

ABSTRACTS

Keynote Address

By Richard Beamish

Beliefs, speculations and the sad history of dogfish management

R.J. Beamish, G.A. McFarlane, and R.M. Sweeting

Abstract

Spiny dogfish are a remarkable fish
Feeding on plankton as Pauly would wish

Gluttony is a sin that is not on their souls
Growing so slowly that they became very old

Babies arrive already to play
After living in their moms for two years less a day

Peaceful in life they avoided confrontation
Until humans arrived with merciless exploitation

Stewardship and respect was not in our game
As we fished and destroyed without any shame

It is amazing how people with advanced education
Could plot or ignore attempts at extermination

But citizens concerns now give dogfish rights
So all of us here must work to reverse their plights

SESSION 1

Review of world fisheries for dogfish

1. European fisheries for spurdog (*Squalus acanthias*): Historical perspective and current status Mike Pawson and Jim Ellis
2. Atlantic coast of North America Paul Rago, Steven Campana, and Vincent Gallucci
3. Pacific coast of U.S. Greg Bargmann

TITLE: The evolution of spurdog *Squalus acanthias* fisheries and assessment of their impact on stocks in the North-east Atlantic: where are we now and how do we manage for sustainability?

AUTHORS: Mike Pawson and Jim Ellis, Centre for Environment, Aquaculture and Fisheries, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK.
00 44 1502 524436
mike.pawson@cefasc.co.uk

ABSTRACT: This paper will provide evidence of stock structure of *S. acanthias* in the North-east Atlantic, describe the fisheries that have exploited these stocks since the early 20th century, and demonstrate that the population is severely depleted. We will discuss the reasons why there has been a lack of effective management of this fishery, and suggest and evaluate possible measures that might be used to aid stock recovery.

TITLE: REVIEW OF PACIFIC COAST FISHERIES FOR DOGFISH

by

Greg Bargmann
Washington Department of Fish and Wildlife
600 Capital Way
Olympia, WA 98501
Phone (360) 902-2825
Email bargmgggb@dfw.wa.gov

ABSTRACT: The commercial fishery for spiny dogfish has occurred in the 1860's. Through this time period the fishery has progressed through several stages:

1870-1916 the fishery for oil for use in lighting and lubrication

1917-1937 the fishery for fish meal and oil

1937-1950 the fishery for livers

1974-present the fishery for human food

Despite indications of local depletion and the economic importance of the dogfish fisheries, it appears that most public and industry concern was that the dogfish abundance was too high rather than too low.

Historically, the fishery extended as far south as Fort Bragg California. The great majority of the commercial catch from the waters of the United States was taken off of Washington state, including Puget Sound. Three fishing gears dominated the catch of dogfish: otter trawl, set net and set line.

SESSION 2

Biology and Ecology Reproduction and Age Studies

1. The potential effects of maternal size on the survival of newborn spiny dogfish. (*Squalus acanthias*) Katherine Sosebee
2. Demography, endocrinology and the management of spiny dogfish (*Squalus acanthias*) in Puget Sound. Cindy Tribuzio, Vincent Gallucci, Penny Swanson, Greg Bargmann
3. Determination of gastric evacuation rate for spiny dogfish. (*Squalus acanthias*) Kristin Hannan
4. Spiny dogfish in Atlantic Canada: biology and age structure, including a new method for age validation. Steven Campana, Cynthia Jones, Gordon McFarlane, and Sigmond Myklevoll
5. Growth change in the spiny dogfish (*Squalus acanthias*) along a latitudinal gradient. Nicci Vega, Vincent Gallucci, Lorenz Hauser, James Franks

TITLE: The Potential Effects of Maternal Size on the Survival of Newborn Spiny Dogfish, *Squalus acanthias*

AUTHOR: Katherine A. Sosebee-Presenter, Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, MA 02543, Katherine.Sosebee@noaa.gov

ABSTRACT: Mature female spiny dogfish from the Northwest Atlantic were examined for the presence of free embryos during Northeast Fisheries Science Center winter, spring, and autumn research bottom trawl surveys conducted during 1998-2005. The embryos were counted, measured and weighed. A positive relationship was found between maternal length and the number of free embryos, as well as between maternal length and the mean size of the near-term embryos. Given that the size structure of the mature female dogfish population has been truncated during the last decade, these relationships suggest that first-year survivorship of spiny dogfish has been negatively impacted in recent years.

TITLE: Demography, endocrinology and the management of spiny dogfish (*Squalus acanthias*) in Puget Sound, WA

AUTHORS:

Cindy A. Tribuzio^{1,2}, Vincent F. Gallucci¹, Penny Swanson², Greg Bargmann³
Corresponding Author:

¹School of Fisheries and Ocean Sciences , University of Alaska Fairbanks
11120 Glacier HWY
Juneau, AK 99801
Phone: 907-465-6441
Fax: 907-465-6447
Email: c.tribuzio@uaf.ed

²School of Aquatic and Fishery Sciences, University of Washington
1122 NE Boat St.
PO Box 355020
Seattle, WA 98105-5020

³Integrative Fish Biology Program, Northwest Fisheries Science Center
2725 Montlake Blvd East
Seattle, WA 98112

⁴Washington State Department of Fish and Wildlife
600 Capitol Way N.
Olympia, WA 98501-1091

ABSTRACT: A one year study was undertaken to investigate reproductive parameters and endocrinology of spiny dogfish (*Squalus acanthias*) in Puget Sound, WA to aid management of the commercial fishery. Size at maturity, fecundity and reproductive timing were estimated from 416 females and 185 males sampled from a commercial trawl catch. Size at 50% maturity was estimated at 89.9cm for females and 66.6cm for males, fecundity was an average of 6.85. The pupping season was determined by the stage of embryonic development and found to peak in September and October. Serum samples were collected from 203 females and 144 males. Samples were assayed for concentrations of estradiol and progesterone (females), and testosterone (males). The results presented here show that distinct reproductive stages can be identified by the hormone concentrations alone with greatest accuracy at the most critical management stages. Sampling blood from live dogfish is less invasive and costly (both economically and timely) than sacrificing and dissecting dogfish to determine reproductive state, making monitoring the reproductive cycling of a population less of a process for fishery managers.

**Determination of gastric evacuation rate for spiny dogfish,
*Squalus acanthias***

KRISTIN HANNAN
Friday Harbor Laboratories
620 University Road
Friday Harbor, WA 98195

Abstract. The gastric evacuation rate was estimated for spiny dogfish from the north Puget Sound. Individuals were fed a fixed ration of herring, removed at fixed intervals, and lavaged. The use of gastric lavage allowed for re-use of animals, which was not found to have a statistically significant impact upon the rate of gastric evacuation, eliminating the need for large numbers of test subjects. An exponential model provided the best fit to the proportion of prey weight remaining over time to describe the rate at which the stomach empties. The resulting estimate provides that the amount of time required for an average meal of 2% to be evacuated is 110 hours or 4.5 days. The rate of gastric evacuation in spiny dogfish is consistent with that of other elasmobranchs of similar size at similar temperatures (e.g. *Scyliorhinus canicula*).

