustering, recurrent group analysis and factor analysis were used to distinguish 12 ommastrephid squids. The resulting taxonomic structure placed Symplectoteuthis oualaniensis and Ommastrephes pteropus into the genus Symplectoteuthis, whereas S. luminosa and Hyaloteuthis pelagica were put in the genus Hyaloteuthis. Author includes species descriptions and notes on ecology, distribution and feeding habits.

Publication of the same information presented in author's PhD dissertation (Wormuth 1971). In addition, ommastrephid biogeography is discussed in more depth.


A short history and description of jigging gear used to catch Todarodes pacificus.


A survey of juvenile cephalopods, from depth-discrete tows made to collect Japanese eel larvae, with a 2.5 m diameter net. Horizontal and vertical distributions are presented for 23 larval squid species.


Description of 33 cephalopod species, collected from 28°N to 34°N by an Isaacs-Kidd mid-water trawl. Includes a key to these species, and discusses characters, systematics and distribution. Contains 38 plates of illustrations.

Trawl survey of the squid Leachia pacifica, off Oahu, Hawaii. Larvae to young adults were found in near surface waters; but, mature animals occurred at depths greater than 1000 m. Branchial photophores probably serve as sexual attractants.

*6 YOUNG R E / L PACIFICA / TRAWL / VERTICAL / PACIFIC / REPRODUCTION

YOUNG, R. E. 1975b. A brief review of the biology of the oceanic squid, Symplectoteuthis oualaniensis (Lesson). Comp. Biochem. Physiol. 52B:141-

A short summary of the biology of Symplectoteuthis oualaniensis, which occurs in the tropical Pacific and Indian Oceans. Report states although little is known about this squid's biology and vertical distribution, seabirds feed upon it, and its abundance indicates it may be an untapped ocean resource.

*6 YOUNG R E / S OUALANIENSIS / DISTRIBUTION / SEABIRDS / FISH / INDIAN / FEEDING HABITS / VERTICAL / SQUID DIET / TRAWL / PACIFIC


A study of six midwater squids, to investigate if counterillumination could serve as a concealment behavior at upper depths. Paper presents vertical distributions (from day and night trawls), countershading behavior, and data on bioluminescent organs. Bioluminescent countershading was believed to occur in four of the six species.

*6 YOUNG R E / VERTICAL / PACIFIC / REPRODUCTION / TRAWL / ABRALIOPSIS / P M CROLAMPAS / S MELANCHOLICUS / H HAWAIENSIS / ENOPLOTEUTHIS / H DOFLEINI / T ALESSANDRI NI / TRAWL / PACIFIC


Survey of the vertical distribution of 47 cephalopod species, which revealed habitat separation among related species, and reported day-night migrations in 25 of the 47 species. Reproductive processes were linked to vertical zonation. Size and shape of photosensitive vesicles were associated with detection of downwelling light and regulation of vertical migration and counterillumination.

*2 YOUNG R E / VERTICAL / PACIFIC / REPRODUCTION / TRAWL / ABRALIOPSIS / P M CROLAMPAS / P ADDOLUX / P GIARDI / OCTOPODA / A TRI GONURA / H HAWAIENSIS / E PYGMAEA / A PELAGICUS / V INFERNALIS / V RI CHARDS / J DI APHANA / G PACIFI CA / B LYROMMA / H BEEBEEI / S MELANCHOLICUS / T PAVO / P FI SHERI / L PACIFI CA / L REI NHARDTI / L VALDI VI AE / M NERMI S / G BOMPANI I / M FAMELI CA / P LI PPULA / C PI CETI / CHI ROTEUTHI S / BRACHIOTEUTHI S / O NIELSEN / C SI RVENTI / D LACNI OSA / C SI CULUS / O COMPACTA / H STI OUTEUTHI S / H CELETARI A / H DOFLEINI / ENOPLOTEUTHI S / T ALESSANDRI NI

Investigation of counterillumination in three mesopelagic squids and one myctophid fish. Counterillumination responses occurred under an upper limit of light intensity. Intensity limits were correlated with moonlit night and day illumination, at depth, and with trawl survey data. Counterillumination was thought to be a concealment behavior at upper depth limits.

