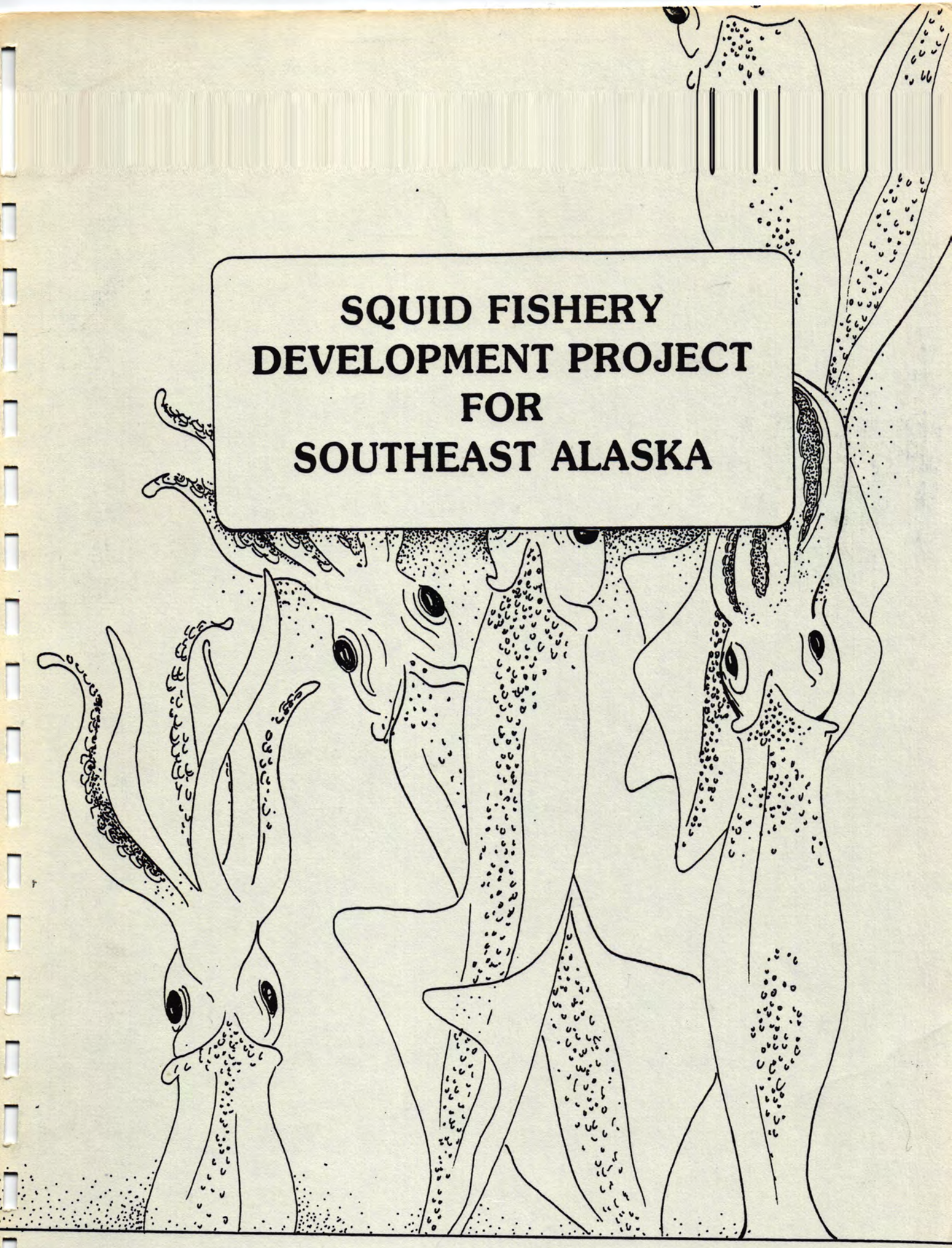

SQUID FISHERY DEVELOPMENT PROJECT FOR SOUTHEAST ALASKA

Alaska Fisheries Development Foundation, Inc.
April 1983

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Report prepared for the Alaska Fisheries Development Foundation, Inc., Anchorage, Alaska.

By: David Street

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ABSTRACT

Before 1980, the occurrence of the market squid Loligo opalescens in Alaska was rumored but undocumented. Now in spring of 1983, several commercial fishing vessels have obtained licenses for catching squid, and a seller's market has materialized in southeast Alaska, just as huge swarms of Loligo appear in nearshore waters off Prince of Wales Island at 55 degrees North latitude. This report documents an exploratory fishing venture undertaken in 1982, which identified apparently significant concentrations of squid and brought commercial recognition to southeast Alaska's squid resource.

In April 1982, the 58-foot purse seiner F/V Odyssey circumnavigated Prince of Wales Island in southeast Alaska, searching the nearshore waters for squid, using side scanning sonar and high wattage attracting lights. The vessel log and charts included in this report illustrate the crew's observations in detail. A number of sightings of both immature and spawning squid are described. The report also includes a list of observations of squid by other vessels in southeast Alaska between March and August of 1982.

The spawning concentrations encountered by the F/V Odyssey were in water too shallow (4 to 6 fathoms) to be fished with a herring seine, but samples were taken by brailing. They were slightly larger than the average size of squid taken in the Monterey Bay fishery. The cumulative evidence presented in this report suggests that Loligo opalescens probably forms spawning concentrations accessible to conventionally rigged fishing vessels by seining or jigging, at various locations in southeast Alaska throughout the spring and summer. However, crucial facts remain to be discovered before even a small scale commercial fishery can exist reliably. For example, the lifespan, reproductive rate, required characteristics of spawning grounds, timing and stimulus for spawning activities, and migratory habits of squid in Alaska are unknown. Though the capital investment necessary for diversifying from the traditional salmon or herring fisheries is not excessive, this scarcity of information represents tremendous risk, especially considering the relatively low value of squid in the marketplace. This report concludes with recommendations for applied research and commercialization efforts that will foster the wise development of the potential Alaska squid fishery.

This fishery development project was conducted by David Street under contract with the Alaska Fisheries Development Foundation. Financial assistance was provided by the National Marine Fisheries Service through NOAA Cooperative Agreement #81-ABH-00114, Amendment 14.

INTRODUCTION AND BACKGROUND

The objectives of the Squid Fishery Development Project in Southeast Alaska were to identify and locate spawning concentrations of squid, collect biological information, attempt a preliminary estimate of resource abundance and estimate the potential for a commercial squid fishery. The project data were generated primarily during a two week investigative cruise during the spring of 1982, and also included observations made during the spring and summer of 1982. The project findings have identified what may be a significant Loligo opalescens population, and the report discusses its feasibility for commercial harvesting.

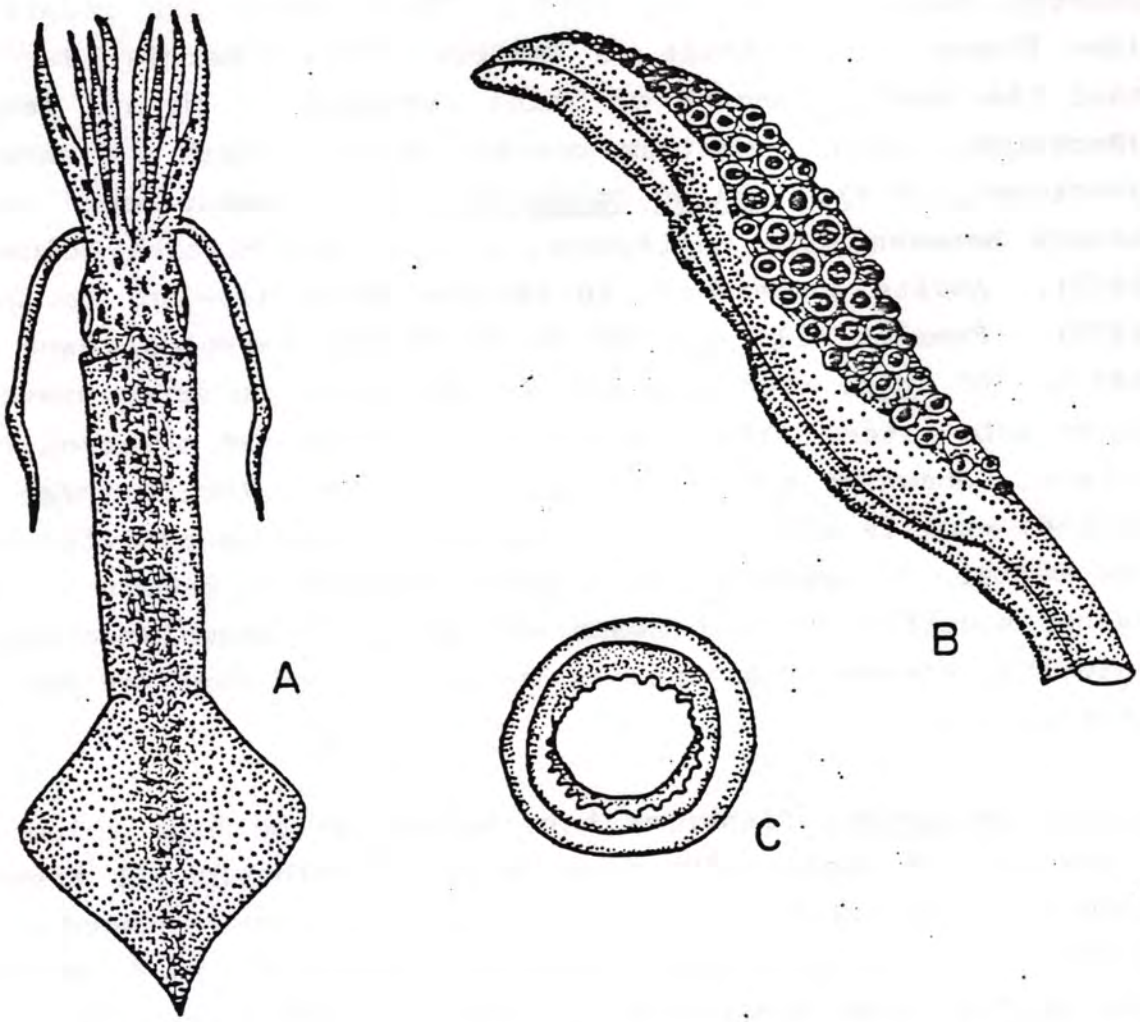
This project was supported by a grant from the Alaska Fisheries Development Foundation. I want to thank Chris Riley and Sharon Gwinn of that organization for their assistance in making this project possible.

In light of the virtual absence of scientific data concerning squid in Alaskan waters, this project's objectives may have seemed ambitious, yet by my experience not unwarranted. Squid have been caught incidentally in the Southeast Alaska salmon and herring net fisheries and have been observed in both the west coast and protected inside waters. When I began my investigations in 1980, I identified the squid samples I took in the fall of that year as Loligo opalescens. At that time the identification was unconfirmed. Squid research done in British Columbia suggests the abundance of a number of squid species, including Loligo opalescens (Bernard, 1980). I suspected the marine environment of Southeast Alaska might prove to be a viable habitat for this species as well. In light of the substantial market that exists for this species (Vesper, 1977) and the many harvest techniques available (Kato, 1975, Taber, 1976), I chose to further investigate the resource potential of Loligo in Southeast Alaska. A study of the California Loligo opalescens biology and fishery provided me with a background to direct my investigations and develop the design and strategy for this project's spring effort in Southeast Alaska.

Biologically, what is known about Loligo opalescens is incomplete. They have been studied at their spawning grounds and little attention has been directed to other phases of their life. It is strongly suspected that like many squid species Loligo opalescens has a short life span, perhaps 18 months, and that it spawns but once and dies shortly thereafter (Kato, 1975). These squid are relatively small (See Figure 1). Studies on Monterey Bay commercial landings found that the mantle lengths of males averaged 15 cm and females 14 cm (Recksiek, 1978). Maximum overall total length is about 30.5 cm (Recksiek, 1978). Loligo opalescens is a common squid in nearshore waters between Baja California, Mexico and British Columbia (Kato, 1975). Adults concentrate in shallow water (15-35m) to spawn (Kato, 1975). Females will extrude 20 to 30 egg capsules, each containing 180 to 300 eggs. Egg capsules are deposited on sand, gravel and even rocky substrates. Often spawning activities are observed in bays and inlets. Spawning activities can occur over a two to three month time period, usually with a definite peak of spawning activity over one to two weeks. It appears that a given population returns to spawn at a rather specific location again and again. A spawning ground can have annual or bi-annual spawns, as in the case of Monterey Bay (Recksiek, 1978).

Loligo opalescens fisheries have proven to be high volume fisheries occurring nearshore in shallow water. Virtually all fishing effort occurs at the spawning grounds when squid are engaged in spawning activities. At this time the squid concentrate in dense schools; at the surface they appear docile, moving slowly, seeming sometimes to just float, easily available for harvest by the many types of fishing gear that are used in commercial squid fisheries (Kato, 1975). Squid are commonly harvested with lampara seines, purse seines and brailers. Fishing activities usually take place during the hours of darkness when the squid typically move from the deep to the shallows of the spawning grounds. The southern California fishery depends primarily on the use of lights to attract squid for harvest (Kato, 1975). Spawning squid have a very positive response to lights; they will concentrate under the focus of the attracting lights. Out of season, non-spawning squid have a positive response as well, yet will stay out

FIGURE #1, from Bernard, 1980.



Loligo opalescens Berry. A) Dorsal view; B) Tentacle club; C) Sucker from inner row on tentacle club.

of the focus of light, concentrating in the shadow areas, and exhibit a wariness and skittishness unlike the spawning squid. In California, vessels target on the productive traditional spawning grounds, such as Monterey Bay or the Channel Island area.

PROJECT DESIGN

The primary objective of the project was to locate squid spawning grounds. The secondary objective, collecting biological information, making rough abundance estimates, gaining insight into fishing techniques and collecting samples, depended on success in achieving the primary objective. Determining when and where such spawning grounds may exist in Southeast Alaska using the data from California and British Columbia is not an easy task. The marine environments of California and Southeast Alaska are fundamentally different and information on squid dynamics in British Columbia is very limited. Offshore squid species had been identified in the Gulf of Alaska (Wilson, 1982) yet the existence of Loligo opalescens north of Vancouver Island was undocumented. Squid species have not been identified in Southeast Alaska and spawning events had been unknown. The observations I had collected previously in Southeast Alaska and the study of the available literature aided me in approximating when and where spawning events may occur and in planning the scope of the project cruise activities.

The project cruise was planned for April 10th to 26th, 1982. Mid-spring provided a good chance of success as summer and fall observations recorded only sub-adults and non-spawning behavior. This timing also facilitated the cooperation of H. C. Phillips; a seafood cold storage/processor in Ketchikan. They would have a lull in activities and would take the time to process squid samples resulting from the project.

Four areas were determined as study areas for the project activities. These areas are identified in Figure 2. In all four areas squid, presumably Loligo opalescens, had been observed previously. Although

no squid spawnings had been observed, these areas offered suitable spawning substrates. These areas also were selected to offer a sampling of some of the diversity of typical near shore marine environments in Southeast Alaska. Essentially the selection of study areas allowed for the circumnavigation of Prince of Wales Island and created an activity schedule that could be accomplished within the fourteen days of the project. Actually much additional area was included in the project (Figure 3) owing to the motivation of the crew of the F/V Odyssey (vessel used for project).

Arrangements were made to prepare and organize equipment and personnel for the project. Equipment and personnel were selected to provide for a thorough consistent search of the study areas and provide flexibility in harvest techniques.

The F/V Odyssey, a 58' vessel rigged as a purse seiner, was chartered for the project. Equipment on-board included a Bay-Mar model BR-105 Mk2 chart recorder and a Wesmar SS165 side scanning sonar which were to be primary searching tools during the project. The vessel also had a 40kw generator, more than enough to power the 6,000 watts of lighting we used for attractive purposes. The 4,000 watts of rigging lights provided general area lighting, while another 2,000 watts of lighting was secured amid ships on the starboard side, six feet outboard and eight feet above the surface of the water. This lighting was focused directly at the water's surface. A 150f by 10f herring purse seine, squid dip net, squid brailer, 17' aluminum skiff with outboard, 3kw portable light plant, 2kw portable attracting lights, 17' steel seine skiff and an assortment of squid jigs were brought on-board the F/V Odyssey. In sum, this equipment provided good underwater searching tools as well as a versatile light attraction system and adaptable fishing operation.

Project personnel included three crew members; Keddy Gould, Ann Chilcott, Jim Bacon, Captain David Jones, and myself as project leader. Chris Riley was on-board as an observer from Alaska Fisheries Development Foundation for approximately half of the project.

FIGURE #2: Location of the four study areas.

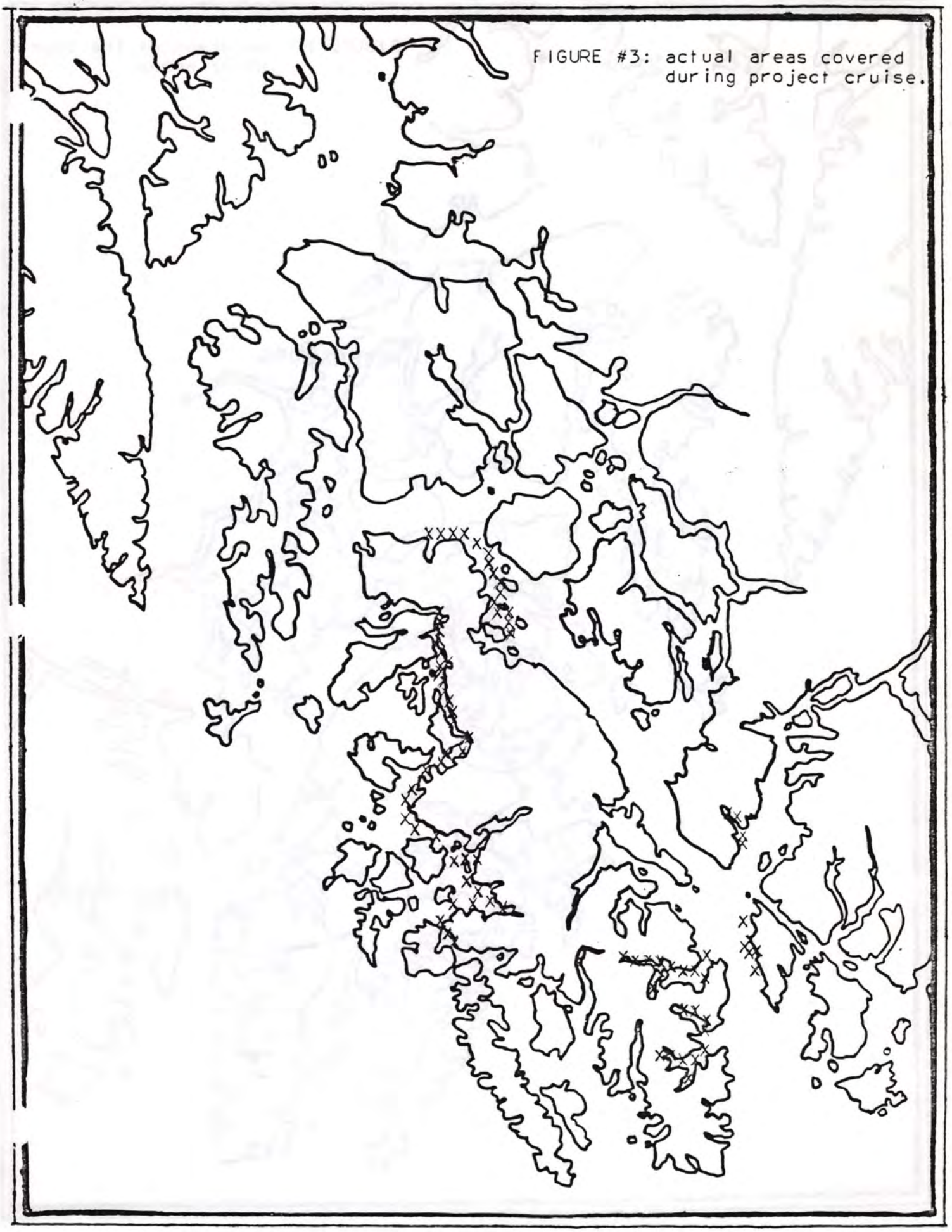


FIGURE #3: actual areas covered during project cruise.

The procedure for searching an area for squid concentrations was established soon after the start of the project cruise. I had planned to utilize searching techniques common in the practice of locating herring, with which I was quite familiar. This, however, was initially ineffectual and did not take advantage of the attracting light system which we came to regard as our most valuable tool for locating squid. This factor was instrumental in establishing our search procedure.