Key words: gastric evacuation; gastric lavage; exponential model; spiny dogfish, Puget Sound

TITLE: Spiny Dogfish in Atlantic Canada: Biology and Age Structure, Including a New Method for Age Validation

AUTHORS: Steven E. Campana, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2, 902-426-3233, campanas@mar.dfo-mpo.gc.ca; Cynthia Jones, Center for Quantitative Fisheries Ecology, Old Dominion University, Norfolk, Virginia 23508, 757-683-4497, cjones@odu.edu; Gordon A. McFarlane, Pacific Biological Station, Nanaimo, British Columbia, Canada V9R 5K6, 250-756-7052, mcfarlanes@pac.dfo-mpo.gc.ca; Sigmund Myklevoll, Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway, sigmund.myklevoll@imr.no.

ABSTRACT: Spiny dogfish are abundant in Atlantic Canada, although their population status is unknown. There appears to be strong links to dogfish in U.S. waters, which are currently believed to be in danger of recruitment collapse. To quantify dogfish abundance and assess population health, the fishing industry and DFO have entered into a 5-year cooperative research program to study dogfish biology and population status in Atlantic Canada. Preliminary results indicate that Atlantic Canadian dogfish mature at younger ages, and at smaller sizes, than their Pacific counterparts. To verify that the apparent differences in growth rate are not an artifact of differences in ageing methods, a new method of age validation was developed to confirm the accuracy of annual growth bands on the dorsal fin spines. Here we report the first application of bomb radiocarbon as an age validation method based on date-specific incorporation into spine enamel. Our results indicate that the dorsal spines of spiny dogfish recorded and preserved a bomb radiocarbon pulse in growth bands formed during the 1960s, which was used to confirm the validity of spine enamel growth band counts as accurate annual age indicators to an age of at least 45 yr. Based on the age-validated spines, the growth rate of spiny dogfish in the northwest and northeast Atlantic is substantially faster, and the longevity is substantially less, than that of dogfish in the northeast Pacific.

TITLE: Growth change in the spiny dogfish (*Squalus acanthias*) along a latitudinal gradient

AUTHORS: Nicci Vega, Vince Gallucci, Lorenz Hauser, James Franks

ABSTRACT: The spiny dogfish (*Squalus acanthias*) is numerous in Pacific waters from the Gulf of Alaska/Bering Sea to Baja California, particularly in northern regions (Washington State/British Columbia and Alaska). The life history traits of the dogfish do appear to vary among regions within the North Pacific, and it is theorized that variations in life history between regions may be evidence for the existence of subpopulations of dogfish. The objective of this project (see also abstract by Hauser et al.) is to determine whether dogfish from different regions can be shown to be demographically and/or genetically distinct and to use this genetic and demographic information to describe the subpopulation structure of the spiny dogfish in the North Pacific.

Results and potential difficulties of fitting a von Bertalanffy growth curve to age-length data are discussed, particularly with regard to making statistical comparisons of growth curves between regions. Results are shown for comparisons of growth curves between regions along the latitudinal gradient and between inshore and offshore waters. Statistical results are compared with the results of genetic analyses available to date.

Session 3

Stock identification and ecology

1. Genetic differentiation and phylogeography of Atlantic and Pacific spiny dogfish (*Squalus acanthias*). Lorenz Hauser, Nicci Vega, Vincent Gallucci, James Franks
2. Coastal migration of tagged spiny dogfish, (*Squalus acanthias*) released on overwintering grounds in North Carolina coastal waters. Roger Rulifson
3. Report of an ongoing investigation of the life history, ecology and population dynamics of spiny dogfish (*Squalus acanthias*) in Alaska. Cindy Tribuzio & Gordon Kruse
4. Phylogeny and fossil record of dogfishes. Jürgen Kriwet

TITLE: Genetic differentiation and phylogeography of Atlantic and Pacific spiny dogfish (*Squalus acanthias*)

AUTHORS: Lorenz Hauser, Nicci Vega, Vince Gallucci, James Franks

ABSTRACT: Many shark species are particularly vulnerable to exploitation, as they exhibit slow growth, long time to maturity, and low fecundity. Historically, spiny dogfish (*Squalus acanthias*) are among the most exploited elasmobranch species, and have been declared overfished in the North Atlantic. With the potential for expansion of the northeast Pacific fishery, valuable lessons may be learned from the rise and fall of the North Atlantic fishery. However, the taxonomic relationship between Atlantic and Pacific dogfish is uncertain, and differences in life history characters suggest considerable differences in environment or genetics of the two groups. Here we present genetic data of spiny dogfish in comparison with other related shark species, suggesting long separation between Atlantic and Pacific populations. Results are compared to patterns in marine teleosts, considering differences in ecology and life history as well as in mutation rates and genetic variability.

TITLE: Coastal Migration of Tagged Spiny Dogfish, *Squalus acanthias*, Released on Overwintering Grounds in North Carolina Coastal Waters.

AUTHORS: Roger A. Rulifson, Institute for Coastal and Marine Resources, and Department of Biology, East Carolina University, Greenville, NC, 252-328-9400 (W), rulifsonr@mail.ecu.edu. Tina M. Moore, NC Division of Marine Fisheries, Washington, NC, 252-948-3875 (W), tina.moore@ncmail.net.

ABSTRACT: This study was conducted to determine the origin and long distance migration pattern of spiny dogfish overwintering in North Carolina waters. The spiny dogfish was an underutilized species along the US eastern seaboard but in the 1980s fishery agencies encouraged harvest to reduce fishing pressure on other commercial species. North Carolina harvest was greatest in the early 1990s but now is restricted by the ASFMC due to recruitment overfishing. Spiny dogfish collected by trawl and gill net in NC coastal waters were sexed and measured, then tagged with Floy SS single barb dart tags and released at the location of initial capture. Each tag bore a return address and reward of \$5, \$10, \$20, or \$50. To date 15,106 fish have been released during a seven-year period, with 140 recaptures. Overwintering fish migrate northward in the spring, summer in New England, and return in late fall to North Carolina. Spiny dogfish south of Cape Hatteras to the SC-NC state line are part of this migration pattern. Longest time for a fish at large is 2,350 days, although most are recaptured within a year. Until recently tags have not been returned from Canadian waters; however, with a directed fishery for spiny dogfish now in place, several tags have been returned from the Scotian Shelf. There is a significant difference in tag return rates from fish caught by gill net (0.48%) versus trawl-caught fish (2.38%), suggesting higher mortality rates for fish released from gill nets.