*6 YOUNG R E / KAMPA E M / MAYNARD S D / MENCHER F M / ROPER C F E / TRAWL / VERTICAL / PACIFIC / ABRALIOPSIS / P GIARDI


Comprehensive work covering squid resources, based on a survey of worldwide literature and the authors' own data. Topics covered include form and structure, growth and reproduction, feeding, distribution, biological review by major genera and species, and fishing methods and production.


Presentation of characteristics of some ommastrephid squids, and some suggestions related to their taxonomic positions. In Russian with English summary.

*2 ZUEV G V / NESIS K N / NIGAMATULLIN CH M / WORLDWIDE / E LUMINOSA / H PELAGICA / O BARTRAMI / S PTEROPUS / S OUALANIENSIS / D GIGAS / ORNITHOTEUTHIS / DISTRIBUTION
References are listed by broad taxonomic groups. Literature may deal with either one of the species listed or a broader taxa (genus, family, or order).

TEUTHOIDEA

Architeuthidae:

Architeuthis

Anonymous 1982a
Beluyev 1962
Clarke 1962, 1980
Gaskin and Cawthorn 1967
Hess and Toll 1981

Architeuthis

Morejohn et al. 1978
Packard 1972
Roper et al. 1969
Sasaki M 1929

Bathyteuthidae:

Bathyteuthis abyssicola, B. baci difera, B. berryi, Benthoteuthis

Fields and Gayley 1972
Herring 1977
Hoyle 1904
King and Iversen 1962
Nesis 1973a
Okutani 1974

Bathyteuthis abyssicola

Robson 1948
Roper et al. 1969
Roper and Young 1975
Voss 1971
Young 1972

Brachioteuthidae:

Brachioteuthis riisei

Iversen 1962
King and Iversen 1962
Nesis 1973a
Okutani 1974
Roper et al. 1969
Young 1978

Chiroteuthidae:

Chiroteuthis calyx, C. imperator, C. picteti, C. veranyi, Doratopsis,

Planktotheuthis lippula, Valbytheuthis danae, V. obligobessa

Clarke 1962, 1980
Clarke et al. 1976
Clarke and Kristensen 1980
Fiscus 1982
Fiscus and Mercer 1982
Harris 1973
Kawakami 1980
King and Iversen 1962
McGowan 1967
McHugh 1952
Nesis 1972, 1973a
Okutani 1974

Okutani and McGowan 1969
Pearcy 1965
Perrin et al. 1973
Robson 1948
Roper et al. 1969
Roper and Young 1975
Sasaki 1929
Stroud et al. 1981
voss 1971
Walker 1981
Young 1972, 1978
Cranchiidae:

Alverson 1963
Anonymous 1982a
Belyayev 1962
Blackburn 1968
Clarke 1962, 1966, 1980
Clarke and Stevens 1974
Clarke et al. 1976
Clarke and Kristensen 1980
Fields and Gauley 1972
Herring 1977
Hess and Toll 1981
Hoyle 1904
Iversen 1962
Iversen 1971
Iverson and Pinkas 1971
Kawakami 1980
King and Ikehara 1956
King and Iversen 1962

McGowan 1967
McHugh 1952
Morejohn et al. 1978
Nesis 1972, 1973a, 1978
Okutani 1974
Okutani and McGowan 1969
Packard 1972
Pearcy 1965
Pinkas 1971
Robson 1948
Roper et al. 1969
Roper and Young 1975
Stroud et al. 1981
Voss 1971
Walker 1981
Wolff 1982a, 1982b
Wolff 1982a, 1982b
Yanamato and Okutani 1975

Ctenopterygidae:
Ctenopteryx siculus

Blackburn 1968
Hess and Toll 1981
King and Iversen 1962
Nesis 1972, 1973a
Okutani 1974
Okutani and McGowan 1969
Packard 1972
Roper et al. 1969
Yanamato and Okutani 1975
Young 1978

Cycloteuthidae:
Cycloteuthis sirventi, Discoteuthis discus, D. lacniosa

Clarke 1980
Kawakami 1980
Nesis 1973a
Roper et al. 1969
Young 1978

Enoploteuthidae:

Alverson 1963
Anonymous 1982a
Ashmole and Ashmole 1968
Ashmole and Ashmole 1967
Enoplotheuthidae (continued):