Study locations were identified in each of the study areas. These stations were selected to provide a sampling of the kinds of substrates, depths and local area characteristics that each area offered. All search activities were done during the hours of darkness. At each station the vessel would anchor or drift with the attracting lights on for a minimum of 30 minutes. The sub-surface would be searched with the sonar and chart recording fathometer. Many marine creatures have a positive response to light such as those we were using. Squid have a low hydroacoustic target strength due to lack of an air bladder, and have a different reflected signal than fish targets on the sonar and chart recorder. Initially we monitored all targets that showed a positive response to our lights until they rose to the surface so we could identify them. Although we had a good idea how squid targets would appear on the chart recorder (Figure 4), we did this to get the "feel" of the electronic equipment we were using so as to interpret and identify targets more quickly and reliably.

Once squid were located we would proceed to the accomplishment of our secondary objectives. This included taking samples for identification, processing and determining average lengths and weights, and attempting to set the seine around the school to get a rough estimate of local abundance and gain insight into the utility of our fishing gear.

PROJECT DATA

The data of the project is presented in the following section. The small area charts (Figures 5 through 29) serve to locate each study

FIGURE # 4, from Recksiek and Frey, 1978.

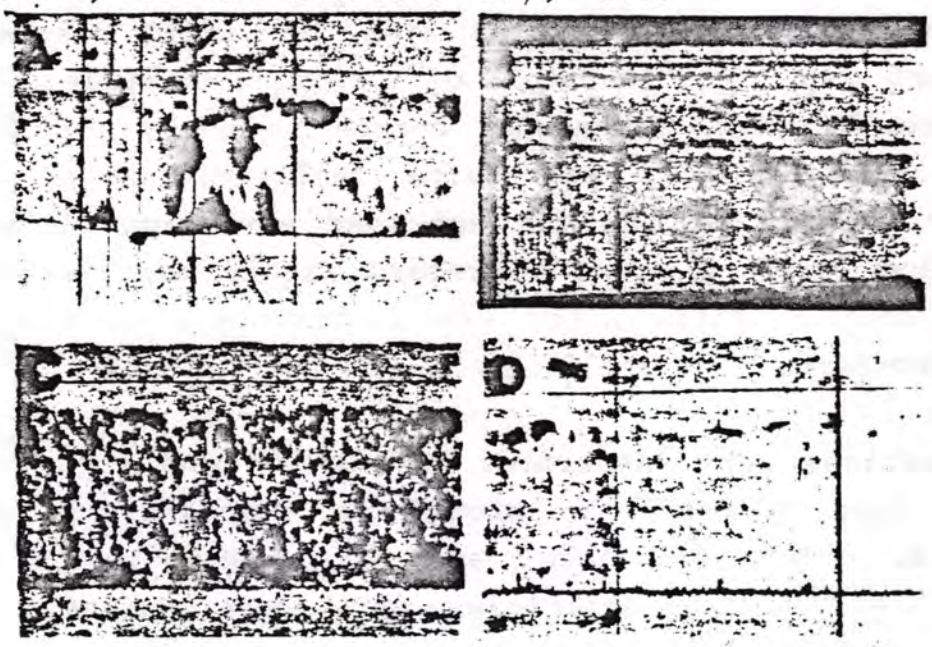


FIGURE 50. Echogram traces representing market squid at night-light station near Santa Rosa Island 8 June 1976 (ALASKA). A. A 200 kHz echogram showing traces throughout the water column. Light on at approximately 0340 (mark 'E'), mark 'F' made at approximately 0344. Plume traces after mark 'F' represent squid rising toward surface. B. A 38 kHz echogram. Continuous traces next to bottom between marks 'E' and 'F' assumed to be squid. C. A 200 kHz echogram taken approximately 0405–0430 showing 'splotch' traces almost saturating water column; a continuous trace along bottom. D. A 200 kHz echogram taken 0449–0510 showing fewer traces with approach of daylight.

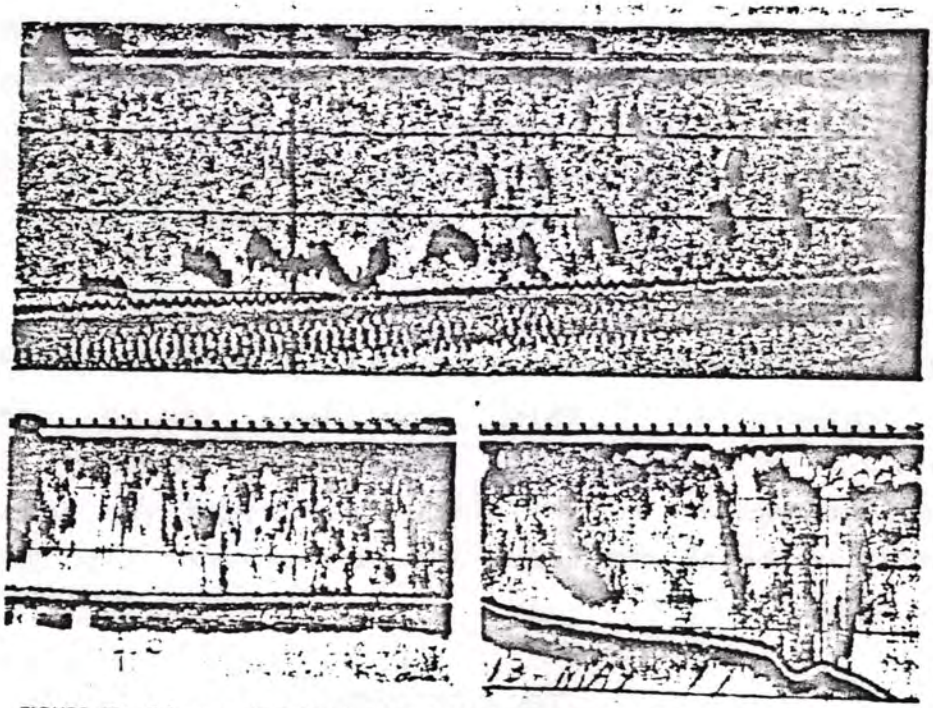


FIGURE 53. Echogram (200 kHz) traces representing market squid in southern bight of Monterey Bay (OCONOSTOTA). A. Traces recorded underway (approximately 2.5 knots) during acoustic search 2254–2260, 12 May 1977. B. Traces recorded from drifting vessel with night-light on 0024–0049, 13 May 1977. C. Traces recorded underway (2.5 knots) 0538–0604, 13 May 1977.

station of the cruise and identify briefly what was found at each station. The log of the cruise included in Appendix A provides a further account of activities and observations. The log is organized by station. Additional observations of squid were collected from 3/82 through 8/82. I made a request of Alaska Department of Fish and Game, local fishermen and fish tendermen to provide basic information (date, location, size and behavior) on any squid they encountered. This resulted in a good number of squid sightings (Figure 30 of the following section), most of which I believe are Loligo opalescens, and perhaps only two sightings of another species.

FINDINGS OF PROJECT

The squid samples were identified as Loligo opalescens. Samples were sent to a workshop sponsored by The Institute of Marine Science, University of Alaska at Fairbanks, where they were identified by Dr. Takashi Okutani from the National Museum in Tokyo, Japan. This is the first documentation of the existence of the species north of Vancouver Island, British Columbia. This was the only species encountered during the project cruise and I believe it was the species seen during the observation period in all but two of the sightings.

Loligo opalescens was encountered in three of the four study areas (Figure 2). Sub-adult squid were encountered in areas 1, 3, and 4; no squid were observed in area 2 (The Snow Pass area) and mature spawning squid were encountered in area 4. The sub-adult squid were commonly observed in very sparse concentrations, except for the large sub-adult (5" to 7" total length) schools observed 8/20/82 near Gravina Island. Adult squid spawning schools (or those exhibiting spawning behavior) were always seen in dense concentrations. The distribution of both adult spawning and sub-adult Loligo opalescens are displayed in Figure 31.

Spawning activities appear to be distributed over a wide time frame. Observations near stations 69 through 72 suggest squid spawning activities as early as January. Overall spawning activities seem to

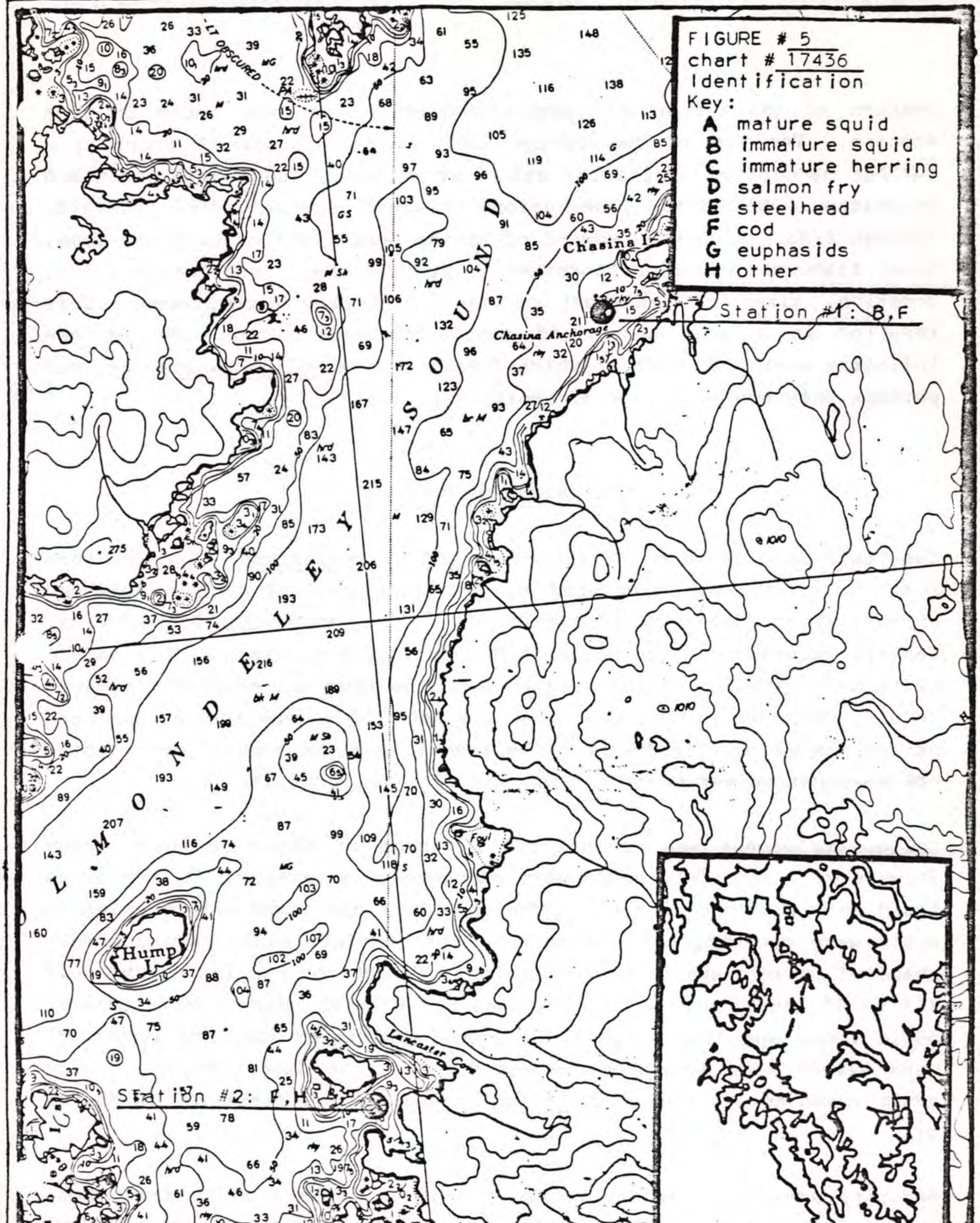
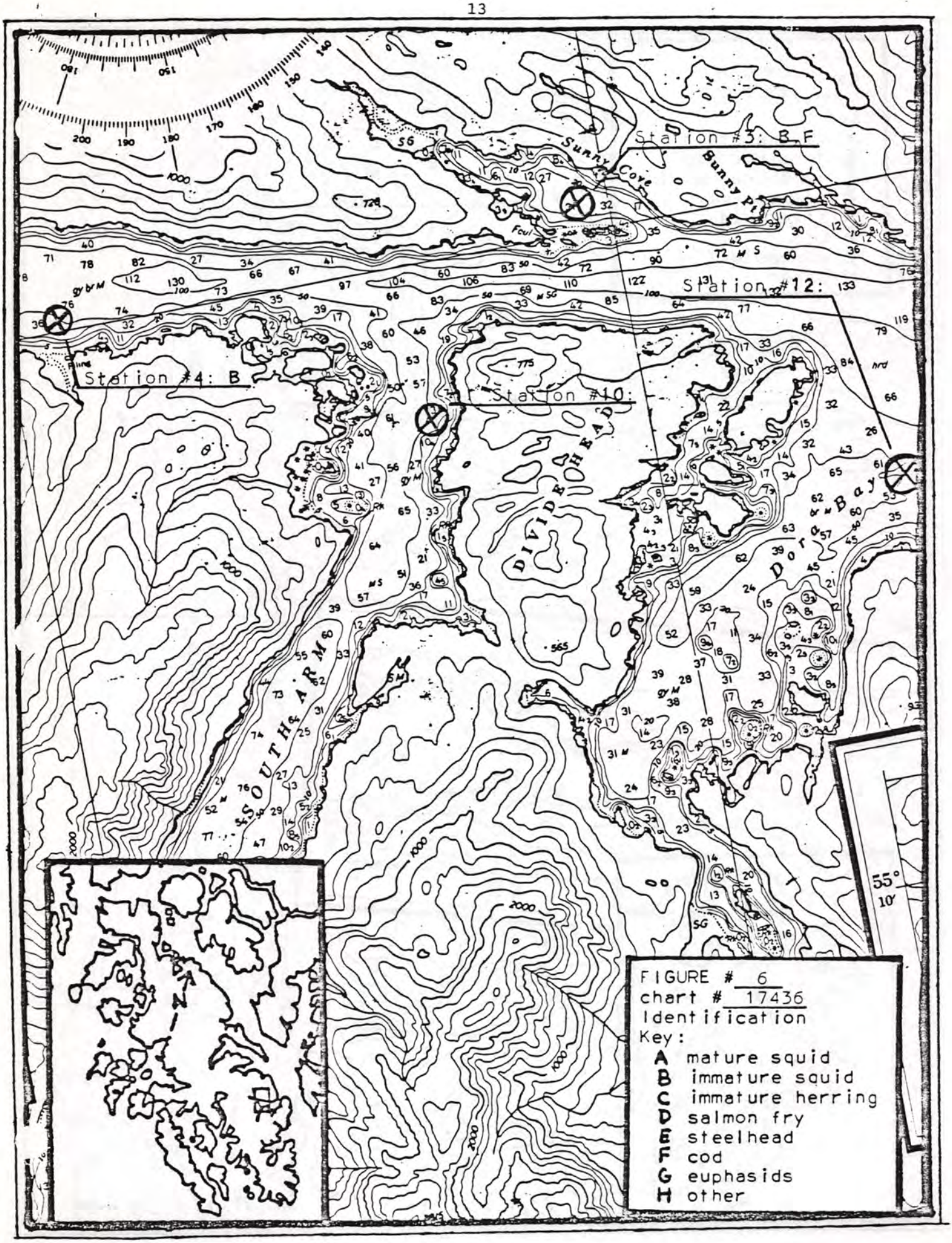


FIGURE # 5
chart # 17436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #1: B,F
Station #2: F,H,B
Chasina I.
Chasina Anchorage
Hump I.
Lancaster Cove
CLEMONDELEY SOUND
LT OBSCURED


Station #3: B,F
Station #12:
Station #4: B
Station #10:
Sunny Cove
Bunny Pt
DIVIDER HEAD
Dor
Bay
SOUTH ARM
55°
10'
FIGURE # 6
chart # 17436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other

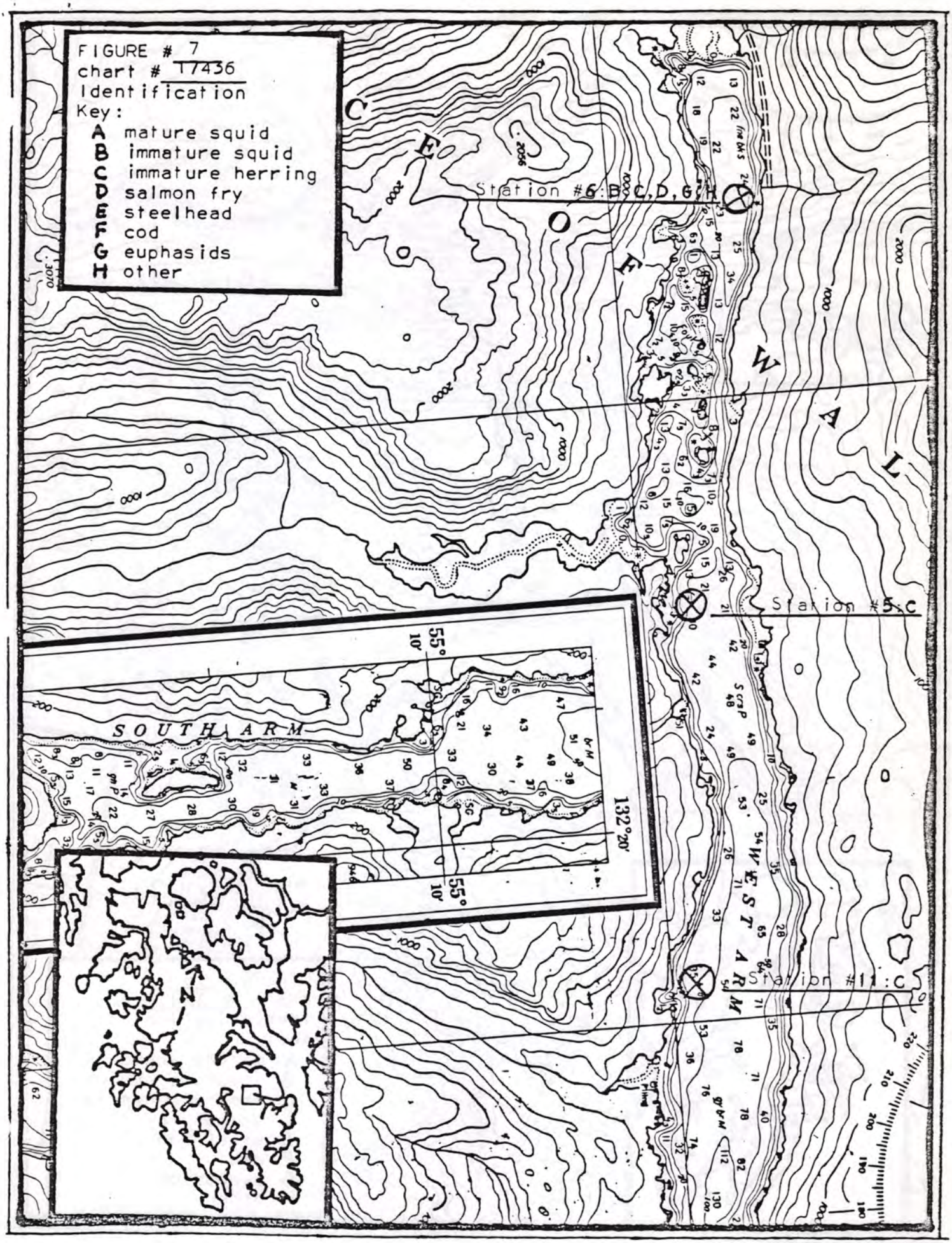


FIGURE # 7
chart # T7436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #6: B,C,D,G,H
Station #5: C
Station #1: C
SOUTH ARM
55° 10'
132° 20'
WEST ARM