TITLE:

Report of an ongoing investigation of the life history, ecology and population dynamics of spiny dogfish, *Squalus acanthias*, in Alaska

AUTHORS:

Cindy A. Tribuzio, Gordon H. Kruse

University of Alaska Fairbanks, Juneau Center School of Fisheries and Ocean Science
11120 Glacier Highway, Juneau, Alaska 99801
(907)465-8453, c.tribuzio@uaf.edu

ABSTRACT: In the Northeast Pacific Ocean, spiny dogfish (*Squalus acanthias*) have supported commercial fisheries for over 100 years, despite sparse biological knowledge about the species. Tagging studies suggest diverse stock structure, including migratory offshore stocks and distinct non-migratory inshore stocks that require region-specific management and research. Biological differences exist between these groups of dogfish. For example, a related study by one of us (CAT) found differences in timing of parturition among dogfish in British Columbia (BC, Canada) inshore waters and those residing in neighboring Puget Sound, Washington (WA). This suggests that biological differences will exist between these previously studied groups and Alaskan dogfish, and possibly even differences among Alaskan dogfish. In Alaska, there is currently no directed fishery, but interest in opening one is increasing. Thus, it is crucial to advance our region-specific knowledge of this species, so that management strategies can be adapted from past lessons learned in other jurisdictions with biological parameters appropriate for Alaska. New Alaskan research projects include assessment of stock status, population demography (e.g., age and size composition, maturity, mortality), life history, ecology, and fisheries bycatch. Biological samples are being collected throughout the Gulf of Alaska to document spatial and temporal variability in biology and ecology to assist in the development of appropriate management units. Ecological impacts of this species are also being investigated by examining predator/prey interactions, consumption, abundance, and seasonal and interannual shifts in geographic distributions. This research is intended to assist ADF&G and Alaska Board of Fisheries to assess the merits of proposed new directed commercial fisheries, as well as to support NMFS and the North Pacific Fishery Management Council to manage spiny dogfish bycatch in federal fisheries. This project began in July 2004. This presentation will cover the project design and sampling plans for the next 3 years, as well as preliminary results from sampling to date.

TITLE: Phylogeny and Fossil Record of Dogfishes

AUTHOR: Jürgen Kriwet, LMU Munich, Faculty of Geosciences, Department of Earth and Environmental Sciences, Section of Palaeontology, Richard-Wagner-Str. 10, D-80333 Munich, Germany, ++49-89-21806613, j.kriwet@lrz.uni-muenchen.de.

ABSTRACT: Dogfishes constitute a monophyletic group of predominantly deep-water neoselachians. Their interrelationships have been discussed controversial in the last years. The phylogeny of fossil and extant dogfishes is re-examined using dental and molecular data to attain a better understanding of their evolutionary patterns. The topologies proposed here partly support previously published hypotheses. Eleven partial phyletic source trees of squaliform interrelationships were merged to create a comprehensive phylogenetic hypothesis. The resulting supertree is the most inclusive estimate of squaliform interrelationships that has been proposed to date, and contains 23 fossil and extant members of all major groups. Ten monophyletic groups are recognized within Squaliformes, three of which are only known from the fossil record. The family Somniosidae appear to be paraphyletic. The supertree provides the best prospect to include fossil organisms that are only known by isolated teeth in phylogenies based on extant taxa. The phylogeny and the simple completeness metric (SCM) were used to scrutinize the quality of the fossil record of dogfishes. Although slightly different (48% and 54% respectively) both measures indicate a relatively poor fossil record for squaliforms. Gaps in the fossil record range from 5 to 100 million years. According to the results, I propose a post-Jurassic origination of squaliforms and rather high extinction rates at the K/T boundary.

Session 4

Assessment and modeling

1. Migration patterns of spiny dogfish in the NE Pacific during periods of high and low exploitation examined from tag-recovery experiments. Ian Taylor, Greg Bargmann, Greg Lippert, Vincent Gallucci
2. A Cultural Consensus Analysis of Fishermens' and Scientists' Knowledge of Dogfish (*Squalus acanthias*) in Puget Sound: a first step toward policy. Mark Miller, Vincent Gallucci and Alex Lowe
3. The status of spiny dogfish in Puget Sound, Washington. Wayne Palsson
4. Distribution and abundance of *Squalus acanthias* and *S blainvillei* in the Mediterranean Sea based on the Meditaerranean International Trawl Survey program (MEDITS). Fabrizio Serena, Costas Papaconstantinou, Giulio Relini, Luis Gil De Sola, Jacques Bertrand
5. Trends in abundance of spiny dogfish in the Strait of Georgia 1980-2004. Jackie King and Gordon McFarlane

TITLE: Migration patterns of spiny dogfish in the NE Pacific during periods of high and low exploitation examined from tag-recovery experiments.

AUTHORS: I. Taylor, G. Bargmann, G. Lippert, and V. Gallucci

Note: this preliminary abstract is dependent on approval of all authors.

ABSTRACT: The first tagging program for spiny dogfish in Washington State was conducted in the early 1940s, coinciding with the period of the highest landings in the history of the fishery, when annual landings in the NE Pacific grew to over 50,000 mt. A second tagging program in Puget Sound in 1969, when landings in the NE Pacific were below 500 mt, their lowest level in over 50 years. A third tagging program occurred in British Columbia in 1978, when landings were again increasing. Patterns of recaptures from the two Washington State tagging experiments are compared, and contrasted with results from the BC tagging study (McFarlane and King, 2003). Possible relationships between the exploitation regime, the tagging results, and the general patterns of dogfish movement are described. The inclusion of tagging data in an integrated population dynamics model for spiny dogfish is discussed.

TITLE: A Cultural Consensus Analysis of Fishermens' and Scientists' Knowledge of Dogfish (*Squalus acanthias*) in Puget Sound: a first step toward policy.

AUTHORS: Marc L. Miller, Vincent F. Gallucci, and Alex Lowe
University of Washington, Seattle, WA
mlmiller@u.washington

ABSTRACT: Spiny dogfish (*Squalus acanthias*) are oviparous, long-lived, and have a long gestation period. The species has been economically overfished in the Northeastern Atlantic and most commercial dogfish fisheries in British Columbia and Washington State have been curtailed because of fishing pressure. Historically valuable for oil and also as a food fish, dogfish have more recently garnered the reputation of a trash fish for its predation on commercial and recreational species, and of a nuisance fish for damage caused to fishing gear. This study employs cultural consensus analysis to compare expert knowledge structures concerning dogfish biology and ecology in Puget Sound. Results from samples of commercial fishermen, recreational fishermen, and fishery scientists validate multiple reputations of dogfish. Implications of cultural consensus findings have constructive implications for the development of hypotheses fundamental in scientific inquiry and also for regulatory and educational functions of dogfish management.