Blackburn 1968                                      Morejohn et al. 1978
Clarke et al. 1976                                    Okutani 1974
Fields and Gauley 1972                                Okutani and McGowan 1969
Fiscus 1982                                            Overstreet and Hochberg 1975
Hanlon et al. 1979                                    Packard 1972
Harris 1973                                           Pearcy 1965
Herring 1977                                          Perrin et al. 1973
Hess and Toll 1981                                    Pinkas 1971
Hoyle 1904                                            Robson 1948
Iversen 1962                                          Roper et al. 1969
Iversen 1971                                          Roper et al. 1979
Iverson and Pinkas 1971                                Sasaki 1929
Kawakami 1980                                         Shomura and Hida 1965
King and Ikehara 1956                                 Stroud et al. 1981
King and Iversen 1962                                 Voss 1971
Kubodera and Okutani 1981                             Walker 1981
McGowan 1967                                          Wolff 1982a, 1982b
McGowan and Okutani 1968                              Yanamoto and Okutani 1975

Gonatidae:

*Berryteuthis magister, Gonatopsis borealis, Gonatus anonychus, G. antarcticus, G. berryi, G. californiensis, G. fabricii, G. madokai, G. magister, G. onyx, G. pyros*

Anonymous 1982a                                      Kubodera and Okutani 1981
Belyayev 1962                                         Laevastu and Larkins 1981
Bernard 1980                                          Matsumoto 1982
Berzin 1971                                           McGowan 1967
Clarke and Stevens 1974                               McGHugh 1952
Clarke and Kristensen 1980                             Okutani 1977
Clarke and MacLeod 1980                                Okutani and McGowan 1969
Dawe 1981                                              Pearcy 1965
Fiscus 1982                                            Pinkas 1971
Fiscus and Mercer 1982                                Rice 1963
Iversen 1971                                          Roper et al. 1969
Iverson and Pinkas 1971                                Roper and Young 1975
Jefferts and Pearcy 1979                               Sasaki 1929
Kawamura 1980                                         Wolff 1982b
Kristensen 1980                                       Young 1972

Grimalditheuthidae:

Grimalditheuthis bomplandii

Roper et al. 1969                                      Young 1972, 1978
Histioteuthidae:

<table>
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<tr>
<th>Anonymous 1982a</th>
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<td>Belyayev 1962</td>
<td>Nesis 1972, 1973a</td>
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<td>Hess and Toll 1981</td>
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<td>Iverson and Pinkas 1971</td>
<td>Wolff 1982b</td>
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Lepidoteuthidae (Pholidoteuthidae):
Lepidoteuthis, Pholidoteuthis adami, Tetronychoteuthis massyae

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<th>Anonymous 1982a</th>
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<td>Clarke 1980</td>
<td>Matsumoto 1982</td>
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Loliginidae:

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<th>Ally and Keck 1978</th>
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<td>Alverson 1963</td>
<td>Engel 1975</td>
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<td>Amaral and Carr 1980</td>
<td>Evans 1975</td>
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<td>Ashmole and Ashmole 1967</td>
<td>Fields 1965</td>
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<td>Bernard 1980</td>
<td>Filippova 1971</td>
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<td>Berry 1912</td>
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<td>Blott 1980</td>
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<td>Boletzky 1977</td>
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<td>Calliet et al. 1979</td>
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<td>Christofferson et al. 1978</td>
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<td>Clark and Brown 1979</td>
<td>Hochberg and Fields 1980</td>
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<td>Court 1980</td>
<td>Hucy 1930</td>
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<td>Dawe 1981</td>
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Loliginidae (continued):

Iversen 1962
Iversen 1971
Iversen and Pinkas 1971
Juanico 1980, 1982
Karpov and Calliet 1978, 1979
Kashiwada and Recksiek 1978
Kashiwada et al. 1979
Kato and Hardwick 1975
King and Ikehara 1956
Knipe and Beeman 1978
Koyama 1975
Lange 1980
Lange and Sissenwine 1980
Laughlin and Livingston 1982
Matsui et al. 1972
Matsumoto 1982
McGowan 1954, 1967
McHugh 1952
McInnis and Broenkow 1978
Mearns et al. 1981
Mesnil 1977
Morejohn et al. 1978
Nesis 1973a, 1978