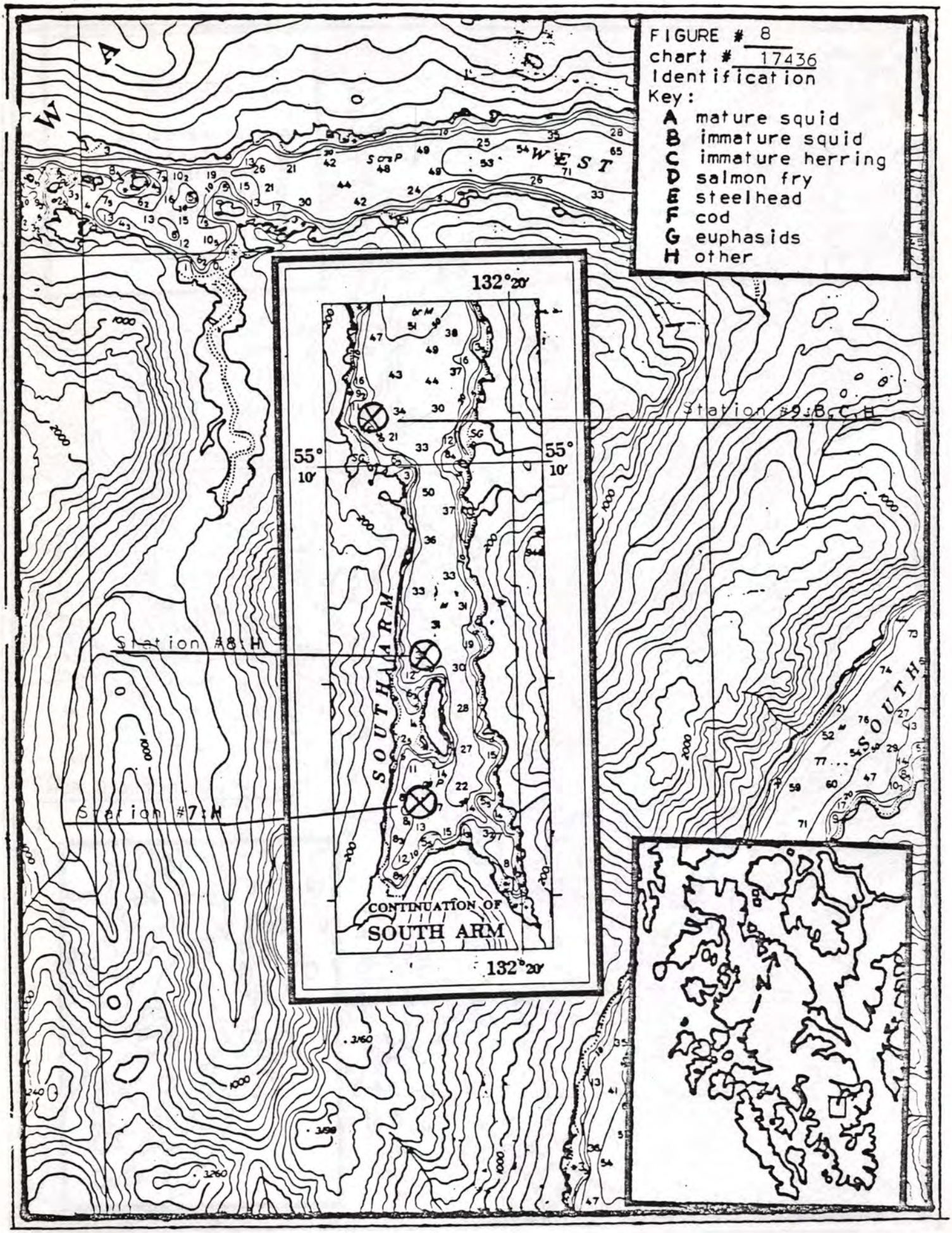


FIGURE # 8
chart # 17436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
132°20'
55° 10'
Station #9: B, C, H
Station #8: H
Station #7: H
SOUTH ARM
CONTINUATION OF
SOUTH ARM
132°20'

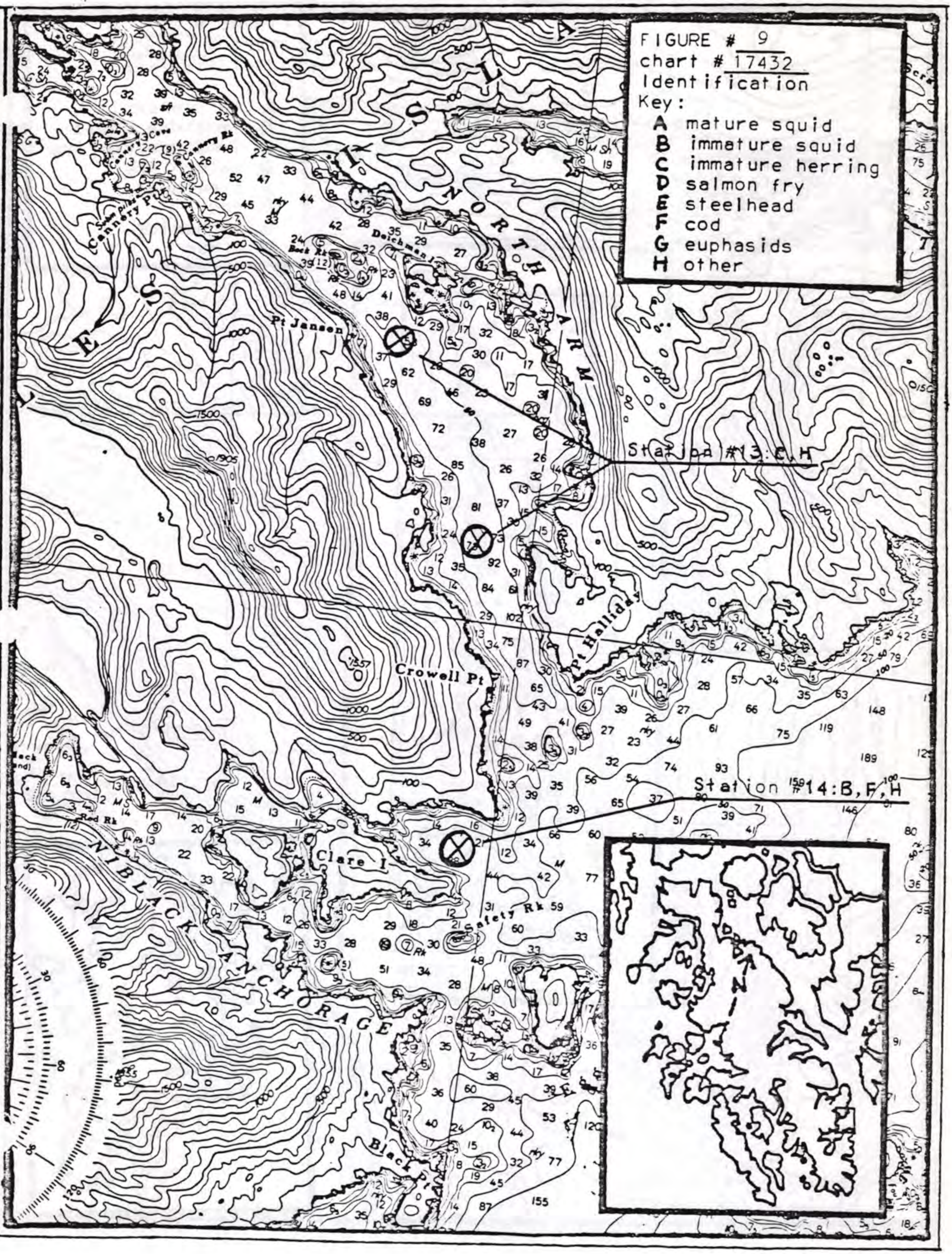


FIGURE # 9
chart # 17432
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #13: E, H
Station #14: B, F, H
NORTH ARM
Pt Jansen
Crowell Pt
Pt Halliday
Clare I
Safety Rk
NIBLACK ANCHORAGE
Cannery Pt
Black Pt

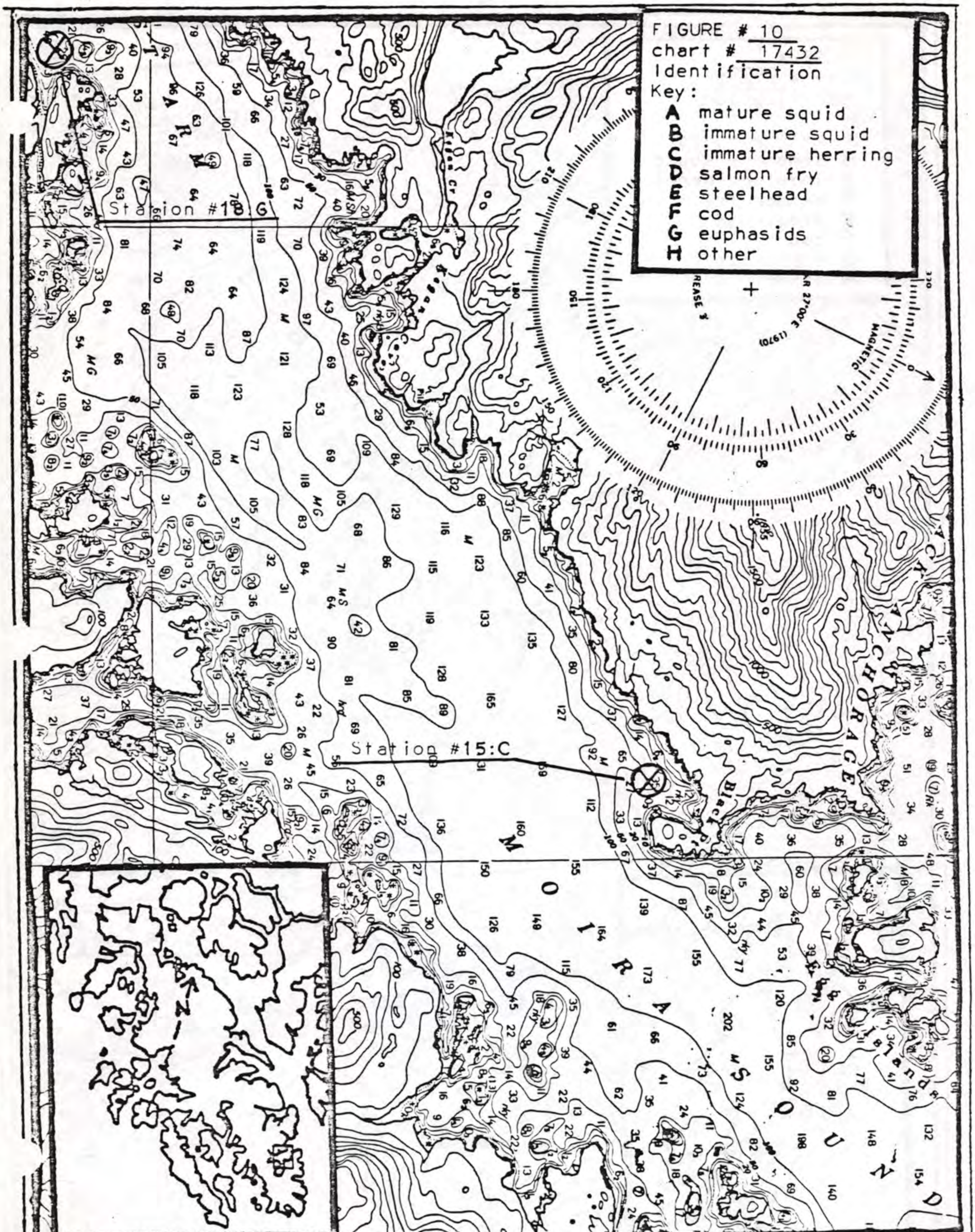


FIGURE # 10
chart # 17432
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #18:G
Station #15:C

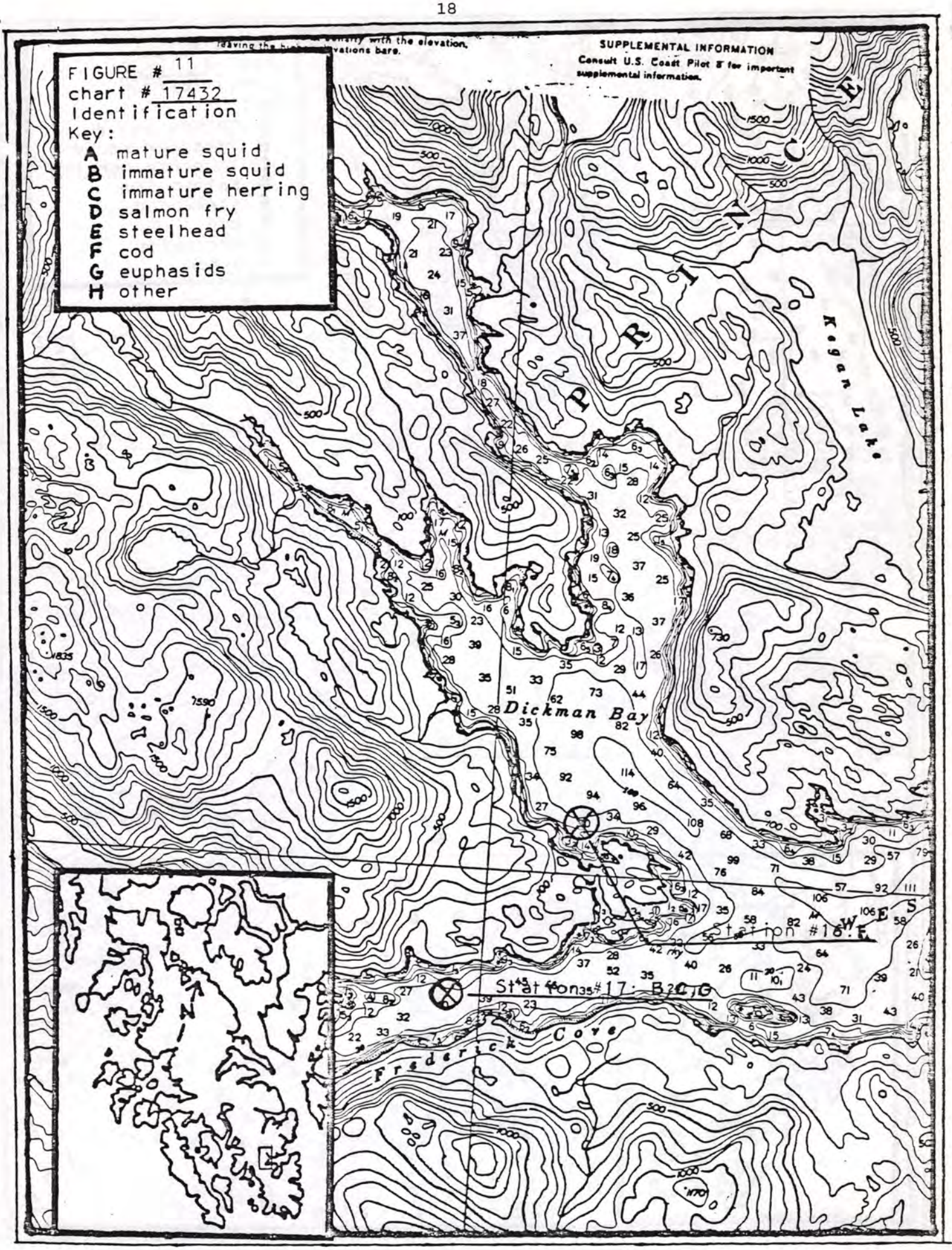


FIGURE # 11
chart # 17432
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
SUPPLEMENTAL INFORMATION
Consult U.S. Coast Pilot 8 for important supplemental information.
leaving the high elevations bare.
Dickman Bay
Frederick Cove
Kegan Lake
Station #16
Station #17
N
E
S
W


FIGURE # 12
chart # 17436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Smooth Mtn
Station #20: F, H
Station #19: C, F, G, H
MAGNETIC
VAR 27° 15' E (1972)
ANNUAL DECREASE 5'

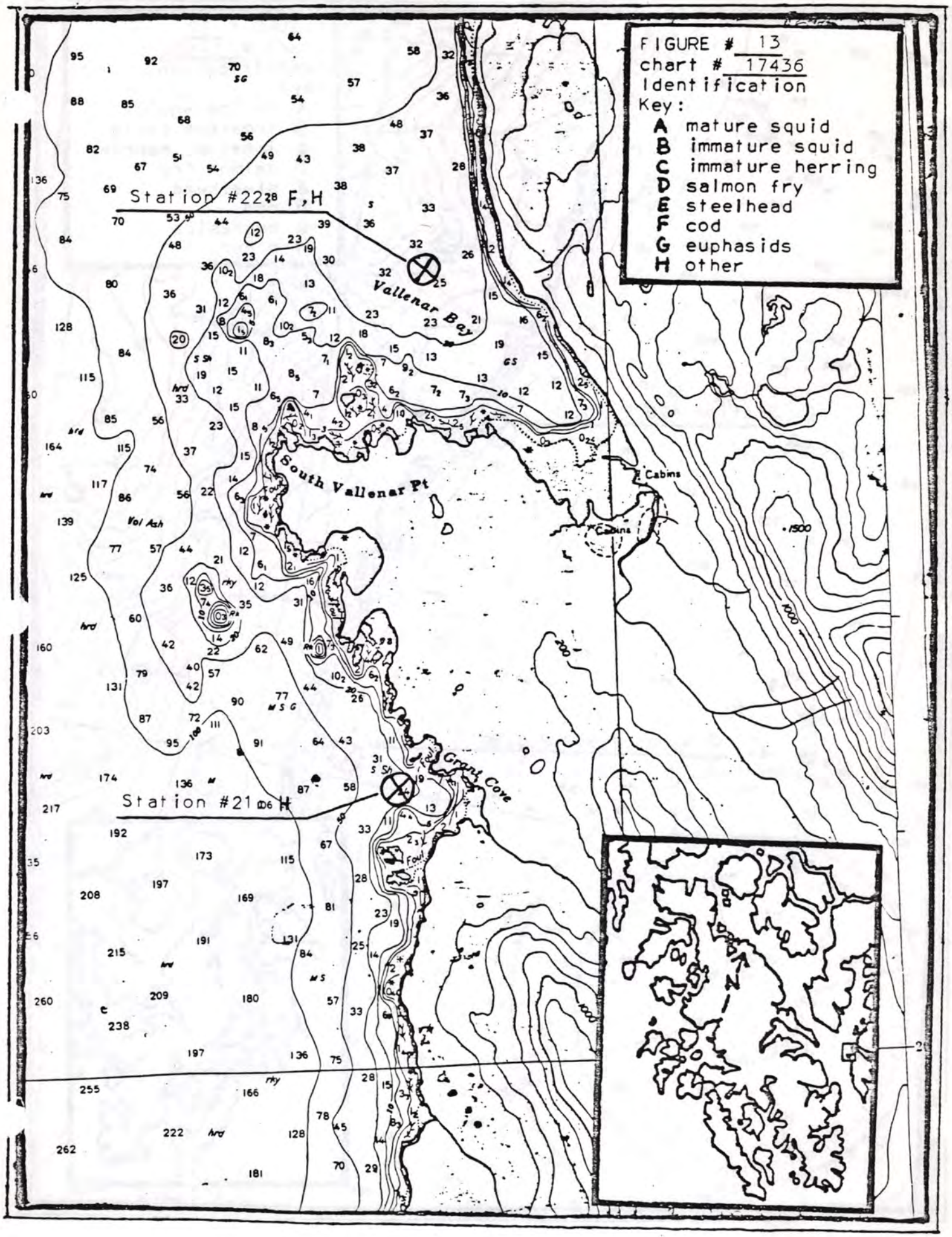


FIGURE # 13
chart # 17436
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #22 F,H
Station #21 H
Vallenar Bay
South Vallenar Pt
Cabins
Cabins
Grindy Cove
Vol Ash
1500
1000
200