Key words: fishery management, environmental anthropology

TITLE:

Status of Spiny Dogfish in Puget Sound, Washington

AUTHOR:

Wayne A. Palsson
Research Scientist
Washington Department of Fish and Wildlife
16018 Mill Creek Blvd.
Mill Creek, WA 98012
palsswap@dfw.wa.gov, 425-379-2313

ABSTRACT: Declining catches and stocks of spiny dogfish in Puget Sound prompted a review of the biology, fisheries, and management. Dogfish in Puget Sound were heavily fished during WWII for their vitamin rich livers. This fishery reduced dogfish populations by the early 1950s and the fishery coincidentally dwindled to a low level through the mid-1970s. Then, entrepreneurs developed European and Asian markets for dogfish and an intense fishery was re-instituted. Trawls, set nets (sinking gill nets) and set lines (long lines) are the principal gears that catch dogfish. Catches of dogfish from Washington's inside waters have declined to a very low level from a peak of 8.6 million pounds in 1979 to less than 140,000 pounds in 2000. Dogfish caught by recreational fishers now account for the greatest catches of dogfish in Puget Sound.

Two population measures show that dogfish populations have declined in Washington's inland marine waters. Fishery measures of catch success have almost universally declined during recent years for the three principal gears. Even greater declines are observed from fishery-independent bottom trawl surveys that have been conducted by WDFW since 1987. Population estimates ranged between 25 million and 42 million pounds in Puget Sound between 1987 and 1991. During the past ten years, population estimates have been less than 7 million pounds for comparable areas. Assimilating the life history parameters for longevity, a harvest model demonstrates that dogfish populations produce low yields and are likely prone to overfishing

TITLE: Status of Spiny Dogfish (*Squalus acanthias*) in Atlantic and Pacific Canada.

AUTHORS: S.S. Wallace, Blue Planet Research and Education, 9580 Gleadle Road, Black Creek, British Columbia, V9J 1G1, 250-337-8521, scottw@island.net, G. A. (Sandy) McFarlane-Presenter, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, British Columbia, V9T 6N7, 250-756-7052, McFarlaneS@pac.dfo-mpo.gc.ca, S. E. Campana, Marine Fish Division, Bedford Institute of Oceanography, 1 Challenger Drive, P.O. Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, 902- 426-3233, campanas@mar.dfo-mpo.gc.ca, J. King, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, British Columbia, V9T 6N7, 250-756-7176, KingJac@dfo-mpo.gc.ca.

ABSTRACT: In this paper we present recent trend and management information relevant to the assessment of Canada's Atlantic and Pacific populations of spiny dogfish. Information includes current distribution, migration and movement, abundance, number of mature individuals (where possible), trends from adjacent jurisdictions, and current commercial catch and management. Based on annual research surveys, the spiny dogfish population on the Atlantic coast appears to be at a low level of abundance on Georges Bank but stable or possibly increasing along the Scotian Shelf region and in the Gulf of St. Lawrence. Off Canada's Pacific coast, indicators suggest that the population is stable; but there may have been a decrease in larger individuals in recent years. It is proposed that the recent increases in large individuals in Alaska may be linked to a shift in the core distribution of spiny dogfish from Canada's Pacific waters.

TITLE: Distribution and abundance of *Squalus acanthias* and *Squalus blainvillei* in the Mediterranean Sea based on the Mediterranean International Trawl Survey program (MEDITS).

AUTHORS: Fabrizio Serena - Agenzia Regionale per la Protezione Ambientale della Toscana, Via Marradi 114, 57126 Livorno, Italy, +39 0586 263496,

f.serena@arpat.toscana.it

Costas Papaconstantinou – HCMR, 46,7 Km, Athens Sounio, Anavissos 19013 Attica, Grece, pap@ncmr.gr

Giulio Relini - DIP.TE.RIS. Università di Genova, Viale Benedetto XV 3, 16132

Genova, Italy, +39 010 357888, sibmzool@unige.it

Luis Gil De Sola – IEO, Puerto pesquero s/n, Apto 285, 29640 Fuengirola, Spain, gildesola@ma.ieo.es

Jacques A. Bertrand IFREMER, Rue de l'Ile d'Yeu, BP 21105, 44311 Nantes cedex 03 France, Jacques.Bertrand@ifremer.fr

ABSTRACT: Data on the two sharks, collected within the European Union MEDITS program are analysed. Indices of abundance for standardised area (km^2), both in weight and number, were collected during spring since 1994 along the European Mediterranean coasts (from Alboran to Aegean Sea). Five depth strata, between 10 and 800 m depth, were considered. Around 10,000 hauls were performed and 44 elasmobranch species identified. The sharks and rays relative abundance in the whole explored area resulted of 55,000 metric tons: *S. acanthias* is one of the most abundant species with relative abundance of 6,700 tons, while *S. blainvillei* represent only the 3% with 1,500 tons.

The mean density of *S. acanthias* is significantly different between the eastern and western basin of the Mediterranean (22,7 and 0,8 kg/km^2 respectively); vice versa, *S. blainvillei* shows higher density in the western basin than in the eastern one (6,6 kg/km^2 and 1,7 kg/km^2 respectively). However, the spatial distribution of both species is fairly restricted: *S. acanthias* has been caught in only 5% of the tows and *S. blainvillei* in 3%.

Even if the range of presence for both species ranges from less than 50 m to more than 700 m depth, the abundance indexes in relation to depth suggest a major coastal presence of *S. acanthias* than *S. blainvillei*, but this is mainly due to its high densities in the shallow grounds of the northern Adriatic Sea; elsewhere the main concentrations are always in the 200-500 depth range.

As concerns the mean weights, for both species a depth dependence effect is not observed and no more than 10% of the population, in the explored area, is represented by specimens over 2 kg.

**Trends in Abundance of Spiny Dogfish (*Squalus acanthias*)
in the Strait of Georgia, 1980-2004**

J.R. King and G.A. McFarlane

Pacific Biological Station
Fisheries and Oceans Canada
Nanaimo, British Columbia
V9T 6N7
(250) 756-7176
KingJac@pac.dfo-mpo.gc.ca

Spiny dogfish have been an important component of the Strait of Georgia fisheries from the late-1800s to the late-1940s, when the fishery collapsed due to overfishing. The stock reattained population levels that have sustained a commercial fishery of approximately 2,000 tonnes since 1978. In the Strait of Georgia, spiny dogfish are primarily captured by longline gear. Recent concerns regarding the status of spiny dogfish stocks worldwide, including inside waters off the west coast of North America, has reprioritized the assessment of the status of spiny dogfish in the Strait of Georgia. In 1986 and 1989, longline research surveys were conducted for spiny dogfish in the Strait of Georgia as sources of baseline information on this stock's abundance. However, these surveys were not continued therefore the only source of additional information is catch and effort data collected through logbook records from the commercial longline fishery. Recent improvements in gear configuration have resulted in a switch from traditional J hooks to Circle hooks. This switch in gear occurred in the mid-1990s, making direct comparison of catch rates difficult. In November 2004 we conducted a calibration experiment using J hooks and Circle hooks. Overall the Circle hook gear caught 1.6 times more spiny dogfish than the J hook gear. We apply this conversion to the commercial longline catch per unit effort data to examine changes in abundance by area, season over the 1980-2004 time period. These data suggest that spiny dogfish abundance in the Strait of Georgia has declined slightly in recent years.