Okutani 1977
Okutani and McGowan 1969
Oliphant 1971
Overstreet and Hochberg 1975
Packard 1972
Pearcy 1965
Pinkas 1971
Roper et al. 1969
Sasaki 1929
Sato 1975b
Sissenwine and Tibbetts 1977
Spratt 1978, 1979
Squire 1983
Squires et al. 1971
Squires and Barragan 1979
Stroud et al. 1981
Vaughan 1978
Vaughan and Recksiek 1978, 1979
Vaughan 1984
Waldron and King 1963
Walker 1981
Whitaker 1980
Wolff 1982a, 1982b

Mastigoteuthidae:
Mastigoteuthis dentata, M. famelica, M. inermis, M. pyrodes

Anonymous 1982a
Clarke 1980
Clarke and Trillmich 1980
Hoyte 1904
Iversen 1971
Iversen and Pinkas 1971
King and Iversen 1962

Nesis 1973a
Okutani 1974
Robson 1948
Roper et al. 1969
Roper and Young 1975
Voss 1971
Young 1972, 1978

Neoteuthidae:
Neoteuthis

Okutani 1974
Roper et al. 1969

Young 1972

Octopoteuthidae (Octopodoteuthidae):
Octopoteuthis (Octopodoteuthis) deletron, Taningia danae

Anonymous 1982a
Belyayev 1962
Blackburn 1968
Clarke 1962, 1980
Clarke and Stevens 1974
Clarke et al. 1976

Clarke and Kristensen 1980
Fiscus 1982
Harris 1973
Herring 1977
Kawakami 1980
King and Iversen 1962
Octopoteuthidae (continued):

McGowan 1967
McHugh 1952
Morejohn et al. 1978
Okutani 1974
Okutani and McGowan 1969
Reintjes and King 1953

Roper et al. 1969
Roper and Young 1975
Walker 1981
Yanamoto and Okutani 1975
Young 1972

Ommastrephidae:
Dosidicus (Ommastrephes) gigas, Hyaloteuthis pelagica(us), Illex argentiniius,
I. tileceebrosus, Nototodarus gouldi, N. (Ommastrephes) hawaiensis, N. sloani,
N. sloani gouldi, N. sloani philippinensis, Ommastrephes bartramii, O. caroli,
O. (Symplectoteuthis) pteropus, (O.) sloani pacificus, Ornithoteuthis
antillarum, O. volatilis, Symplectoteuthis (Eucoteuthis) luminosa, S.
oualaniensis, Stenoteuthis, Todarodes angolensis, T. filippovae, T. pacificus,
T. sagittatus, Todaropsis ebleanae

Alverson 1963
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Ashmole and Ashmole 1968
Ashmole and Ashmole 1967
Balch et al. 1978
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Lu and Dunning 1982
Matsumoto 1982
McHugh 1952
Mearns et al. 1981
Mercer 1975
Mesnil 1977
Morejohn et al. 1978
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Murakami et al. 1981
Nesis 1970, 1972
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Ogura 1976
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Okutani 1977
Overstreet and Hochberg 1975
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Psychroteuthis

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Thysanoteuthis rhombus

Alverson 1963
Anonymous 1982a
Clarke 1962
Hess and Toll 1981

Morejohn et al. 1978
Okutani 1977
Roper et al. 1969
Sasaki 1929

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Benthuctopus, Eledone cirrhosa, Eledoneilla pygmaea, Japetella diaphana, J.
heathi, Octopus bimaculatus, O. briareus, O. maorum, U. vulgaris, Ucythoe
tuberculata, Tremoctopus gracilis, Vitreledonella richardi

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Alverson 1963
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Fiscus 1982
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Hoyle 1904
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Walker 1981
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Kawakami 1980
Nesis 1973a
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Clarke and Stevens 1974
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**DI STRI BUTI ON (SEASONAL)**
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Anonymous 1982a
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Bernard 1981
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Blackburn 1968
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Clarke 1966
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Fields and Gauley 1972
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Hamabe et al. 1975
Harris 1973
Hoyle 1904
Juanico 1980
Juhl 1955
King and Iversen 1962
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