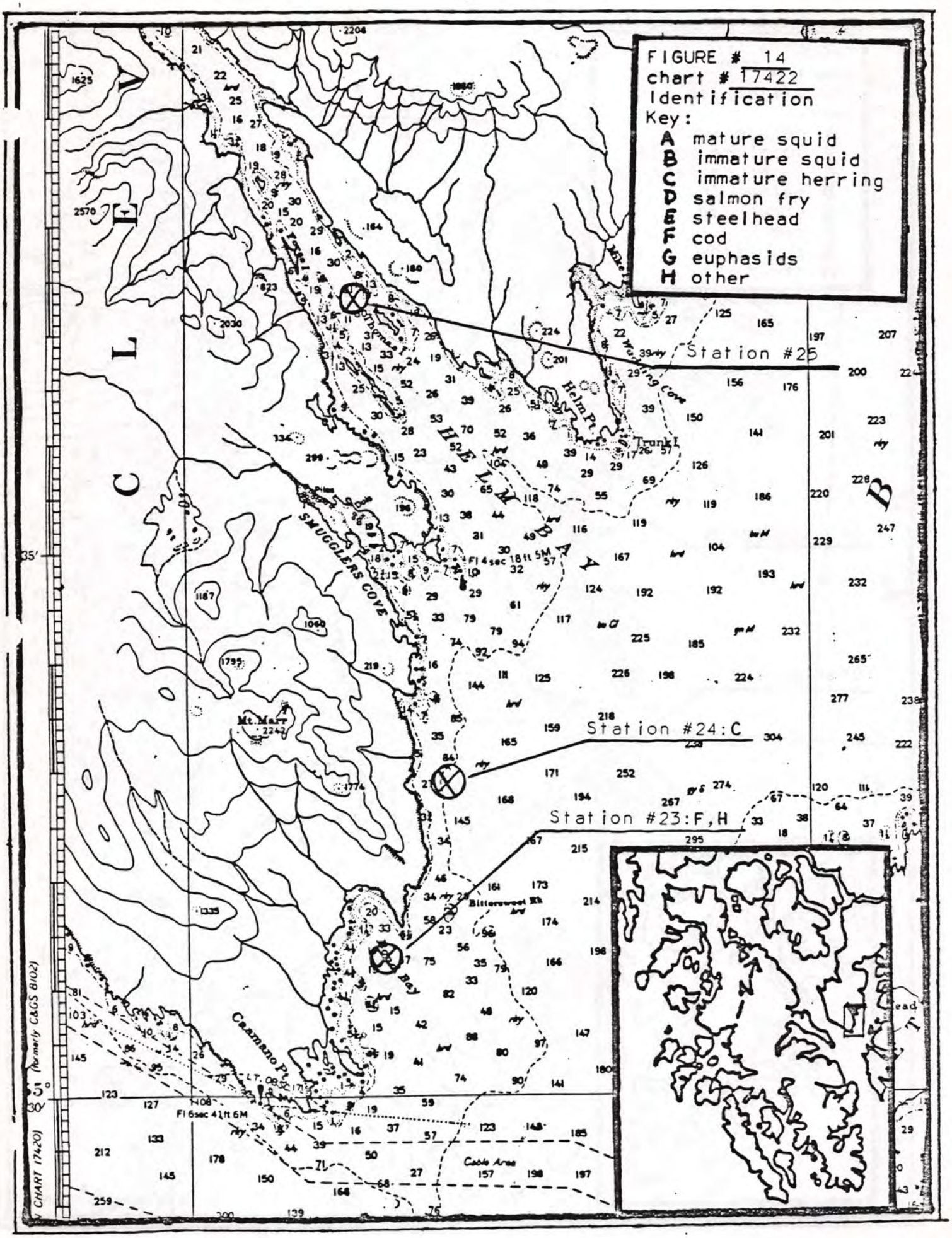


FIGURE # 14
chart # 17422
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #25
Station #24:C
Station #23:F,H
HELM BAY
SMUGGLERS COVE
Helm Pt.
Trunk I.
Mt. Marr
2242
Bitterwood Hill
Cramano Pt.
Cable Area
Fl 4 sec 18 ft 5M
Fl 6 sec 41 ft 6M
CHART 17420 (formerly C&GS 8102)

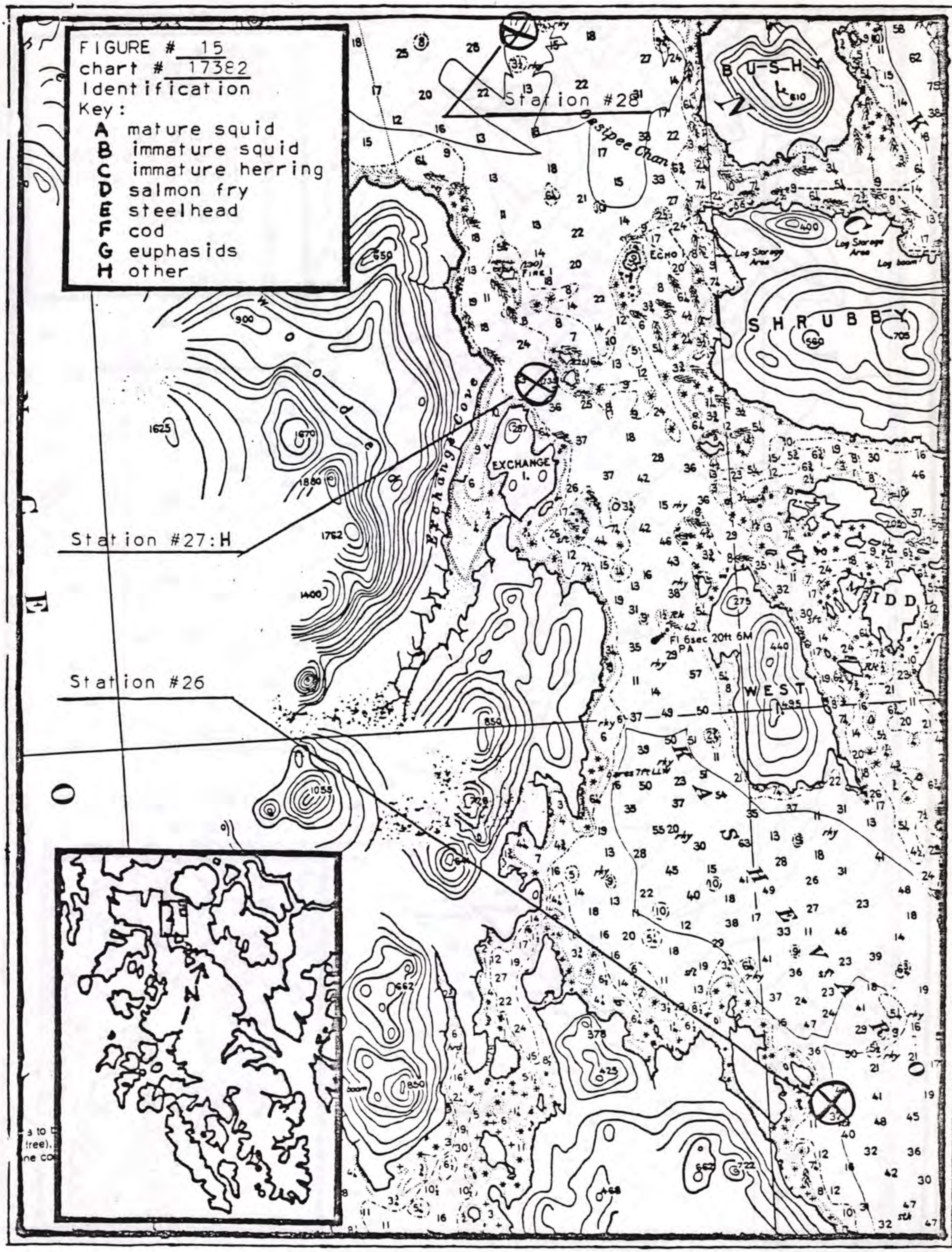


FIGURE # 15
chart # 17382
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #28
Ossipee Chan
BUSH
Log Storage Area
Log Storage Area
Log boom
ECHO I
FIRE I
SHRUBBY
Exchange Cove
EXCHANGE I.
Station #27:H
MIDDLE
Fl 6sec 20ft 6M
PA
WEST
Station #26
KASHEVAROF
BARES 7ft LLW

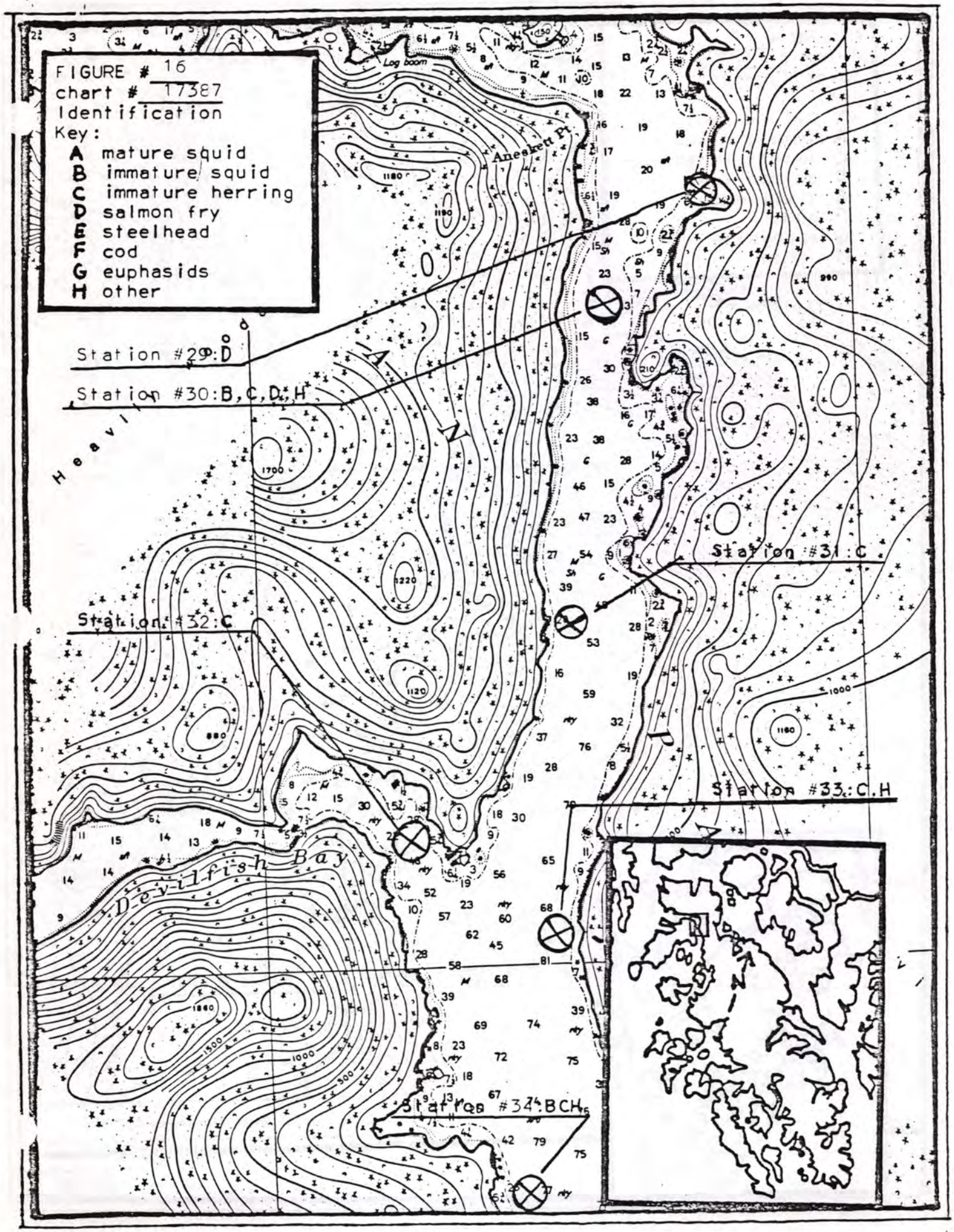


FIGURE # 16
chart # 17387
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Log boom
Aneskett Pt.
Station #29: D
Station #30: B, C, D, H
Station #31: C
Station #32: C
Station #33: C, H
Station #34: B C H
Devilfish Bay

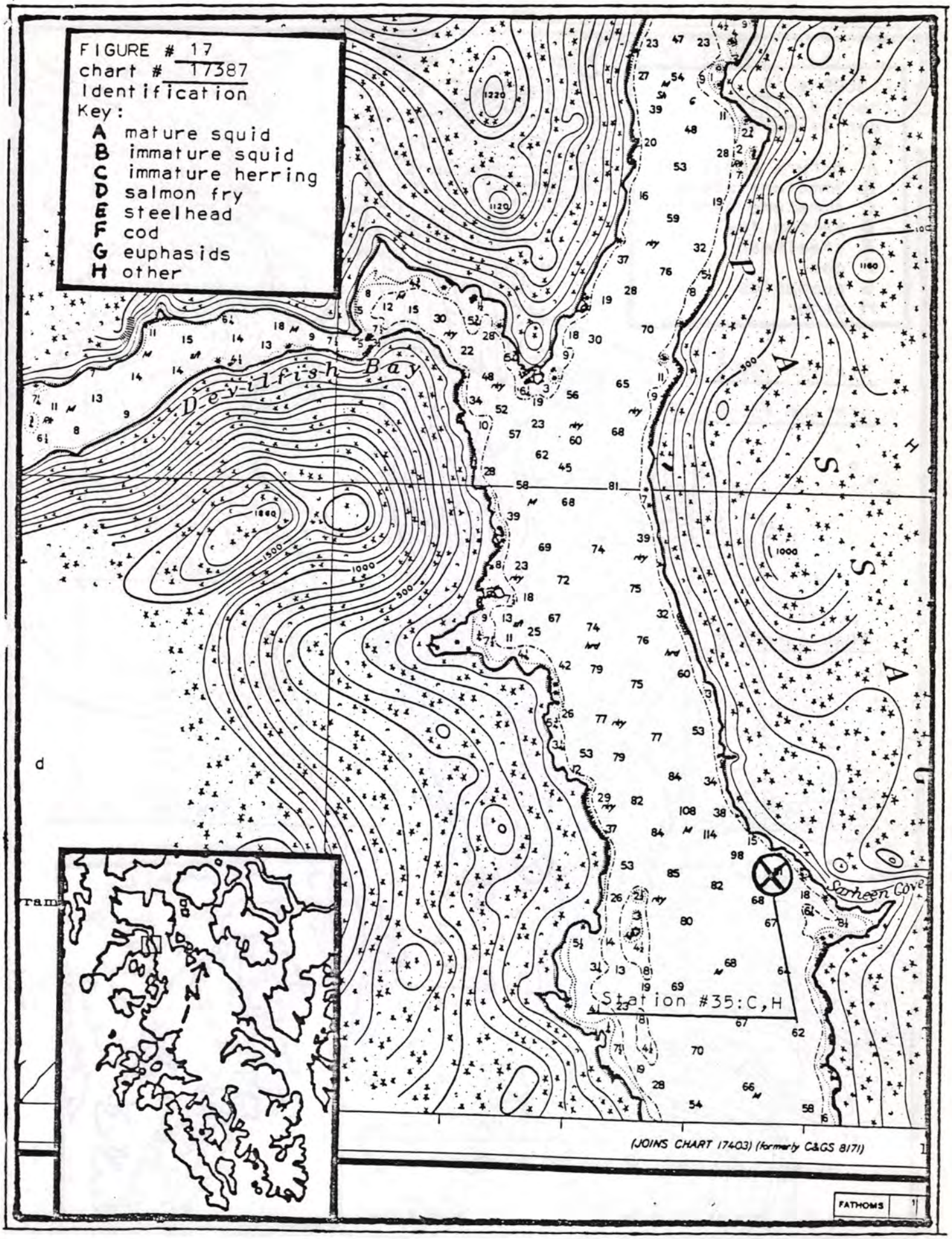


FIGURE # 17
chart # 17387
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Devilfish Bay
Station #35:C,H
Sarheen Cove
(JOINS CHART 17403) (formerly C&GS 8171)
FATHOMS

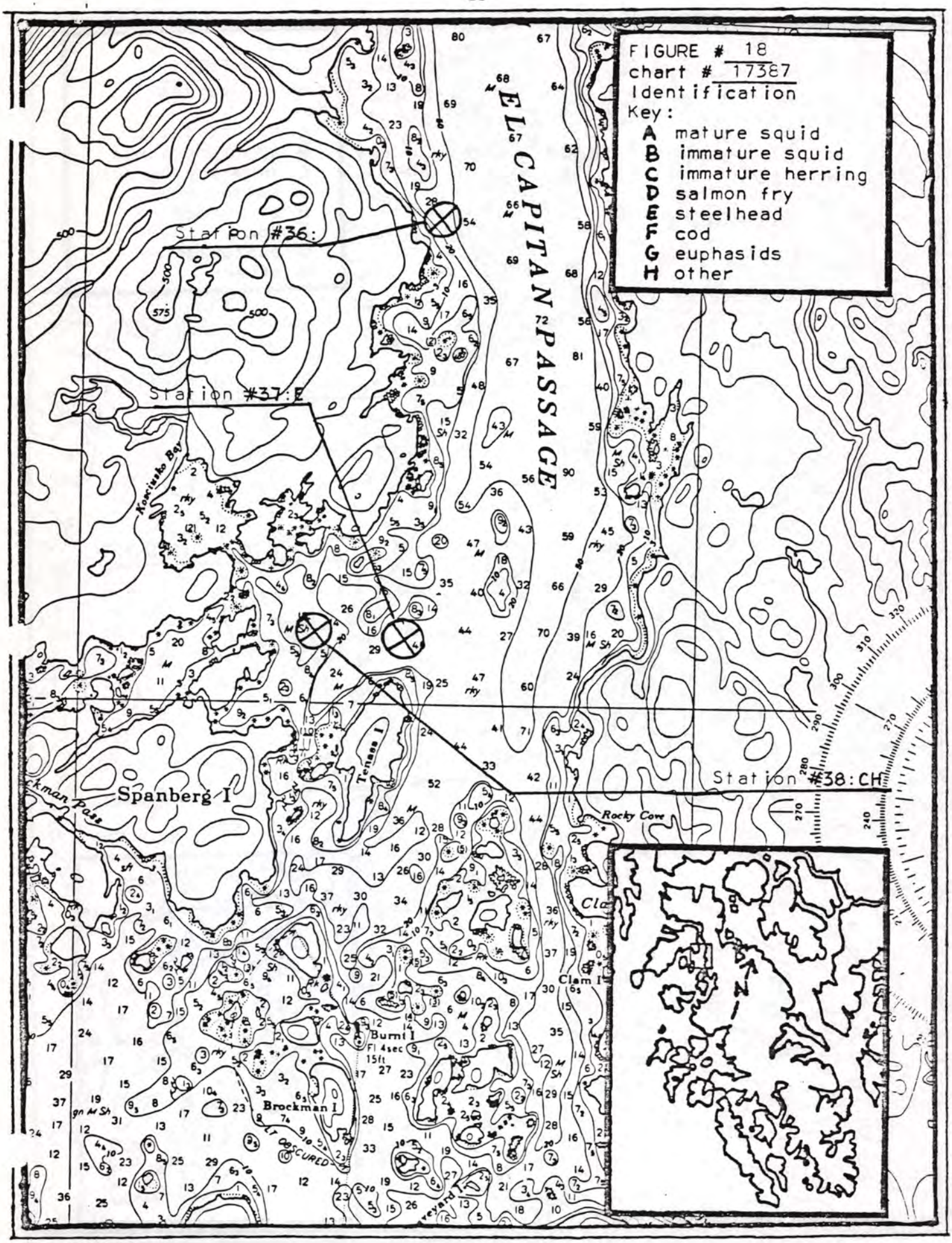


FIGURE # 18
chart # 17387
Identification Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #36:
Station #37:E
Station #38:CH
EL CAPITAN PASSAGE
Spanberg I
Tenass I
Rocky Cove
Clam I
Burnt I
Fl 4sec
15ft
Brockman I
LT OBSCURED