Session 5

Assessment and modeling 2 –

1. Sequel of the directed fishery for spurdog in the 1980's off west coast of Ireland. Edward Fahy, Peter Green, Ayesha Power and Edgar McGuinness
2. Modeling the competition between sixgill sharks (*Hexanchus griseus*) and the commercial fishery on spiny dogfish sharks (*Squalus acanthias*). Vincent Gallucci, Ian Taylor, Brian Langseth, Joel Rice and Greg Bargmann
3. Statistical comparison of age-length keys from spiny dogfish spines. Joel Rice, Vincent Gallucci, Cindy Tribuzio, Gordon Kruse
4. Status of spiny dogfish in Atlantic and Pacific Canada. Scott Wallace, Gordon McFarlane, Steven Campana, and Jackie King

TITLE: Sequel of the directed fishery for spurdog in the 1980s off the west coast of Ireland.

AUTHORS: Edward Fahy¹ (edward.fahy@marine.ie), Peter Green² (peter.green@cfb.ie), Ayesha Power¹ (ayesha.power@marine.ie) and Edgar McGuinness¹ (edgar.mcguinness@marine.ie).

¹Fisheries Science Section, Marine Institute, Galway, Ireland

²Central Fisheries Board, Unit 4, Swords Business Campus, Balheary Road, Swords, Co Dublin, Ireland.

ABSTRACT: *Squalus acanthias* in the north east Atlantic is believed to constitute a single stock. Elements within it make local migrations but evidence suggests there is a more general clockwise trajectory from the Celtic seas northwards. Progress is slow, associated with growth and maturation in this long lived species and local fisheries can effectively remove spurdog from large sea areas to which they gradually re-immigrate.

A directed fishery for spurdog developed in Ireland in the early 1980s, encouraged by new market opportunities. In 1985 Ireland recorded 8,000 t (20% of the European landings) but Irish catches were in sharp decline from 1988 when the total landings from the north east Atlantic stock were also falling. Spurdog is also an angling species and in 1982 Irish angling charter vessels recorded 0.44 per angler-day. By 1988 only 0.03 were recorded and in 1991 no individual was captured in almost 15,000 angler-days. In 1993 angler performance recovered to 0.13 spurdog per angler-day at which approximate level it remained until 1999, declining thereafter in accordance with trends in landings from the north east Atlantic stock.

The paper examines biological characteristics of commercially caught spurdog during the peak fishery of the 1980s and in the years immediately afterwards. Samples taken by trawl in 2003 and 2004 are compared with the earlier findings. The proposition is advanced that spurdog which have been removed from a sea area are essentially replaced by animals of similar age and size, presumably from an earlier point in the migratory journey.

TITLE: Modeling the Competition Between Sixgill Sharks (*Hexanchus griseus*) and the commercial fishery on spiny dogfish sharks (*Squalus acanthias*).

AUTHORS: Vincent F. Gallucci, Ian Taylor, Brian Langseth, and Greg Bargmann
University of Washington, Seattle, Wa.
vgallucc@u.washington.edu

ABSTRACT: Scientific sampling for sixgill sharks (*Hexanchas greisus*) in Puget Sound suggests that they are significant predators of dogfish. The evidence is indirect in that the dogfish preyed upon were already hooked on a long line at the time. Rates of predation and fishing are estimated from the proportion of dogfish on a skate preyed upon and the numbers of sixgill sharks captured without consuming a dogfish. The mathematical model used to describe the competition between the fishery and the sixgill sharks is a system of two autonomous, interacting, dynamical equations with constant, functional response parameters. The effect of a range of predation rates is examined. Phase plane and time series solutions are estimated, and implications for the directed dogfish fishery are examined from model results. The particular, graphic method of sixgill handling and prey consumption is illustrated.

TITLE: Statistical comparison of age-length keys from spiny dogfish spines.

AUTHORS: Joel Rice, Vince Gallucci, Cindy Tribuzio, Gordon H. Kruse

University of Washington, School of Aquatic and Fishery Sciences

University of Alaska Fairbanks, Juneau Center, School of Fisheries and Ocean Sciences

ABSTRACT: With the exception of the Gulf of Alaska and Bering Sea, the status of spiny dogfish (*Squalus acanthias*) populations in the North Pacific and North Atlantic coasts is relatively well known. Alaskan densities seem to be relatively high based on reported bycatch rates and the existence of a very small directed commercial fishery. Little is known about the age/size structure of the population and limited stock assessments have been conducted. Effective management of dogfish fisheries requires greater knowledge of their life history and population dynamics. Age data would contribute to this understanding. Environmental and genetic factors could cause statistical differences in regional age-length relationships. It is critical to ensure that apparent regional variations in age-length relationships are not due to systematic differences in ageing methods among laboratories. In this paper, we compare ageing methods and results among three laboratories using a reference collection of spiny dogfish spines collected off the coast of Washington. Results are based upon actual differences in laboratory readings and upon simulations.

Session 6

Fisheries management

1. The evolution of spurdog (*Squalus acanthias*) fisheries and assessment of their impact on stocks in the North-east Atlantic: where are we now and how do we manage for sustainability? Mike Pawson and Jim Ellis
2. Management of shark bycatch in Alaskan Federal waters. Dean Courtney, Sarah Gaichas, Jennifer Boldt, Kenneth Goldman, and Cindy Tribuzio
3. The occurrence of dogfish shark in recreational fisheries in the United States and implications for stock assessments. Greg Bargmann and Patty Zielinski
4. Spiny dogfish mortality induced by gillnet and trawl capture and tag and release. Roger Rulifson
5. Post-release mortality of discarded *Squalus acanthias* in a NW Atlantic otter trawl fishery. John Mandelman and Marianne Farrington

TITLE: The evolution of spurdog *Squalus acanthias* fisheries and assessment of their impact on stocks in the North-east Atlantic: where are we now and how do we manage for sustainability?

AUTHORS: Mike Pawson and Jim Ellis, Centre for Environment, Aquaculture and Fisheries, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK.
00 44 1502 524436
mike.pawson@cefas.co.uk

ABSTRACT: This paper will provide evidence of stock structure of *S. acanthias* in the North-east Atlantic, describe the fisheries that have exploited these stocks since the early 20th century, and demonstrate that the population is severely depleted. We will discuss the reasons why there has been a lack of effective management of this fishery, and suggest and evaluate possible measures that might be used to aid stock recovery.