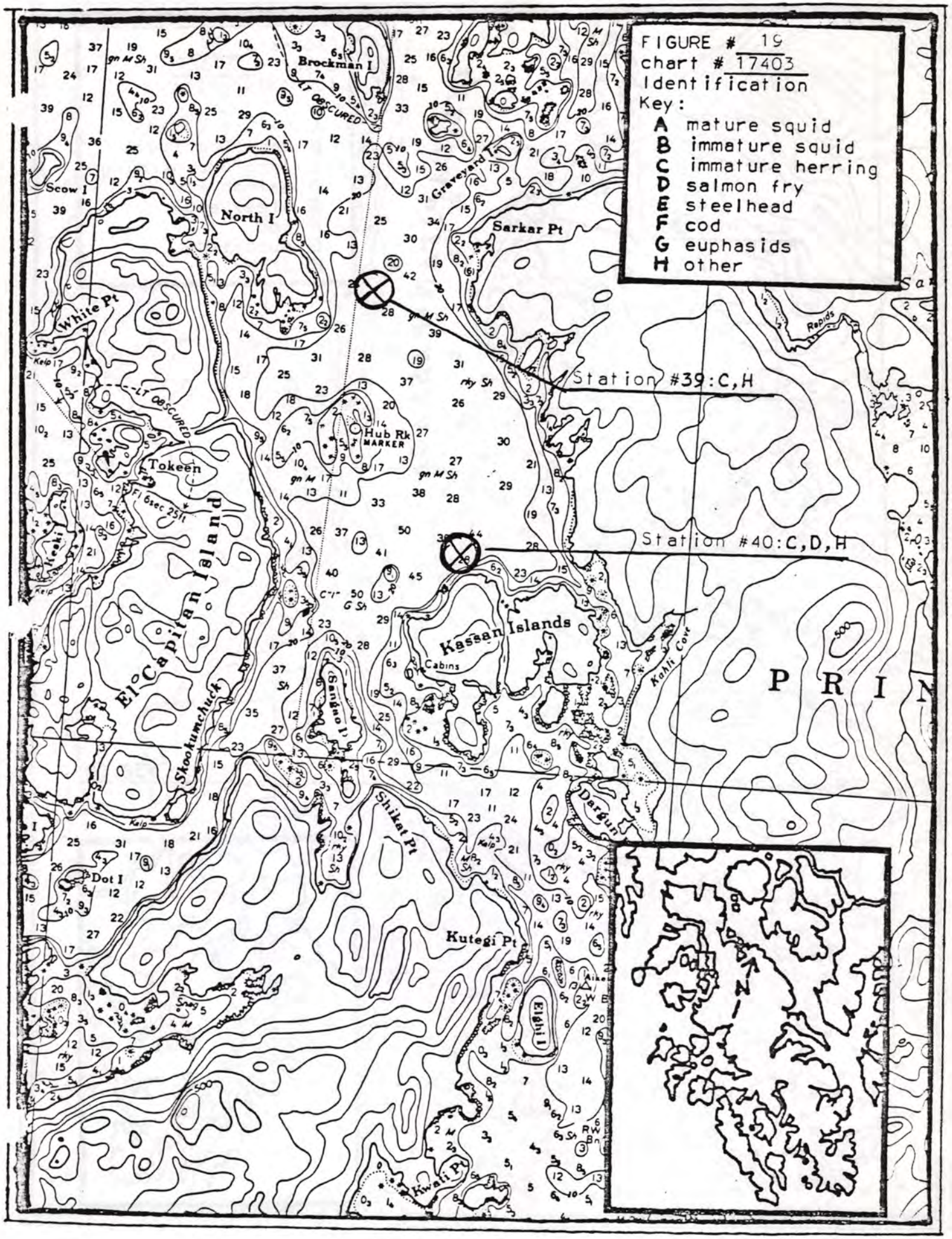


FIGURE # 19
chart # 17403
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #39: C, H
Station #40: C, D, H
Brockman I
Graveyard I
Sarkar Pt
North I
Scow I
White Pt
Hub Rk
MARKER
Tokeen
El Capitan Island
Kassan Islands
Cabins
Sandaa I
Shakumchuck
Shikat Pt
Dargun
Kahli Cove
Dot I
Kutegi Pt
Eighi I
Kiwali Pt
Rapids
PRIN

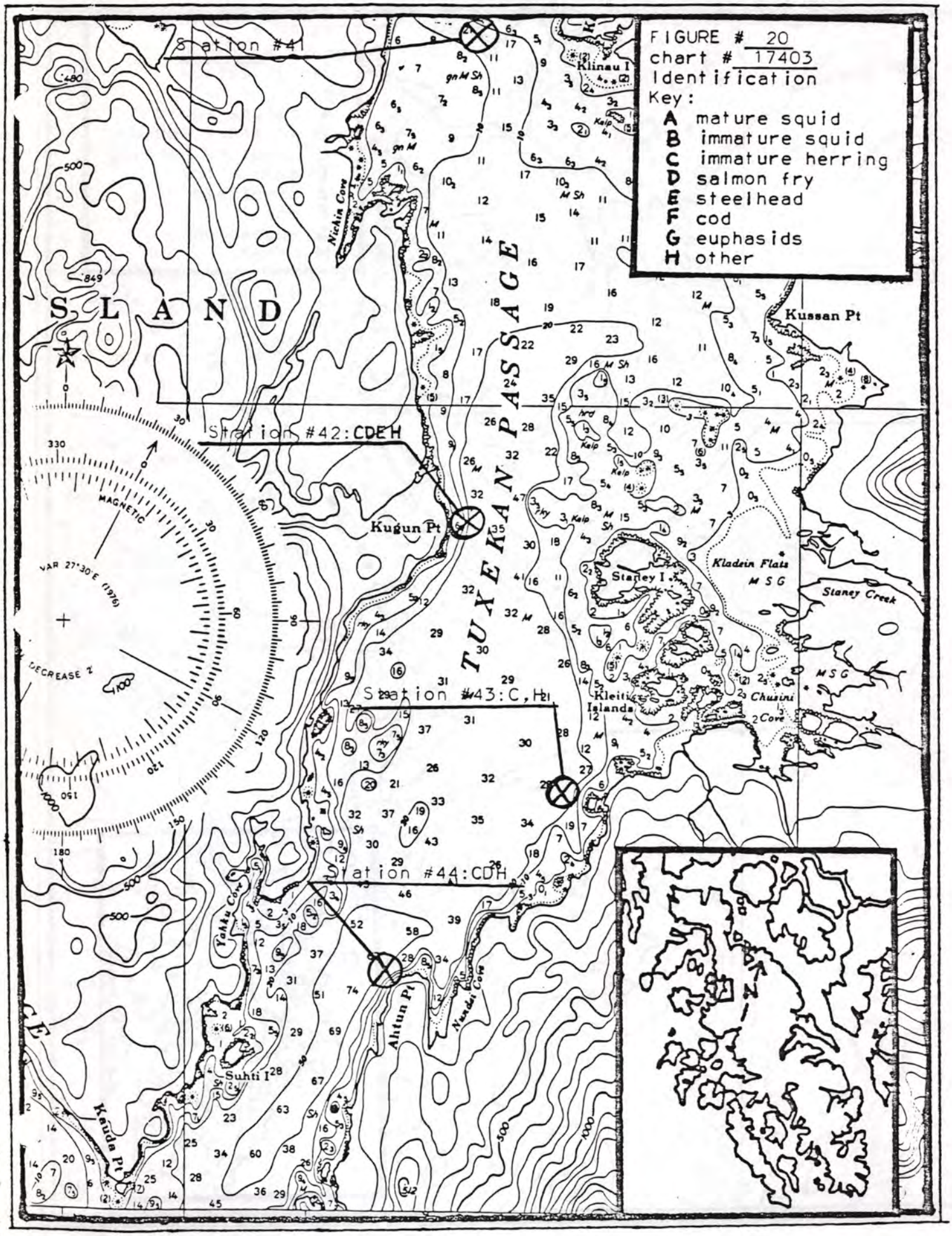


FIGURE # 20
chart # 17403
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #41
Station #42: CDEH
Station #43: C, H
Station #44: CDH
S L A N D
TUXEKAN PASSAGE
Kussan Pt
Klinau I
Nichin Cove
Kugun Pt
Stanley I.
Kladein Flats
M S G
Staney Creek
Kleiti Islands
Chusini Cove
Yaltu Cove
Nandei Cove
Ahtun Pt
Suhti I
Kauda Pt
MAGNETIC
VAR 27°30' E (1976)
DECREASE 2'

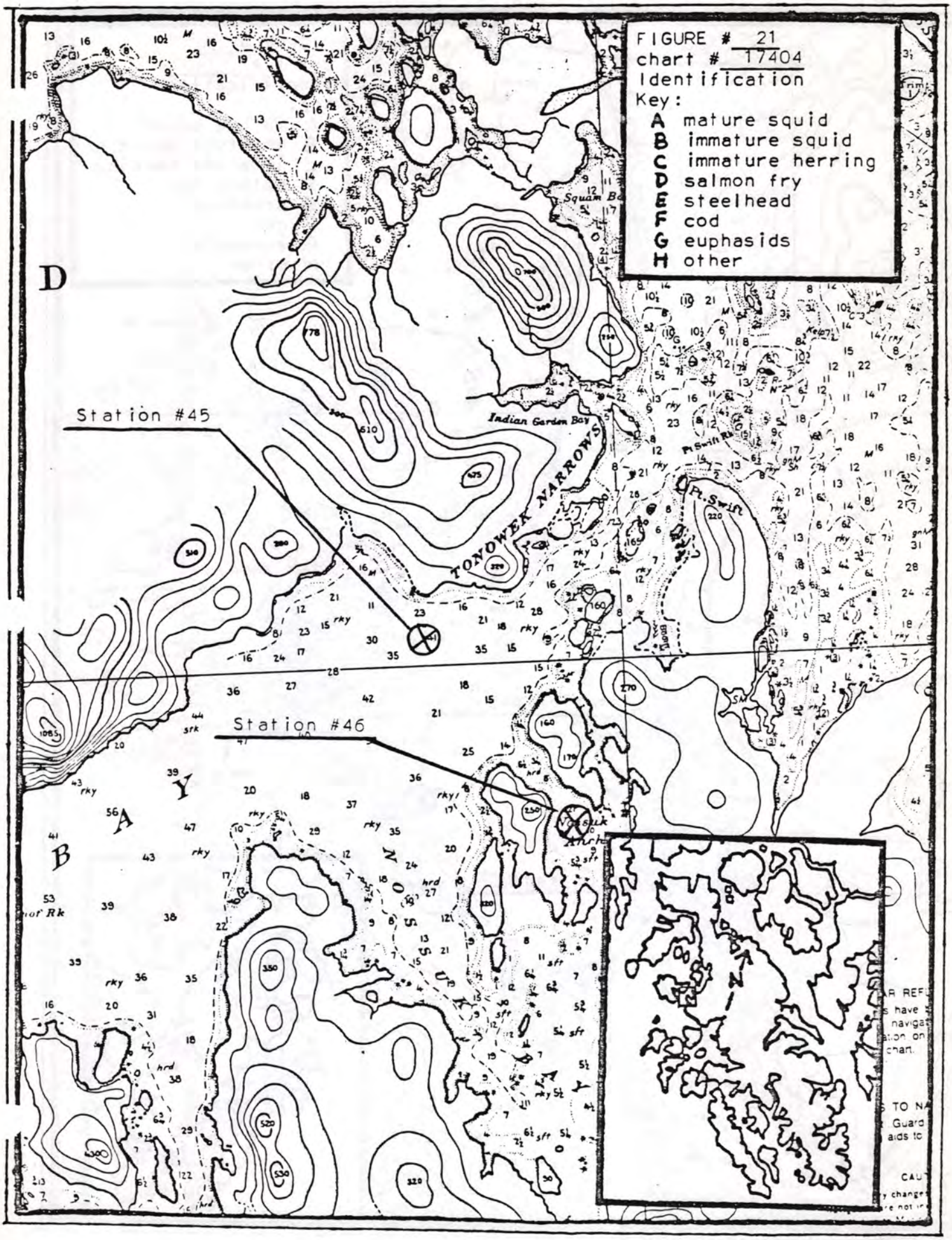


FIGURE # 21
chart # 17404
Identification Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
D
Station #45
Station #46
TONGUE POINT
Indian Garden Bay
Pt. Swift
Pt Swift Rk
Squam Bay
A
B
Y
N O U S

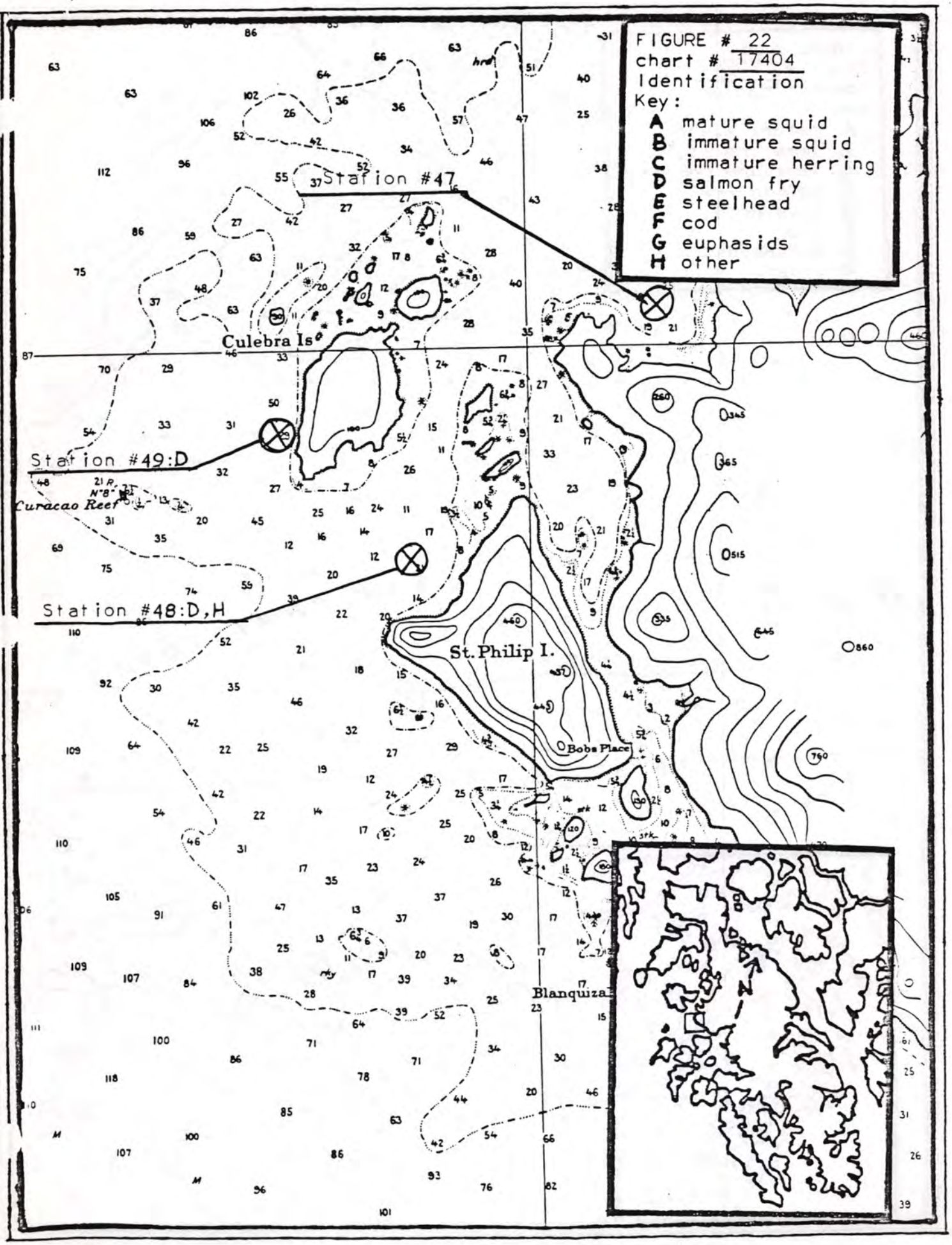


FIGURE # 22
chart # 17404
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #47
Culebra Is
Station #49:D
Curacao Reef
Station #48:D,H
St. Philip I.
Bobs Place
Blanquiza

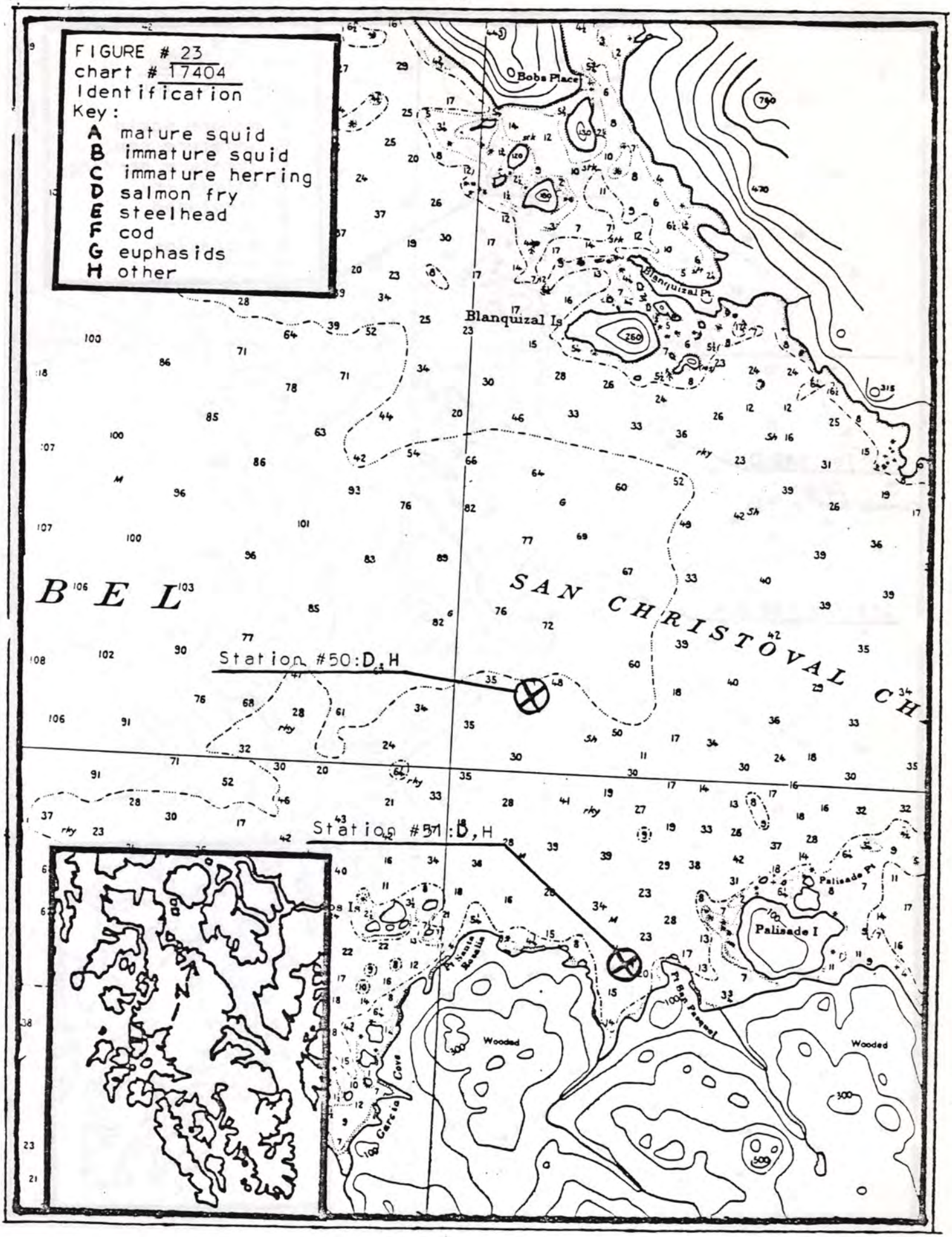


FIGURE # 23
chart # 17404
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Bobs Place
Blanquizal Pt
Blanquizal Is
BEL
SAN CHRISTOVAL CH
Station #50: D, H
Station #51: D, H
Palisade Pt
Palisade I
Pt Santa Rosalia
Bay Pequeno
Wooded
Wooded
Garcia Cove

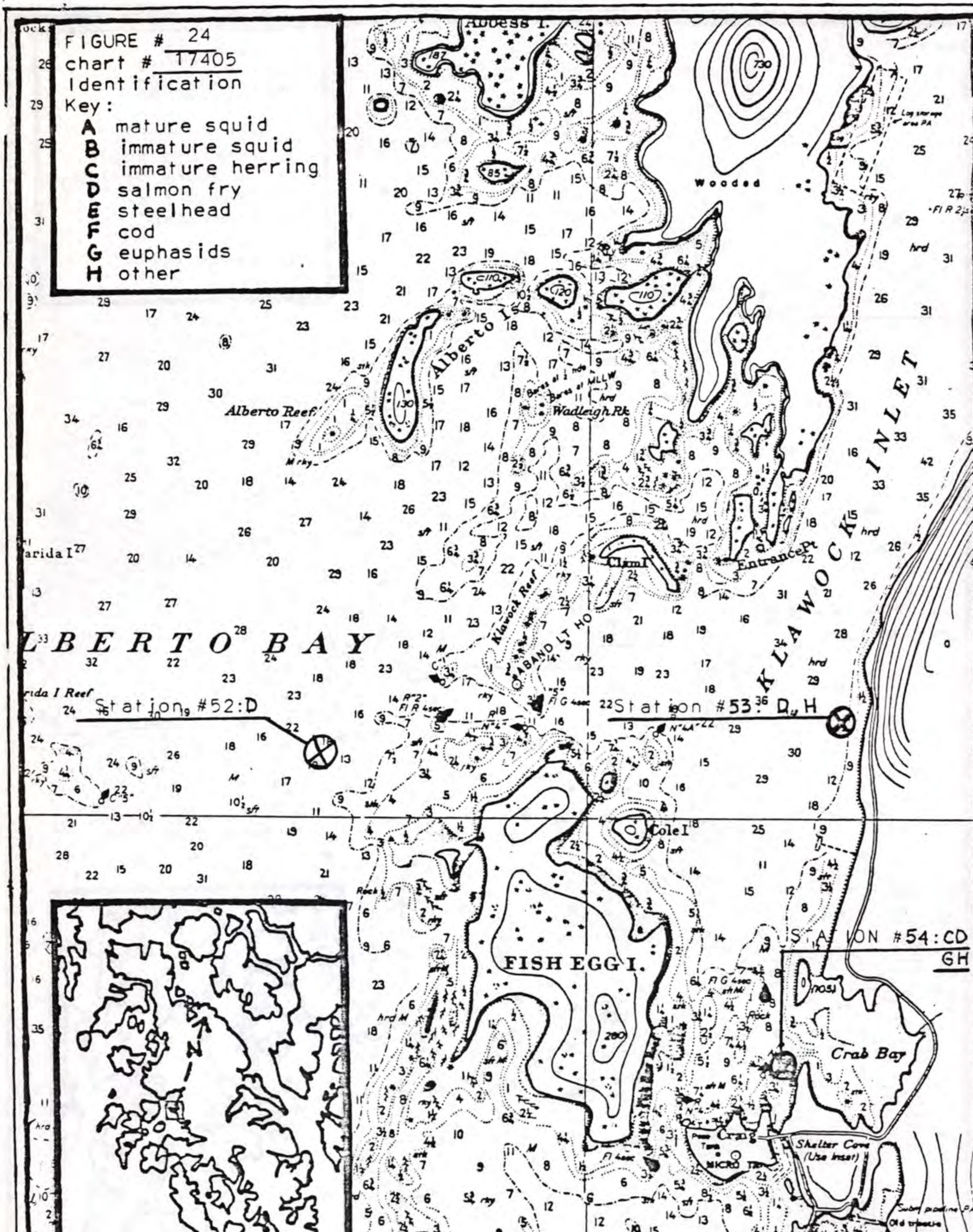


FIGURE # 24
chart # 17405
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #52:D
Station #53: D, H
STATION #54:CD GH
ALBERTO BAY
KLAWOCK INLET
FISH EGG I.
Alberto Is
Alberto Reef
Wadleigh Rk
Klawock Reef
Cole I
Entrance Pt
Crab Bay
Craig
Shelter Cove (Use Inset)
Wooded