TITLE: Management of Shark Bycatch in Alaskan Federal Waters

AUTHORS: Dean Courtney^{1*}, Sarah Gaichas², Jennifer Boldt³, Kenneth J. Goldman⁴, and Cindy Tribuzio⁵

ABSTRACT: Three shark species commonly occur in Alaskan waters: Pacific sleeper shark, *Somniusus pacificus*, spiny dogfish, *Squalus acanthias*, and salmon shark, *Lamna ditropis*. Information on the distribution, stock structure, and life history characteristics of these species is extremely limited. Sharks warrant particular concern for management because of their late maturity, slow growth rates, long life spans, and low reproductive rates. There are currently no directed commercial fisheries for sharks in Alaskan federal waters, but sharks are captured incidentally as bycatch in federally managed commercial fisheries for other species and some shark bycatch is now being retained. Limited available data from the commercial fishery observer program and from fishery independent surveys indicate that bycatch of sharks in Alaskan federal waters is low (< 3%) relative to targeted catch and that current bycatch levels may be sustainable. However, shark bycatch is considered a nuisance, and there is a perception by some that shark numbers are increasing in Alaskan waters. As a consequence there is increasing pressure to open directed commercial fisheries targeting some shark species, particularly spiny dogfish. Establishing sustainable catch limits under the current federal management regime requires either a catch history, or a reliable point estimate of biomass combined with a natural mortality estimate; none of these⁴ exist for shark species in Alaskan waters. As a consequence, alternative management strategies need to be developed and implemented for these potentially vulnerable species if targeted fisheries are permitted.

Oral (Powerpoint) or poster presentation.

^{1*} Auke Bay Laboratory
National Marine Fisheries Service
11305 Glacier Highway
Juneau, Alaska 99801-8626

²Alaska Fisheries Science Center
National Marine Fisheries Service
7600 Sand Pt Way NE, Bldg. 4
Seattle WA, 98115-0070

³UW/NOAA Joint Institute for the Study of Atmosphere and Ocean
Alaska Fisheries Science Center
7600 Sand Point Way NE, Bldg. 4
Seattle WA, 98115-0070

⁴Jackson State University
Department of Biology
P.O. Box 18540
Jackson, MS 39217

⁵School of Fisheries and Ocean Sciences, Juneau Center
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801-8677

TITLE: The occurrence of spiny dogfish shark in recreational fisheries in the United States and implications for stock assessments.

AUTHORS: Greg Bargmann, Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501, bargmggb@dfw.wa.gov (360) 902-2825 V; (360) 902-2944 FAX

Patty Zielinski, NOAA-Fisheries, 1315 East-West Hwy, F/ST1, Room 12441, Silver Spring, MD 20910. Patty.Zielinski@noaa.gov (301) 713-2328 X212 V; (301) 713-4137 FAX

ABSTRACT: Although rarely a target species, spiny dogfish shark (*Squalus acanthias*) are often encountered by recreational anglers along the Pacific and Atlantic coasts of the United States. These dogfish are usually discarded at sea. The reason most commonly stated for discarding dogfish is that the dogfish are considered to be an undesirable species. Anglers report that the majority of fish are discarded alive, however considerable numbers of dogfish are dead or dying when released. Limited information exists on the size or sex composition of the discarded catch. Examination of the size distribution of the landed catch and the stated reasons for discarding dogfish lead us to surmise that juvenile dogfish predominate the discarded catch.

Stock assessments and fishery management plans thjat do not consider recreational fisheries may underestimate the impact of these fisheries on sogfish abundance.which exclude the impact of recreational fisheries on

TITLE: Spiny Dogfish Mortality Induced by Gill Net and Trawl Capture, and Tag and Release.

AUTHOR: Roger A. Rulifson, Institute for Coastal and Marine Resources, and Department of Biology, East Carolina University, Greenville, NC, 252-328-9400 (W), rulifsonr@mail.ecu.edu.

ABSTRACT: This study was conducted to determine the mortality rates of spiny dogfish collected by commercial gillnet and trawl while overwintering in North Carolina coastal waters. Gillnets of 4 ½, 5, 5 ½, 6, and 6 ½ inches were set for approximately 24 hours. Fish were removed and enumerated by sex and by status (alive or dead). A subsample of 30 fish was placed into a rectangular cage – 15 tagged and 15 untagged – and the cage was anchored to the sea floor for 48 hours. This experiment was replicated with 3 additional cages, and 4 sets of experiments, for a total of 480 fish. Dogfish caught by commercial trawl deployed for 30 minutes up to 1 ½ hours were treated in a similar fashion, for a total of 4 sets of experiments using four cages, for 480 individuals. Results showed 100% survival for dogfish collected by trawl after 48 hours for tagged and untagged individuals. Dogfish collected by gillnet showed a 16% mortality rate for those held for 48 hours, with no significant difference between tagged and untagged individuals. Results of the study were applicable to the offshore tagging program started in 1996, but do not reflect mortality rates that might be observed with standard fishing practices in the trawl and gillnet fisheries.

TITLE: Post-release mortality of discarded *Squalus acanthias* in a NW Atlantic otter trawl fishery

AUTHORS: ¹ **John W. Mandelman** (jmandelman@neaq.org); (617) 226-2168
² Marianne A. Farrington (mfarr@neaq.org); (617) 973-5251

^{1, 2} Edgerton Research Lab (Research Dept.)
New England Aquarium
Central Wharf
Boston, MA 02110

ABSTRACT: Fishing places extensive physical and physiological strain upon the catch. The sustainability and management of non-targeted and juvenile members of targeted species depends upon the fate of discarded bycatch and is a crucial fishery-related issue. Because species-specific differences in survival and recovery exist, conducting post-release analyses on representative species in a fishery are essential. In order to gauge resiliency, this study assessed 72-hour (*in situ*) and 30-day (transport and captivity) post-release status of trawl-caught *Squalus acanthias*, a species unintentionally captured at extremely high rates in the NW Atlantic. Hook and line-caught individuals were utilized as 72-hour post-release controls. The species displayed high survival-rates (71.3% 72-hour survival). Because hook and line-caught animals exhibited similar mortality as trawled spiny dogfish and extremely high survival rates (94.1%) were found for the study's transport/captive component, some aspect of caging was implicated in the increased mortality. Assuming minimal predation, the long-term survival in captivity points to an even greater discard survival for this species in the wild. Presumably a function of their inherently larger size, trawl-captured females displayed elevated survival relative to males. Larger hook and line-captured males also more successfully tolerated the associated stresses. In order to ascertain physiological status and potential mechanism(s) for observed mortality, blood physiology was concurrently assessed. In general, the species exhibited significant ability to cope with capture-induced stress.