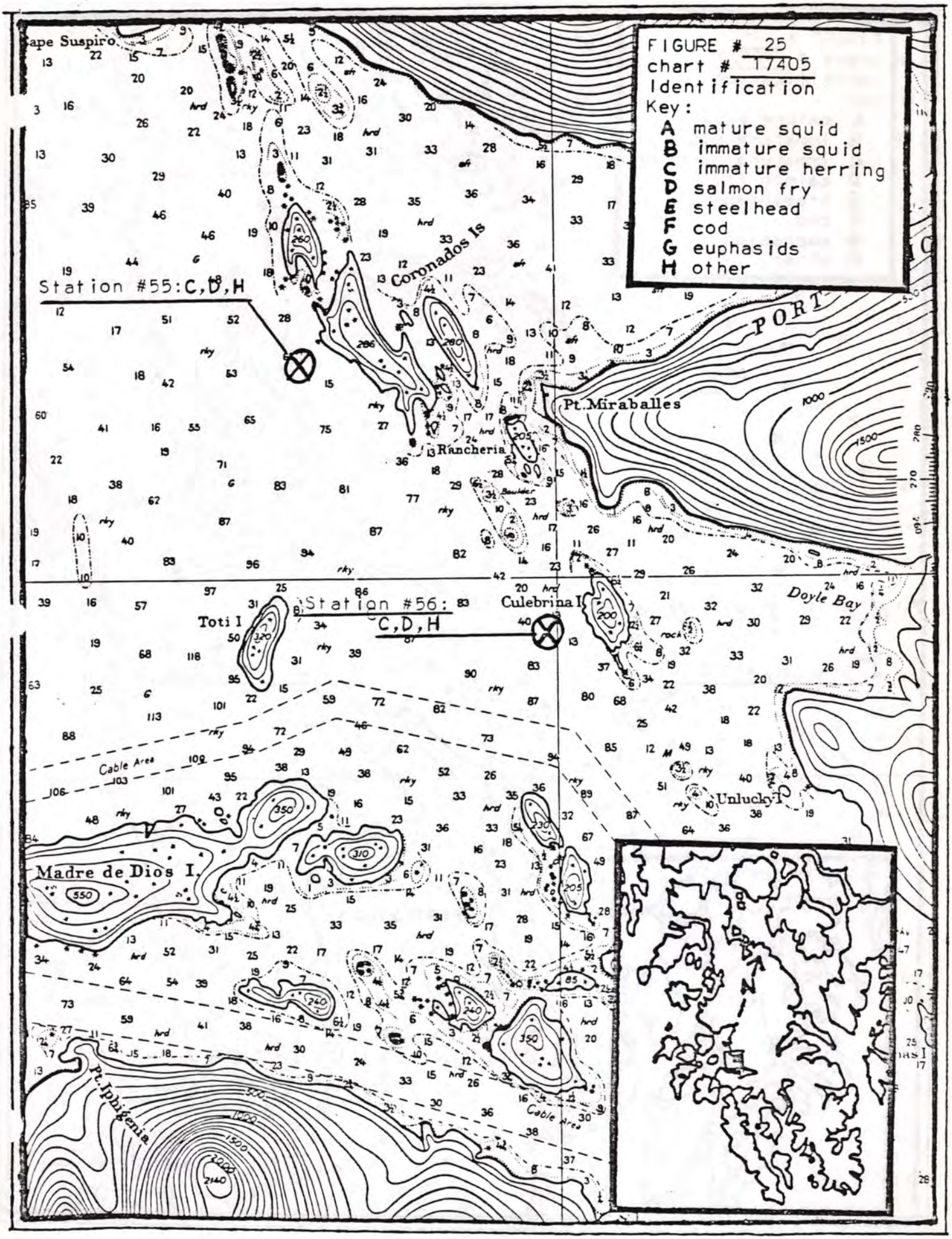


FIGURE # 25
chart # 17405
Identification Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Cape Suspiro
Station #55: C,D,H
Coronados Is
Rancheria
Pt. Miraballes
PORT
Station #56: C,D,H
Toti I
Culebrina I
Doyle Bay
Cable Area
Unlucky I
Madre de Dios I.
Pt. Ipbigenia
Cable Area

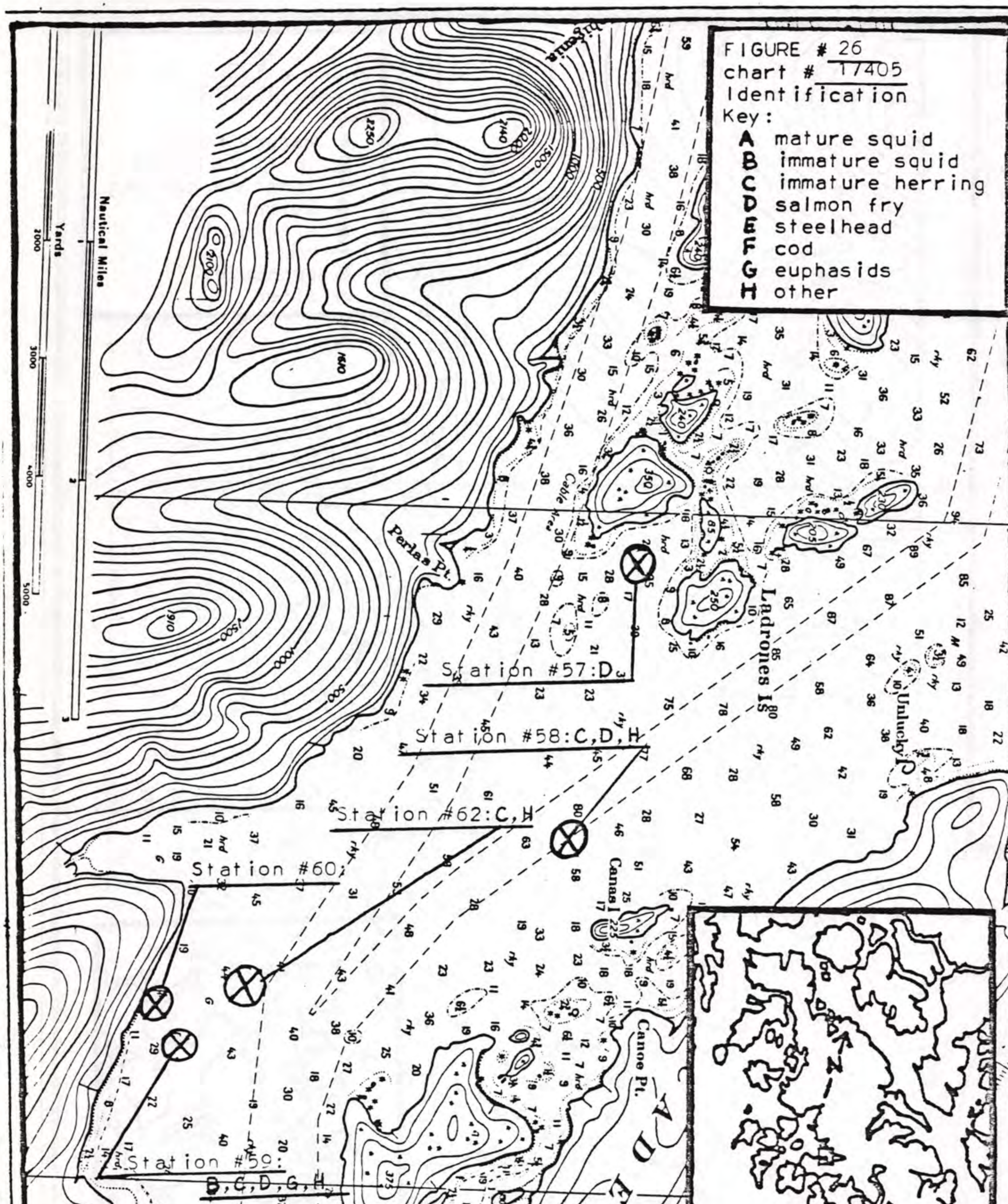
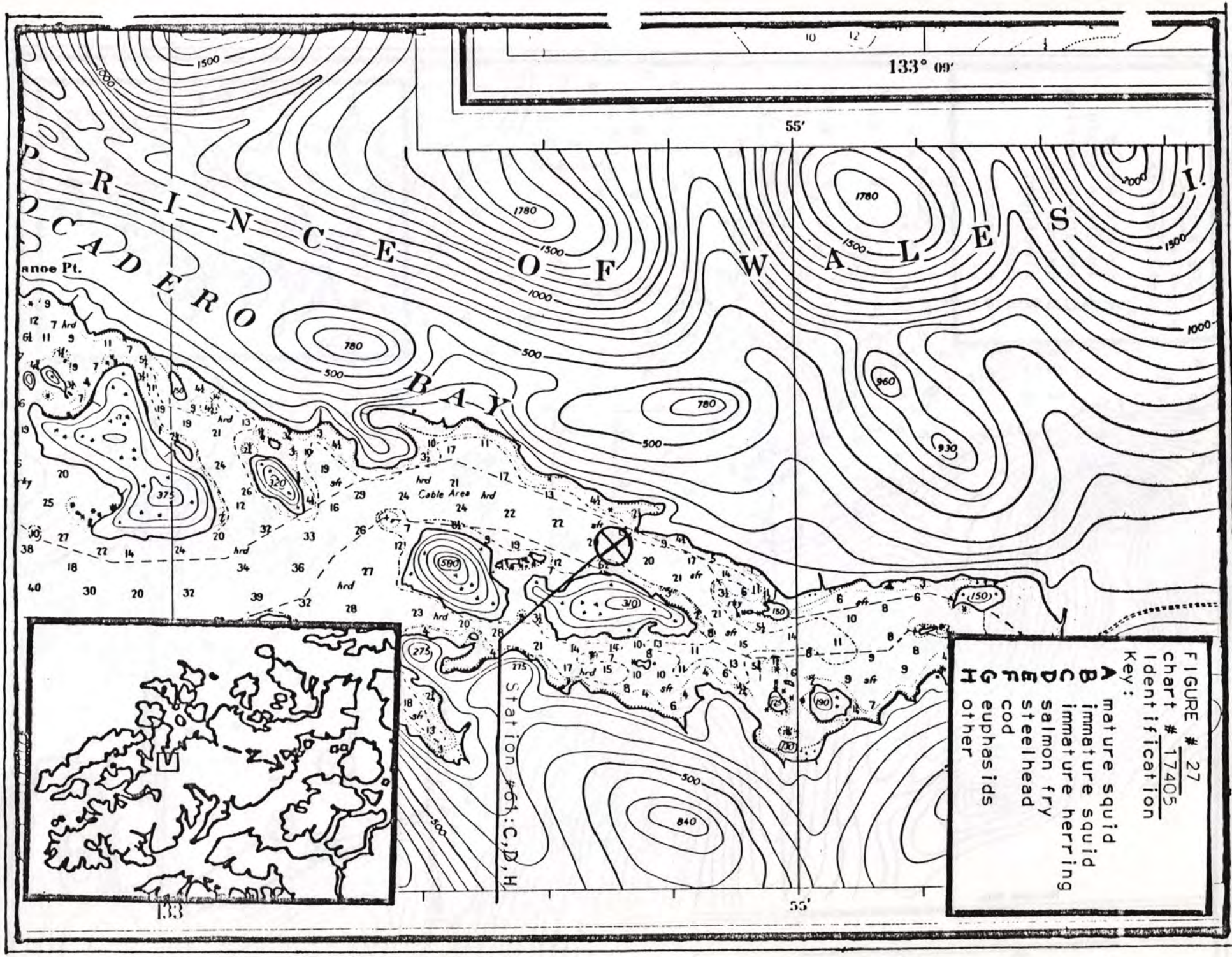


FIGURE # 26
chart # 17405
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #57:D
Station #58:C,D,H
Station #62:C,H
Station #60:
Station #59:
B,C,D,G,H
Perlas Pt.
Ladrones Is.
Unlucky
Canoe Pt.
Nautical Miles
Yards


133° 09'
55'
PRINCE OF WALES I.
CADERO BAY
anoe Pt.
Cable Area
Station #01: C, D, H
133
55'
FIGURE # 27
chart # 17405
identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other

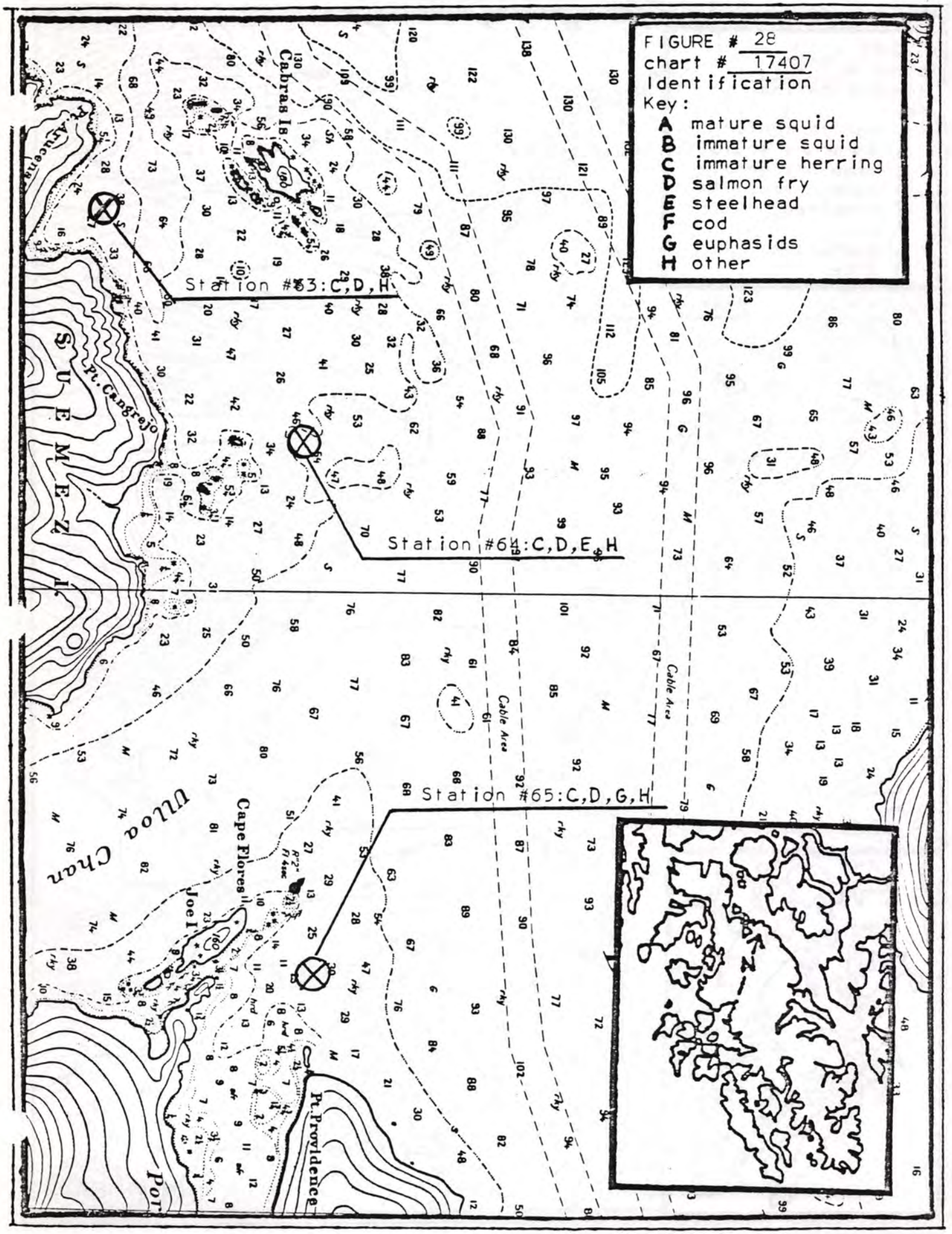


FIGURE # 28
chart # 17407
Identification Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #63: C, D, H
Station #64: C, D, E, H
Station #65: C, D, G, H
Pt. Cabrera
Cabras Is
Cape Flores
Joe I
Pt. Providence
Cable Area
Ulloa Chan
SUEMEZ I.