Session 7

Fisheries management 2

1. Population estimates of spiny dogfish in USA coastal waters using mark-recapture and density methods. Roger Rulifson
2. Management of dogfish fisheries to reduce bycatch of rockfish. Tom Helser
Abstract Unavailable
3. New monitoring and management regime for the longline fishery in British Columbia. Tamee Mawani
Abstract Unavailable

TITLE: Population Estimates of Spiny Dogfish in USA Coastal Waters Using Mark-Recapture and Density Methods

AUTHOR: Roger A. Rulifson, Institute for Coastal and Marine Resources, and Department of Biology, East Carolina University, Greenville, NC, 252-328-9400 (W), rulifsonr@mail.ecu.edu.

ABSTRACT: During the winters of 1997 through 1999, spiny dogfish were captured by commercial sink gillnets and trawl in the overwintering grounds of North Carolina north of Cape Hatteras, tagged, and released. In a separate study we estimated the square area of spiny dogfish aggregations south of Cape Hatteras to the South Carolina line, and assessed dogfish density by “snatch” gillnets. Both population estimates had numerous assumptions, and both were subjected to sensitivity analysis. Commercial harvest data for spiny dogfish were obtained through a web-based data request service (NMFS), and the number of individual dogfish landed per month by state was estimated by assuming an average size ranging from 3.5 to 7 pounds per dogfish landed. We considered an average size of 6 pounds to be the best available estimate based on results of our studies. We estimated population size of spiny dogfish during the February 1997 through December 2000 harvest period, based on NMFS revised landings of 133,407,895 pounds (C), 10,132 fish marked and released (M), and 117 recaptures (R). The Lincoln-Peterson estimator for population size of the 1997-2000 period between Maine and North Carolina was 840 million to 1.155 billion fish, or 152-192 million pounds assuming an average size of 5.5-6.0 pounds, and 40-60% tag reporting rates. South of Cape Hatteras, eight aggregations were identified, with a total population estimate of 1.09 to 2.18 million fish.

Session 8

Age Reading Workshop

Session 9

Management-Recovery Initiatives

1. The thrill of decline and the agony of recovery: Scientific challenges of spiny dogfish recovery programs. Paul Rago
2. Conservation of Northwest Atlantic spiny dogfish under US law and CITES. Sonja Fordham
3. How to recover spurdog in the NE Atlantic: Can CITES assist in achieving recovery? Charlotte Mogensen

TITLE:

The thrill of decline and the agony of recovery:
Scientific challenges of spiny dogfish recovery programs
--DRAFT--

AUTHOR:

Paul J. Rago
National Marine Fisheries Service
Woods Hole, MA 02543

ABSTRACT: Following intense harvests by foreign fleets before 1975, dogfish populations in the northwest Atlantic grew steadily between mid-1970's and late 1980's. Apparent peak abundance in the early 1990's was short-lived as the domestic fleet began a large-scale fishery on mature female dogfish. Between 1989 and 1999, approximately 250,000 mt of female spawning stock was removed, reducing the stock to about 30% of B_{MSY} levels. Abundance of male dogfish, however, was relatively unaffected by the fishery. The rebuilding plan under the federal fisheries management eliminated the directed fishery and allowed a limited, bycatch-only fishery. Efforts to rebuild populations are complicated by residual abundance of males and immature females, concerns about ecosystem function, a disdain for dogfish by most commercial harvesters, a displaced harvesting sector, high rates of discarding, and an apparent shift in dogfish distribution from offshore to inshore areas in the past 5 years.

In a region dominated by much larger and more lucrative fisheries, managers and fishermen have questioned the value of restoring spiny dogfish whose recovery is perceived as a threat to other species. Projection models suggest that recovery of dogfish poses difficult management options owing to the current non-equilibrium size and sex composition of the stock, transient effects of a seven-year string of record low recruitments, slow growth, and the difficulties of implementing an appropriately selective fishery. While the spiny dogfish in the Northeast US have recovered from past declines, the current recovery is both challenged and supported by advocates of ecosystem-based approaches to fishery management.

TITLE: Conservation of Northwest Atlantic spiny dogfish under U.S. law and CITES

AUTHOR: Sonja Fordham, The Ocean Conservancy; 2029 K Street, NW, Washington, D.C. 20006, 202.429.5609 (phone), 202.872.0619 (fax), sfordham@oceanconservancy.org

ABSTRACT: The spiny dogfish is one of the world's best studied and heavily fished sharks, yet one of the hardest to protect from overexploitation. The life history characteristics, serious stock depletion and significant international trade associated with spiny dogfish are exceptionally well-documented. The conservation mandates under the U.S. Magnuson-Stevens Fishery Conservation and Management Act and the goals of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are also clear. Still, spiny dogfish conservation efforts are hampered by the shark's relatively low economic value, reputation as a pest, and general lack of appeal. The level of public support required to secure and sustain dogfish restrictions has been much higher than for other more charismatic sharks. This presentation will review the decade long quest for science-based management of the U.S. and Canadian Atlantic spiny dogfish fisheries and restrictions on spiny dogfish international trade under CITES. Specifically, we document the process and hurdles associated with developing and effectively implementing fishery management plans for spiny dogfish by the Mid-Atlantic and New England Fishery Management Councils, National Marine Fisheries Service and Atlantic States Marine Fisheries Commission. The relevant work of CITES and its Animals Committee as well as Germany's efforts to list spiny dogfish under CITES Appendix II will also be discussed. The presentation will include an outlook for future efforts to conserve dogfish.

AUTHORS: Charlotte B. Mogensen, WWF European Policy Office
36 Avenue de Tervuren, 1040 Brussels, Belgium. Sarah Fowler, Naturebureau
International, 36 Kingfisher Court, Hambridge Road, Newbury, RG14 5SJ
UK.
cmogensen@wwfepo.org

ABSTRACT: *Squalus acanthias* (spurdog) is distributed worldwide and occurs throughout the ICES area. Current levels of harvest are excessive, and have reduced these populations to levels at which their survival may be threatened by other factors and exceeds that which can be sustained. A recovery plan aims to rebuild the spurdog population in the Northeast Atlantic and the North Sea. Until more information on population levels is obtained, any recovery plan will use a target fishing mortality rate of not more than 0.1 and a target relative biomass similar to that estimated in the 1970's. The Convention in International Trade in Endangered Species (CITES) establishes the international legal framework for the prevention of trade in endangered species, and for regulation of trade in species that might become endangered without such regulation. It provides a mechanism for international co-operation in trade regulation, enabling consumer countries to support management efforts of producer countries. International Trade in listed species is regulated and monitored to ensure that it is not detrimental to their status. The EU is the world's largest consumer of spurdog and utilises most spurdog products originating from EU waters; any future CITES listing would not, therefore, affect domestic EU fisheries. It would, however, require that international imports to the EU are derived from sustainably managed fisheries in other states' waters.

Poster Abstracts

TITLE: Distribution, reproduction and food of *Squalus acanthias* in patagonian waters, SW Atlantic Ocean.