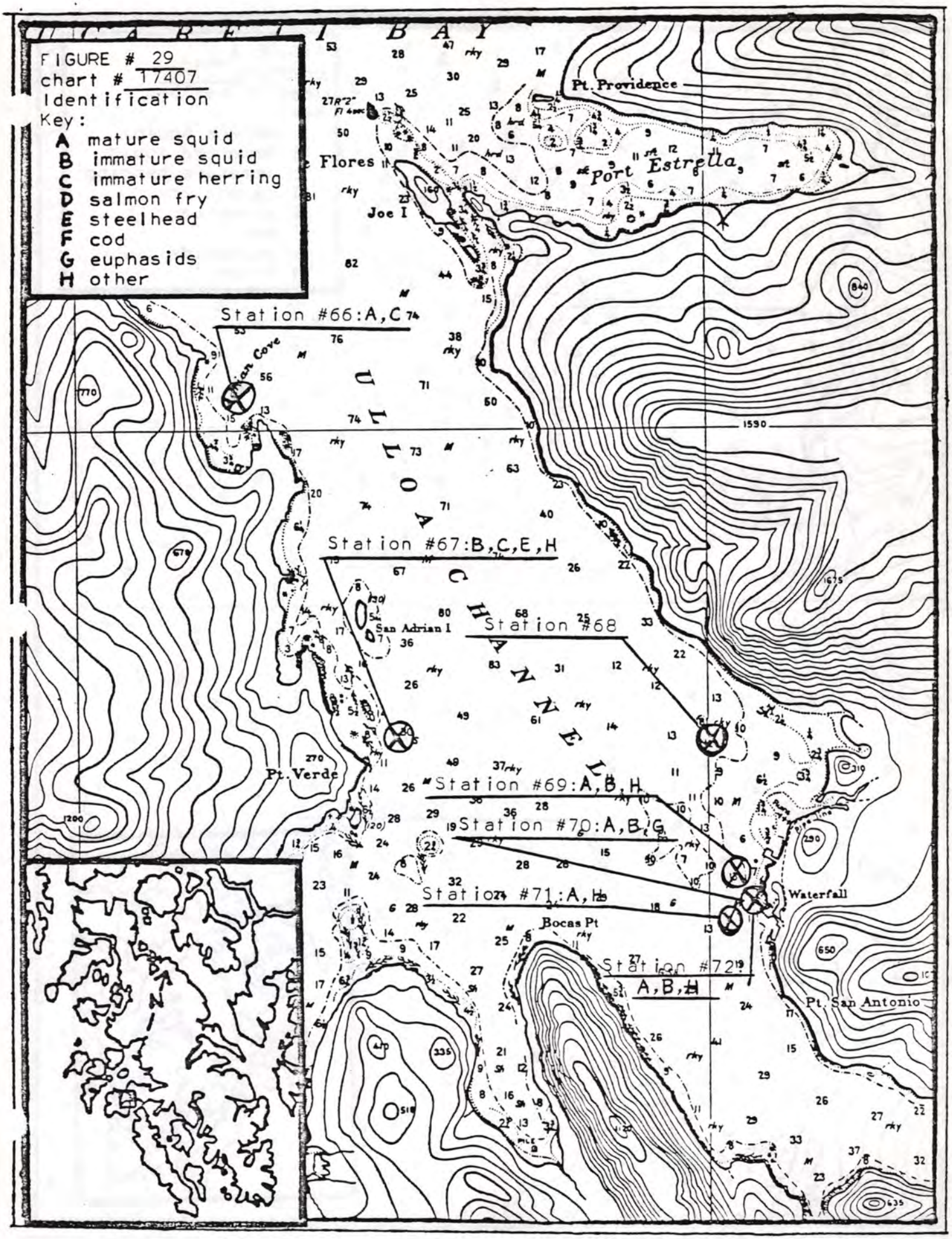


FIGURE # 29
chart # 17407
Identification
Key:
A mature squid
B immature squid
C immature herring
D salmon fry
E steelhead
F cod
G euphasids
H other
Station #66:A,C
Station #67:B,C,E,H
Station #68
Station #69:A,B,H
Station #70:A,B,G
Station #71:A,H
Station #72:A,B,H
Pt. Providence
Port Estrella
Flores
Joe I
San Adrian I
Pt. Verde
Bocas Pt
Waterfall
Pt. San Antonio
ULLOA
CHANNEL

FIGURE 30: Additional Observations

DATE	LOCATION	COMMENTS
3/20/82	Naket Island	SSRAA: Spawning and eggs observed
3/20/82	Craig, AK	F/V Carrie: Larger species
4/20/82	Mansinita Bay	F/V Alsek: Adult spawning behavior
4/25/82	Port Chester	Hap Leon: Spawning and eggs observed
5/23/82	Francisco Pt.	F/V Icy Straits: Large spawning schools
5/20-6/7/82	Steamboat Bay	F/V Carrie: Large schools
6/7/82	Steamboat Bay	F/V North Cape: Large schools
6/10-15/82	Bocas Bay	F/V Pioneer: Large spawning schools
	Ulloa Channel	F/V Pioneer: Large spawning schools
	Steamboat Bay	F/V Pioneer: Large spawning schools
	View Cove	F/V Pioneer: Sub-adult squid
	Cholmondeley Sd.	F/V Pioneer: Sub-adult squid
7/3-20/82	Cape Ulitka	F/V Prosperity: Adult squid
	Steamboat Bay	F/V Prosperity: Adult
7/20/82	American Bay	F/V Odyssey: 5" - 7" squid
8/10/82	Windham Bay	F/V Odyssey: Larger species
8/20/82	E. Long Island	F/V Prosperity: 7" squid
8/20/82	W. Gravina Island	F/V Lady Nina: Large schools 5"-7" squid

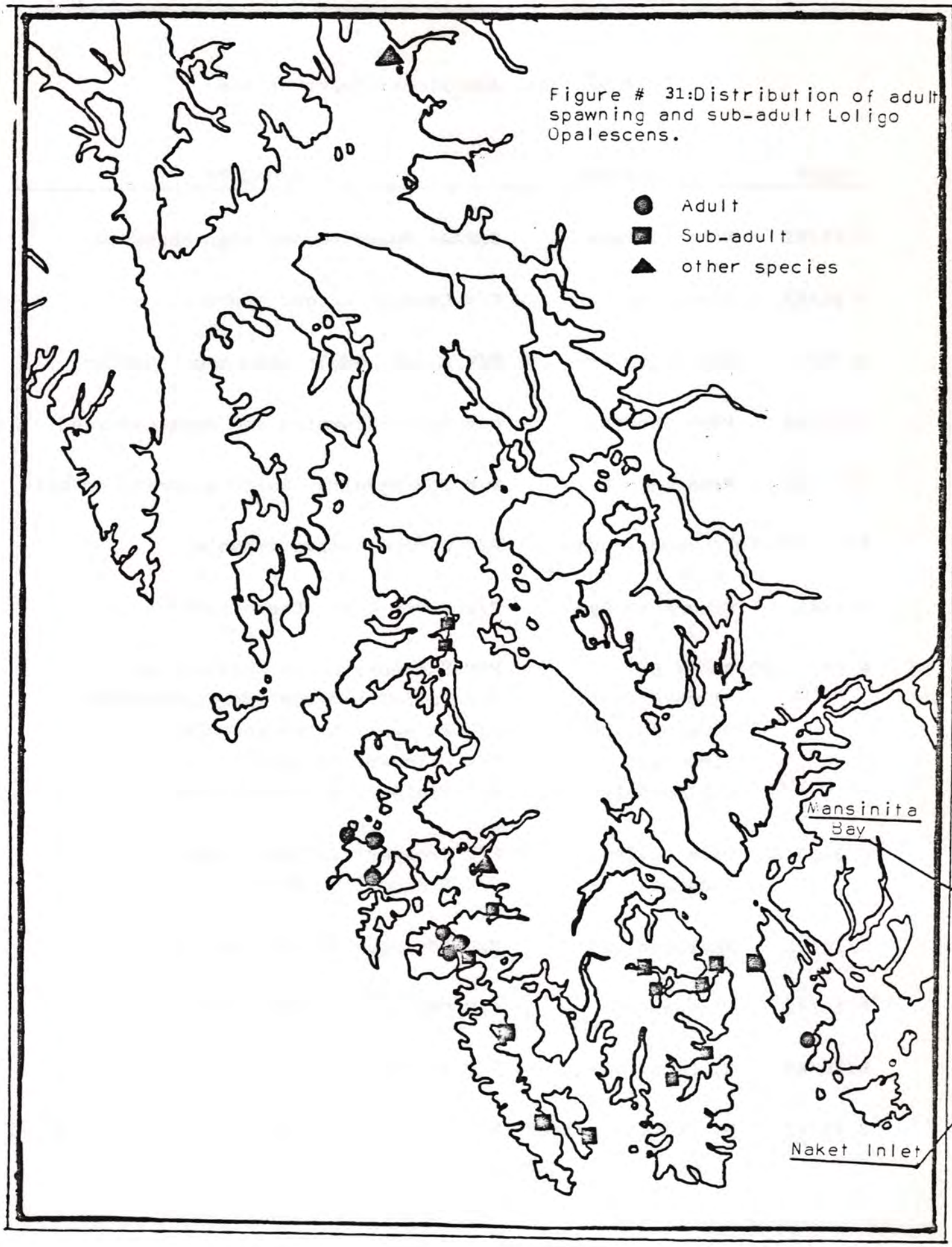


Figure # 31:Distribution of adult spawning and sub-adult Loligo Opalescens.

have persisted into June. Perhaps spawning activities persist for five to six months, or may even be sporadic throughout the year as suspected in waters off British Columbia, Canada (Bernard, 1980). The great diversity in overall squid size observed supports the idea that spawning activities occur through a large part of the year. The evidence of this project suggests that the time period from mid-May until mid-June seems to be when the greatest amount of spawning activity may occur. However, this could reflect the presence of more observers out on the waters at that time than earlier in the year, rather than a peak of spawning activity.

It proved impossible to get a good estimate of abundance during the project cruise. The one large spawning concentration we encountered had a strong liking for the shallower water (approximately 4 fathoms) of the spawning ground. Our 10 fathom deep seine was impossible to use in this situation. Our efforts at concentrating and holding these squid with our attracting lights in deeper water were unsuccessful; as darkness commenced, squid appeared to rise up from the deep, and momentarily the schools would linger under the lights and then quickly move to the shallows. Sightings during the observation period suggest some abundance (e.g. observation such as one to two thousand tons or the water filled with squid as far as I could see), and the aggregation of spawning squid we encountered was sizable, yet these are really just subjective descriptions. The observational evidence suggests numerous spawning locations, spawning activity persisting for months, and dense schooling activities on the spawning grounds, all of which are indicators of abundance. However, an objective, reliable estimate of species abundance at this time is unwarranted.

Squid were found spawning at depths of 4 to 6 fathoms. The water temperature at a depth of one fathom was 44°F. The sample of spawning squid (Appendix B) averaged 5.25 inches in mantle length and 7.7 squid to the pound. Spawning activities were observed only during the hours of darkness. A thick layer of spawning squid would be observed on the bottom with a somewhat sparser distribution of squid throughout the water column (See Figure 32). On the surface the squid had a very

positive reaction to the attracting lights, lazily circling under the focus of light on the water, sometimes appearing to stop moving and float. These squid could frequently be seen engaging in some sort of coupling activity.

Sub-adult squid were commonly found with immature herring (See Figure 33). These squid did not exhibit the docile character of the spawning squid. They were much more wary and preferred the areas of dim illumination, not the area under the attracting lights.

Squid appeared to confine their spawning to areas with sand, silt and mud substrates. This is not conclusive as our observations are limited on this topic. It is interesting to note that the sample of squid we took and kept alive in the hatch full of water aboard the F/V Odyssey actually spawned in the hatch.

From the project evidence I can deduce no precise elements for predicting other areas where adult or sub-adult squid may be found with any confidence. Whatever the squid consider specifically important about their spawning or general habitat remains a mystery for now. Whether they spawn annually in the same areas as observed is unknown. These are matters for further investigations.

The sample of squid (approximately 350 pounds) was easily taken from the spawning school with a dip net. Observations during the project cruise do not include squid concentrations dense enough for a commercial brail fishery such as occurs in Southern California, although observations by F/V Pioneer 6/82 lend support to this possibility. Indeed a shallow depth encircling net (i.e., purse seine or lampara net) would be very effective in capturing a large volume of squid. Attracting lights are essential for this fishing method. The efficiency of this gear would seem to outweigh that of trawling or jigging. Note that the spawning squid readily struck at jigs.

The squid sample was transported to E. C. Phillips Cold Storage in Ketchikan, Alaska. They were carried in a full hatch of sea water. Although the F/V Odyssey had a RSW system, it was not used, as we

Figure #32: Squid targets displayed on the chart recorder (station #70).

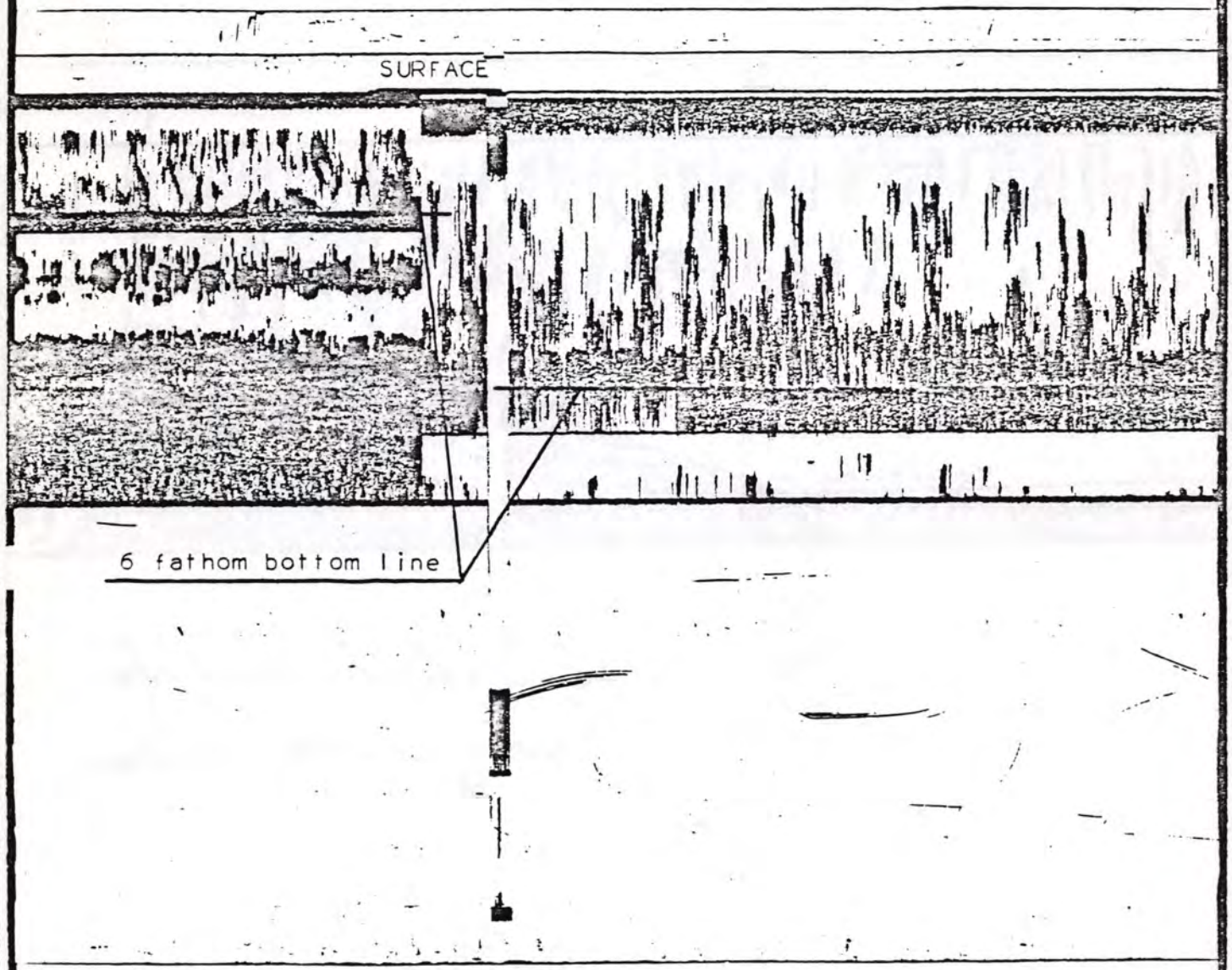
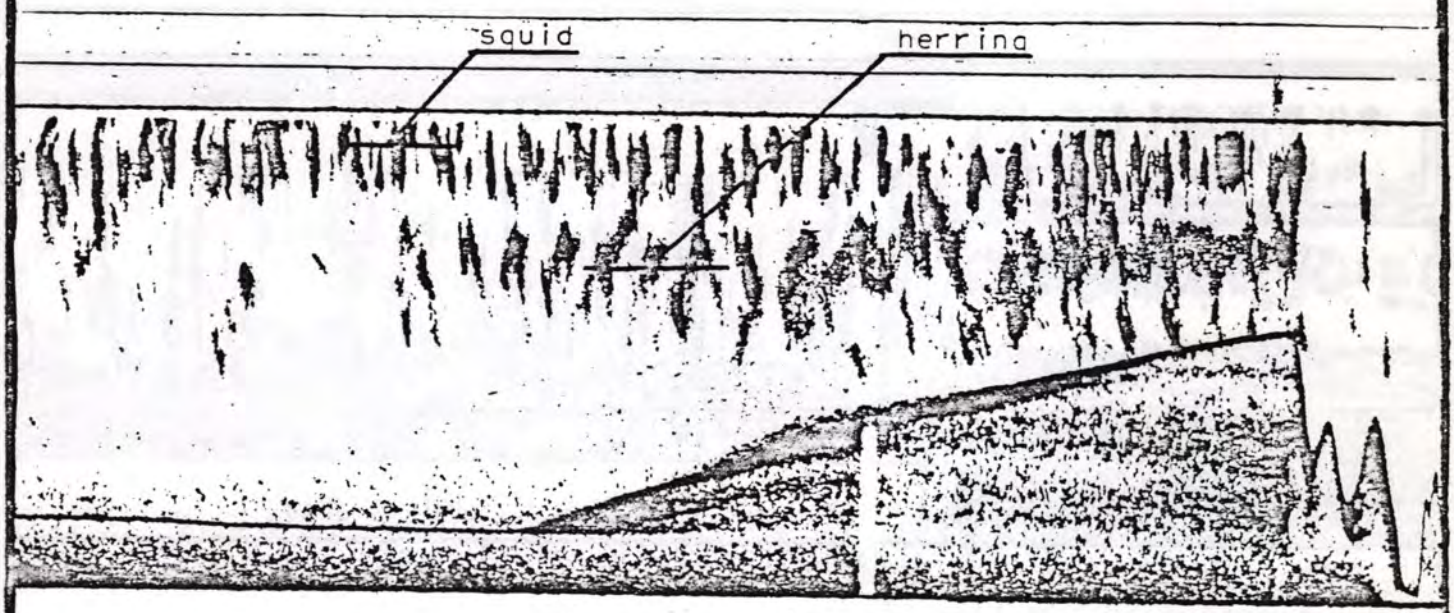


Figure # 33: Chart recorder display of immature herring and squid schools (station #14).



4/14
0400
squid & herring
seen in surface
P-53 #13

squid schools near surface
Herring schools underneath

thought the squid would be drawn into the suction pipes. The squid stayed alive for hours like this, but all died before we reached Ketchikan. Some had been in the hatch for over 36 hours, yet we had no trouble with quality.

Squid fisheries are commonly done with dry hold vessels. Even in Southern California where there are RSW boats fishing, they elect not to use the system because the squid clog the suction intakes. The use of dryhold vessels in California does not present a problem as vessels off-load every day and the fishing grounds are close to off-loading ports. In Southeast Alaska dry hold vessels would be attracted to a squid fishery and the holding time of the catch is a factor to reckon with. The distance between fishing grounds and off-loading stations is significant but not extreme. The cool water and air temperatures in the spring would contribute in a positive way to prolonging holding time.

DISTRIBUTION OF SQUID SAMPLES

The squid sample was processed, washed and packaged into 40 pound and 5 pound containers, and then frozen. This was done by hand, but based on this experience, Phillips Cold Storage thought they could adapt their herring off-loading and processing equipment to do the job. The 40 pound size would be easy to process, while the 5 pound and smaller sizes would involve some hand processing and be more time consuming and costly. However, the small sizes would also have greater market value. For the 40 pound size Phillips estimated a $.20 per pound custom processing rate and Halibut Producers Coop in Sitka estimated a $.23 per pound rate including transportation to their Bellingham, Washington warehouse. These are custom packing charges and do not reflect actual commercial processing costs, which may be as low as $.06 to .09 per pound in an on-going operation (Brian Paust, personal communication, 11/82). Processing cost estimates were not made for smaller sizes.

Processed samples were sent to Blue Pacific Corporation, Silver Lining Seafoods, and Pillar Point Seafoods. AFDF received a small quantity

for further distribution, and samples were sent to the SIAL exposition in France as part of the Alaska Seafood Marketing Institute's seafood presentation. Pillar Point Seafoods, a large volume broker for California squid products, indicated they would be interested in all the processed squid I could deliver to them in Seattle. Silver Lining Seafoods wanted to experiment in developing a smoked squid product, yet have provided me with no response regarding the sample. Blue Pacific Corporation buyers were pleased ("tickled") with the frozen squid product and initiated a test fishery for themselves; sending the F/V Pioneer out to find and harvest Loligo opalescens in Southeast Alaska for one week in 6/82. They observed many concentrations of squid, as listed in Figure 30. They found large fishable concentrations of squid, yet were unsuccessful in catching more than samples. One problem they encountered was lack of darkness at that time of year, causing their attracting lights to be much less effective. They began their salmon operations and had no further time for this venture, but indicated their interest for pursuing this in the future.

LOCAL REACTION

During the last two years I have seen growing local interest in the possibility of a commercial squid fishery in Southeast Alaska. Local fishermen's attention has increased considerably and the local Alaska Department of Fish and Game is finally cognizant that some resource potential exists. It seems probable that many local fishermen would participate in a spring squid fishery.

There are numerous benefits that would result from establishing a squid fishery in Southeast Alaska. Squid products have a local bait value as well as an export value, so harvesting squid would provide a new source of income for the Southeast Alaska fishing industry. The timing of the fishery would be off-season, not conflicting with the traditional fishery interests of fishermen and processors. Existing vessels could readily adapt to the gear requirements. The fishery would have a strong tendency to attract local fishermen, as it is not valuable enough to attract outside interests. Overall, development of

the fishery would contribute to the healthy diversification of the regional fishing industry, provide employment, and promote resource utilization. These are obvious reasons, but is fishery development possible? The findings of this report provide a lot of positive support yet not a clear cut answer of feasibility.

LIMITATIONS AND RECOMMENDATIONS

The findings of the project have resulted in a fragmented view of the squid resource of Southeast Alaska. The project identified the resource in a general way and answered some questions of when, where, and how to harvest the resource. Yet there are unanswered questions: How abundant is the resource? What sort of catch per unit effort would the fishery have? And is it economically feasible to process and sell squid products from Southeast Alaska? It is beyond the scope of this project to answer these questions. This project has been a limited effort; a two week cruise and some follow-up observations concentrating on a small area of Southeast Alaska on essentially a hit or miss basis.... it has been a shot in the dark really! Yet, it has successfully contributed valuable fundamental information about the resource and provides strong encouragement to further squid fishery development in Southeast Alaska. Where does this work go from here? Further progress in research investigations and commercialization are necessary. Technically the methods of commercial harvest have been worked out and can be readily adapted to the conditions of Southeast Alaska.

Research efforts on Loligo opalescens should be directed towards spawning grounds investigations. The goals of this research should be to provide further information on the distribution and extent of spawning, and get a handle on resource abundance (e.g. hydroacoustic studies may be possible on spawning concentrations).

This approach could provide a fairly comprehensive basis for evaluating the vitality of the resource for commercial management purposes. Squid spawnings are not readily apparent, in contrast to herring spawnings which are obvious from the surface, both from the

discoloration of the water by milt and the abundance of predators. Squid spawnings could and apparently have gone unnoticed in Southeast Alaska. It would take a coordinated effort to illuminate these investigations further. Alaska Department of Fish and Game should be responsible for pursuing this investigation. The vessel and equipment requirements are similar to those involved in their herring research, so perhaps this work could be done in conjunction with that effort. Fish and Game also has access to the catch records that would result from a commercial squid fishery, and these data combined with a fisherman's log book program regarding squid could be the foundation of a data base for squid management.

Investigations of the existence of squid species other than Loligo opalescens should be encouraged. Other species have been observed. The strategy of investigation should take a different approach than that used for Loligo opalescens, as it is quite unlikely other species would have the same behavior and spawning characteristics.

An effort should be made to commercialize the Loligo opalescens resource of Southeast Alaska. A large market already exists for this product. Shoreside processors are available and harvesting could occur at a convenient time for their operation. It appears that their existing herring processing equipment could be easily adapted to large volume processing of squid. As of yet however, processing costs are undetermined and it is uncertain for what cost you could deliver these products to the eventual buyer. This risk factor is the fundamental obstacle at present. A processing subsidy or some other arrangement to reduce this risk could really open the door to commercialization.

The design for the commercial fishing operations has been worked out, yet there are some essential elements to consider for Southeast Alaska. Initially fishing effort should occur during the peak of the spawning season, perhaps May to mid-June. The operation should occur during the hours of darkness and employ a minimum of 2,000 watts of attracting lights. The use of attracting lights focused directly at water's surface seems essential. The use of a small meshed encircling net, one small enough to use near the rocky shorelines of Southeast

Alaska yet large enough to catch a large amount per set, seems appropriate. Obviously the fisherman's goal is a large volume harvest per night as he cannot hold his catch for any great length of time. The common Southeast Alaska seine vessel would be a suitable vessel for this fishery, being capable of operating the required gear and able to hold and transport large catches. These vessels have significant operating expenses as well. The low squid product value makes the profit expectations less than alluring. How large a catch per unit effort can the fisherman realize on a consistent basis? This will take an investment of time, energy and money on the part of the fisherman before he can answer this. Given an economic incentive, a reasonable market value for his catch, there would be many interested participants in Southeast Alaska.

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APPENDIX A: Log of Activities

April 10, 1982

Station 1: Cholmondeley Sound, Chasina Anchorage, drifting.

2100: Attracting lights turned on.
Individual squid observed streaking through the perimeter of light.
Small school (25) cod passing through lights.

2130: Cod schooling under lights (12"-14").
Great amount of plankton in water, can see to approximately 7' depth under the focus of the starboard attracting lights. Two more squid observed, decided to move after 70 minutes.

Station 2: Cholmondeley Sound, Lancaster Cove, anchored.

2350: Attracting lights on.
No targets on acoustic equipment.
Night is completely dark, overcast, no moon.

April 11, 1982

0010: Small school of cod schooling under lights.

0030: Small school, like target on chart recorder.
Schools concentrate and layer at 10 fathoms.
Fuzzy and stick-like approximately 3 to 5 fathoms in depth.

0110: Schools moving towards surface.

0200: Schools dispersed at surface. Appears to be large concentration of cod.

Station 3:

0300: Cholmondeley Sound, Sunny Cove, drifting in 30 fathoms.

0320: Small school of cod under lights. Heavy snowfall.

0325: One 5" squid observed streaking through light.

0335: Leaving and searching to West Arm.

Station 4:

0415: Cholmondeley Sound, West Arm, drifting. Faint targets on acoustic equipment.

0430: Some small squid observed.

Station 5:

0445: Cholmondeley Sound, near Lagoon Creek, anchored.

0450: Schools accumulating under boat. Schools at 7 fathom deep. 3 to 4" herring observed continuously at surface in all areas of light.

0510: Target schools rising, amount of small herring at surface increasing to large number.

0515: First noticeable light of dawn.

0523: Schools descending and dispersing.

0550: Schools descended yet still observable.

April 11, 1982

2100: Anchored, attracting lights on.

2345: No squid observed, pull anchor, search to head of West Arm.

April 12, 1982

0025: Anchored head of West Arm, attracting lights on.

0030: Thick layer of fish targets (25 fathom thick school).

0050: Layer under vessel continues to concentrate.

0110: Layer continues to concentrate. Small targets near surface.

0200: Laver concentrating and moving towards surface. Small school of 10" squid observed. Another small school observed in shadow of light.

0210: Layer has moved to within 3 fathoms of surface.

0230: A few squid seen at surface. Visibility approximately 2 fathoms into water. 30 mph S.E. rain and snow, lots of windchop.

April 12, 1982

0420: Euphausiids and salmon fry observed all night.
0520: No confirmation of target layer.
0545: Target layer descending. Dawn.
1700: Search to South Arm to begin nightly activities.
1930: Many stick-like herring schools and other less dense targets observed during run.

Station 7:

2020: Cholmondeley Sound, South Arm, anchored. Attracting lights on.
2100: Target layer appears to be lifting from bottom.
2150: Leave station, search South Arm area.

Station 8:

2200: South Arm, drifting on light trace of targets.
2215: Layer similar to last two nights.

Station 9:

2330: South Arm, drifting atop target concentrations.
2350: A few small squid seen under lights. 6".

April 13, 1982

0045: Target concentrations moving towards surface. Appears to be pulsing up and down. 2 fathoms in depth. A few 5" squid at surface.
0130: Target concentrations have moved to surface. Appears to be large concentration of small herring. 5". Herring stay in shadows of light.

Station 10:

0245: Cholmondeley Sound, drifting 38 fathoms, ledge west of Divide Head.
0310: No observable targets.

Station 11:

0330: West Arm, drifting, at 70 fathoms.
0430: Small herring observed.

Station 12:

0500: Cholmondeley Sound, Dora Bay, drifting.
0525: No observable targets.
0530: Anchored Lancaster Cove.
1800: Pulled anchor, search to Moria Sound.

Station 13:

2050: North Arm, Moria Sound, drifting on deep targets.
2125: School concentrates under boat, rise to surface, small herring seen on surface.
2140: Searching North Arm near Diechman Island.

Station 14:

2300: Moria Sound, Clara Island Cove drifting.
2350: Very dramatic patter of pulsation of target school, up and down 10 fathoms every 2 to 3 minutes. Small school of cod under lights at surface. Small squid observed.

April 14, 1982

Station 15:

0030: Moria Sound, Black Point Cove.
0100: Small herring observed.

Station 16:

0155: Moria Sound, outer Dickman Cove.
0220: 20 cod under lights, no targets under vessel.

Station 17:

0245: Moria Sound, West Arm, Fredrick Cove.

0320: 300 plus 4" squid seen on surface and on recorder.

0400: Immature herring present. Both squid and herring schools on recorder squid will not strike jigs. Great amount of Euphasids.

Station 18:

0440: Moria Sound, middle of West Arm, drifting.

0450: Euphausiids at surface under lights.

0510: Head to Port Johnson.

0700: Anchored at Port Johnson.

Station 19:

2030: 2 miles north Nelson Cove, Gravina Island.

2130: Light spotty layer within 2 to 4 fathoms of bottom, no observations under lights.

2145: Small 4" herring and cod under lights, shrimp also.

Station 20:

2220: Gravina Island shore, off Smooth Mt. 60 fathoms drifting.

2225: Small targets in water column. Cod under lights.

Station 21:

2440: Gravina Island shore, off Grant Cove, 35 fathoms drifting.

April 15, 1982

0220: Small shrimp at surface.

Station 22:

0225: Gravina Island, Vallner Bay, 35 fathoms drifting. Clear sky, no moon, northern lights.

0220: A few cod under lights. Small individual targets on recorder.

Station 23:

0305: North Behm, Bond Bay, 20 fathoms drifting.

0340: Small shrimp, 8" cod.

Station 24:

0405: North Behm, Sandy Beach, 50 fathoms drifting.

0425: Few small herrring, no targets on meter.

Station 25:

0505: North Behm, Helm Bay.

0525: No activity under lights, no targets on meter.

0545: Head to Ketchikan, drop off AFDF observer Chris Riley. Make further arrangements with Phillips Cold Storage concerning sample processing. Take on fresh water.

April 16, 1982

1500: Leave Ketchikan for Snow Pass area.

Station 26:

2230: Snow Pass area, Thorne Island 20 to 40 fathoms drifting.

2304: No targets.

Station 27:

2355: Snow Pass area, north of Exchange Island at mouth of Exchange Cove 27 fathoms drifting.

April 17, 1982

0025: A couple shrimp under lights, no other targets.

Station 28:

0055: Snow Pass area. 1 mile west of Tide Island, 25 fathoms drifting.

0120: No targets on recorder, no observations under lights.

0300: Anchor in Red Bay. 40 mph S.E.

1400: Pulled anchor Red Bay, headed to El Capitan.

Station 29:

1845: El Capitan, small cove east of Anneskett Point, anchored.

2220: Salmon fry at surface (50) no targets on recorder.

Station 30:

2235: El Capitan, drifting targets on recorder.

2300: Immature herring, salmon fry, shrimp and 6 to 8" squid at surface.

2310: Large concentration 3" herring at surface. Largest squid observed so far.

Station 31:

2330: El Capitan, drifting.

April 18, 1982

0000: Small (4") herring at surface.

Station 32:

0030: El Capitan, Devil Fish Bay, drifting.

0100: Immature herring under lights, heavy snowfall. Sparrows circling boat and diving into water.

Station 33:

0110: El Capitan, across from Devilfish Bay.

0131: Immature herring, shrimp under lights, small targets on recorder.

Station 34:

0200: El Capitan, 2 miles south of Devilfish Bay.
0230: Immature herring, shrimp under lights.
0252: No more squid observed many immature herring at surface. Herring-like layer on recorder.

Station 35:

0305: El Capitan, Sarheen Cove, 75 fathoms drifting.
0335: Thick herring - like layer on chart recorder, immature herring seen under lights.

Station 36:

0352: El Capitan, 1 mile south of Sarheen Cove, drifting.
0420: No targets on recorder, no observations at surface.

Station 37:

0455: El Capitan, north of Tenass Island, drifting.
0500: 4 steelhead observed under lights.
0520: No other targets.
0530: Anchored.

Station 38:

2100: El Capitan, north of Tenass Island.
2130: No observations at surface under lights. About 3 fathoms herring like layer near the 20 fathom bottom seen on recorder.

Station 39:

2220: El Capitan Passage, drifting North Island.
2240: 4" herring on surface, think herring-like layer on recorder.

Station 40:

2305: El Capitan Passage, 1/8 mile north of West Kassaan Island.

2335: Salmon fry under lights. Small herring-like targets on recorder.

2340: Searching towards Tuxecan area.

April 19, 1982

Station 41:

0035: South entrance to Tuxecan Narrows, drifting. Shallow less than 10 fathoms.

0050: Strong winds continue to increase, difficult to maintain any stationary position.

0105: No targets on recorder. No observations under lights. Flock of geese knock down the VHF antenna and VHF scanner antenna.

Station 42:

0130: Tuxecan Passage, ¼ mile east of Kogun Point, drifting..

0250: Immature herring on surface, salmon fry, two adult steelhead, herring-like layer on recorder.

Station 43:

0215: Tuxecan Passage.

0255: No observations under lights 15 fathom herring-like layer on chart recorder.

Station 44:

0308: Tuxecan Passage, 50 yards off Athun Point, drifting in 65 fathoms.

0315: Thin layer on chart recorder at 20 fathoms.

0335: Needle fish, salmon fry observed under lights. Thick (15 to 25 fathoms) herring-like layer on recorder.

0340: Searching towards Nossuk Inlet.

Station 45:

0425: South of Tonewek Narrows, drifting in 45 fathoms.

0450: No observations under lights. No targets on recorder. (First light 0440).

0500: Head to Nossuk anchorage.

Station 46:

2100: Nossuk anchorage, anchored.

2200: No observations on recorder or under lights. S.E. storm all day, currently S.E 50+ mph. Stay on the pick tonight.

April 20, 1982

Station 47:

2110: Salt Lake Bay. 1 mile south of the entrance (twilight still).

2200: No observations under lights. No targets on recorder.

Station 48:

2230: St. Phillips Island, drifting off north shore. Clear skies, S.E. 10 mph.

2300: Salmon fry and needle fish observed under lights. No targets on chart recorder.

Station 49:

2310: Culebra Island, ¼ mile off west shore, drifting.

2340: Salmon fry observed under lights. No targets on chart recorder, continue search.

April 21, 1982

Station 50:

0025: Santa Rosalia Point, 1 mile north drifting in San Christoval Channel in 35 fathoms.

0052: Salmon fry under lights a few small targets on recorder, continue search.

Station 51:

0103: Entrance of small cove west of Port San Pasqual, drifting in 16 fathoms.

0127: Many salmon fry, some needle fish under lights, no targets on chart recorder.

0130: Continue search.

Station 52:

0242: Fish Egg Island, 1 mile N.W. in San Alberto Bay, drifting in 20 fathoms.

0310: Salmon fry observed under lights. No targets on recorder.

0320: Continue search.

Station 53:

0337: 250 yards off east shore of Klawock Inlet across from north tip of Fish Egg Island, drifting in 25 fathoms.

0407: Salmon fry and needle fish under lights. No targets on chart recorder.

0410: Continue search.

Station 54:

0420: Craig Cold Storage dock, 100 yards off.

0445: Thick plankton bloom present. Immature herring under lights (8"). Salmon fry.

Station 55:

2125: Coronados Island, drifting in 70 fathoms. Dense herring-like layer at 20 to 30 fathoms depth as seen on recorder.

2155: Very thick layer on recorder, to 25 fathoms.

2217: Salmon fry under lights, target layers on recorder thought to be herring. Continue search.

Station 56:

2230: Culebrina Island, drifting in 45 fathoms.

2240: Herring-like layer on recorder 10 to 15 fathoms in depth.

2230: Salmon fry and immature herring observed in light at surface. The target layer has been rising and accumulating. I assume this to be small herring.

2335: Continue search.

Station 57:

2355: Ladrones Island, in the hole.

April 22, 1982

0025: Salmon fry under lights at surface. No targets on chart recorder.

Station 58:

0037: Trocadero Bay, drifting in the south end of the trench, ½ mile south of Canas Island.

0118: Salmon fry under lights at surface. Thin herring like layer on recorder.

0120: Continue search.

Station 59:

0138: Cove S.W. of Port St. Sebastian, drifting in 24 fathoms.

0200: A dozen 1 to 2" squid observed in light.

0208: School of 50 3 to 4" squid under lights. Thin herring-like layer on recorder.

0235: Salmon fry, needle fish and small squid appear compatible at surface. School of approximately 100 small squid passing through light. Plankton very thick in water.

Station 60:

0240: Move to within 50 yards of shore, drifting in 20 fathoms.

0250: No targets on recorder. No observations under lights.

Station 61:

0313: 1 mile east of the copper mine inside Tracadero Bay, drifting in 22 fathoms.

0343: Salmon fry under lights. Thin herring-like layer on recorder.

0350: Continue search.

Station 62:

0417: Return to Station 59 to search area.

0425: Some school targets on bottom (45 fathoms) gravel flats.

0445: No response from targets. No observations under lights. Herring like-layer on recorder.

0535: Anchored Port Caldera.

Station 63:

2120: Small cove east of Pt. Arucenas, Bucareli Bay, drifting in 45 fathoms, sandy bottom.

2200: Immature herring, needle fish, salmon fry observed under lights. Scattered targets (2) near bottom on recorder.

2205: Continue search.

Station 64:

2215: 1/4 mile off rocks at Port Cangrejo, drifting.

2245: Salmon fry, needle fish, steelhead under lights, also many small herring flipping on surface at perimeter of light. Herring-like targets on recorder.

0250: Continue search.

Station 65:

2305: Mouth of Port Estrella, east of Cape Flores light, drifting.

2320: Salmon fry, needle fish, euphasids under lights, small herring, flipping at perimeter of lights.

2335: Continue search.

Station 66:

2355: In mouth of Adrian Cove, drifting in 22 fathoms.

April 23, 1982

0030: Approximately 20 10 to 14" squid passing under lights. Squid will not strike jigs. Salmon fry under lights. Small herring flipping at perimeter of light.

0100: Small school of squid continues to pass through area of light.

0125: Three squid caught on jigs. Approximately 50 squid in school stay 4 to 6 feet below surface.

0130: Continue search.

Station 67:

0143: 1/4 mile east of Port Verde.

0152: One 1" squid under lights. Water temperature 44°F. Salmon fry, needlefish under lights. A lot of small herring flipping at surface in perimeter of light. Herring-like layer on recorder.

0218: Two steelhead under lights.

0220: Continue search.

Station 68:

0230: Drifting over the large flats of the stream just north of Waterfall Cannery.

0300: No observations under lights. No targets on recorder. Continue search.

Station 69:

0310: Near Waterfall Cannery, drifting in 6'.

0315: Squid in all areas of light, many targets on recorder.

Station 70:

0325: Tie up to Waterfall dock.

0405: Squid in all areas of light under boat to bottom of recorder. Dip net squid out of large school near dock, squid are very docile, on surface in light.

0430: 1" squid and large spawning squid under lights of vessel. Euphausiids at surface.

0515: (Dawn). Squid under vessel, lights are gone. Squid still under lights of dock in shallows.

0600: Squid still at surface. Eggs found in squid. Squid alive in hatch full of water. Watchman at Waterfall resort has observed large concentrations of squid since December and previous year as well. Greatest abundance in February. Larger species also observed.

Station 71:

2035: Near Waterfall Cannery, anchored in 11 fathoms. Attempt to concentrate squid in deeper water as they move to the shallows tonight.

2120: No observations under lights. No targets on recorder.

2135: A few squid swimming through light schools seen on recorder thought to be squid.

2225: More squid moving through lighted area feeding on euphausiids. Schools on recorder, moving not stationary.

2327: Schools of squid have stopped briefly under lights, then move off.

2340: Surveillance with small skiff reveals large concentrations of squid under dock lights. The squid appear to have moved toward the shallows from the deeper areas. Frequent coupling behavior observed in the large schools.

April 24, 1982

0000: Recorder indicates thick layer of squid on bottom, with scattered targets throughout water column to surface, this distribution seems to prevail over a large area that we have searched yet only in shallows less than 8 fathoms.

Station 72:

0200: Near Waterfall dock. Large concentration of squid under focus of collecting lights, very docile. Dip net sample squid from this concentration.

0230: Squid observed on surface to the extent of light on water, a very large concentration.

0240: Searching area, isolated schools found in deeper areas, yet only squid in shallows seem to be stationary targets. There is a thick blanket of squid on the bottom in the shallows (less than 8 fathoms), all areas with squid on bottom have squid through the water column to the surface.

0300: Run sample to Ketchikan.

1600: Arrive in Ketchikan. Phillips will not process samples until Monday.

April 25, 1982

1200: Squid still alive.

1700: Spend day unloading fishing equipment.

April 26, 1982

1300: Unload squid at Phillips Cold Storage. All squid dead, some for 24 plus hours. 334 pounds total sample. Squid washed in fresh water. Boxed and frozen. 160 pounds in 40 pound containers. 174 pounds in 5 pound containers.

1400: Squid spawned in hatch. Egg sacs translucent white 1½ to 2" long.

APPENDIX B: Squid Sample, Station 70
Mantle Length, inches

5.0
5.25
5.75
5.5
5.0
5.5
5.25
5.25
4.75
4.25
5.5
4.74
5.0
5.25
5.5
5.0
5.0
5.0
4.75
5.0
4.5
4.0
5.25
5.5
5.5

* Average mantle length = 5.25 inches
* Average weight: .13 pounds
  Eggs found in females
* This analysis done from a small sampling of a larger, approximately 200 pounds of sample.