AUTHORS: Edgardo E. Di Giacomo – Presenter, eedg52@yahoo.com.ar, María R. Perier, mred@canaldig.com.ar, Nidia M. Coller, nmcoller@yahoo.com.ar. Instituto de Biología Marina y Pesquera Alte. Storni. Güemes 1030, (8520) San Antonio Oeste, Río Negro , Argentina.

ABSTRACT: *Squalus acanthias* is distributed in the SW Atlantic Ocean between 34°S and 55°S. The presence of this species in the Patagonian coastal waters was confirmed from landings of the commercial fishing fleet and bottom trawl surveys. In this work the information collected in bottom trawl surveys carried out between 1986 and 2004 is analyzed. Size, sex, stomach contents, oocyte size, presence of gravid females and embryos size and sex relation were assessed from samples collected in these surveys. The species was reported in the depth range of 66 to 165 m being the maximal densities found between 86 and 105 m. Female size was in the range of 57 and 101 cm and male size was in the range of 60 to 81 cm. The most abundant catches were represented by gravid females of sizes between 69 and 98 mm. These females presented a variable number of embryos ranging from 4 to 11 embryos per female (mean= 7.8 ; sd= 1.74). Intrauterine embryos growth was detected between August (female: 19.89; male: 19.86) and November 1996 (female: 22.26; male: 22.56). Embryos numbers did not correlate with female size, and non significant differences among sexes were found in embryos size. This species preys mainly on fish, squids, shrimps and crabs; food composition showed differences among sexes. Maximal catch reported during surveys was 2.5 t per 30´ tow. Information on *S. acanthias* presented in this work is discussed in relation to previous work done on this species from the SW Atlantic Ocean.

TITLE: Physiological Response to Trawl-Net Capture in Spiny Dogfish, *Squalus acanthias*

AUTHORS:

Matt Rhodes, University of Maryland Eastern Shore, Living Marine Resources Cooperative Science Center, Department of Natural Science, 1 Backbone Rd, Princess Anne, MD, 21853, Tel: 410-725-6068, fax: 410-651-7869, mattandcrystal@dmv.com

Andrea Johnson, Ph.D., University of Maryland Eastern Shore, Living Marine Resources Cooperative Science Center, Department of Natural Science, 1 Backbone Rd, Princess Anne, MD, 21853, Princess Anne, MD, 21853, Tel: 410-651-8447, fax: 410-651-7869, akjohnson@mail.umes.edu

ABSTRACT: Presently, the Northwest Atlantic spiny dogfish (*Squalus acanthias*) stock is considered overfished due to the limited abundance of reproductively mature females. The Federal Spiny Dogfish Fishery Management Plan recommended a bycatch quota of 4.0 million pounds and very low trip limits to discourage direct harvesting. In the fiscal year of 2003, over 80% of spiny dogfish caught commercially were discarded. To understand the physiological stress response due to capture on the stock, spiny dogfish were collected in the Northwest Atlantic aboard the R/V Albatross IV using a 36' Yankee otter trawl. A total of twenty-four fish (19 females and 5 males) were collected, twelve individuals were euthanized immediately, while the remaining twelve were placed in a flow-through tank for 48 h. Females (n = 8) caught had litters of 2-7 pups. Prior to the fish being euthanized, blood samples were collected to measure hematocrit, and serum constituents (glucose, phosphorus, calcium, total protein, albumin, globulin, and electrolytes). For each fish, total length, body weight, liver weight and spleen weight were measured and samples of heart, kidney, spleen, liver, gills and gonads were collected for histopathology. Spiny dogfish sacrificed immediately after being landed showed an increase in hematocrit, decrease in spleen weight and some serum chemistry alterations compared to fish held for 48 h. Recognition of the physiological stress response due to capture of spiny dogfish will provide valuable information to fisheries managers that can be used to help develop a management plan that will prevent further depletion of the adult stock.

TITLE: Determining long-term feeding habits of the spiny dogfish (*Squalus acanthias*) using stable isotope analysis.

AUTHORS: Sue Hazlett, Presenter, University of Alaska Fairbanks, School of Fisheries and Ocean Science, Fairbanks, AK 99775, 907-347-6293 (cell), shazlett@hotmail.com, Nicole Misarti, University of Alaska Fairbanks, Institute of Marine Science, Fairbanks, AK, 99775, 907-474-5939, n.misarti@uaf.edu, Gordon (Sandy) McFarlane, Fisheries and Oceans, Canada, Pacific Biological Station, Nanaimo, BC, (250) 756-7052, mcfarlanes@pac.dfo-mpo.gc.ca, Matthew Wooller, University of Alaska Fairbanks, Alaska Stable Isotope Facility, Fairbanks, AK 99775, 907-474-6738 (w), ffmjw@uaf.edu,

ABSTRACT: Spiny dogfish (*Squalus acanthias*) are an abundant and commercially important species off both the Atlantic and Pacific coasts of North America. They are opportunistic feeders and have a varied diet that can include many fish species, especially small forage fish such as herring, capelin, and sandlance as well as crustaceans, worms, euphausiids, jellies, and cephalopods. The purpose of the present study is to investigate the utility of the second dorsal spine in providing multi-year information on the feeding habits of spiny dogfish using stable isotope (C and N) analysis. The outer enamel layers of a spine from a 105 cm. long female spiny dogfish (caught off the coast of British Columbia) were analyzed using stable isotope ratio mass spectrometry to obtain their stable isotope composition for $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$. Each sample consisted of rings from several years (5-8) so that possible seasonal migrations/prey availability were averaged over samples. The $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values ranged from 12.21 to 14.87 ‰ and -16.05 to -11.5 ‰ respectively. These results imply that the spiny dogfish preyed on different trophic levels throughout its lifetime, with a distinct trend (an increase of ~3 ‰ for $\delta^{15}\text{N}$ with age ($r^2 = 0.72$)) towards a higher trophic level with maturity. Analysis of both $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ showed shifts in feeding behavior over time, implying a shift from consuming invertebrates such as squid to fish species such as capelin, hake, and sardines. The $\delta^{13}\text{C}$ values are consistent with either a diet higher in benthic species than pelagic species or unique fractionation of carbon isotopes in the spine's mantle. Stable isotope measurements of the spines from *Squalus acanthias* could potentially be a valuable means of determining long-term changes in habitat usage and feeding strategies.

TITLE: Age, growth and reproduction of deepwater dogfishes from southeastern Australia.

AUTHORS:

Sarah B. Irvine, CSIRO Marine and Atmospheric Research, GPO Box 1538 Hobart, Tasmania, Australia 7001 & School of Ecology and Environment, Deakin University, PO Box 423, Warrnambool, Victoria, Australia 3280 Tel: +61 8 9204 4434; sarah.irvine@csiro.au,

John D. Stevens CSIRO Marine and Atmospheric Research, GPO Box 1538 Hobart, Tasmania, Australia 7001. Tel: +61 3 6232 5222, john.d.stevens@csiro.au

Laurie J. B. Laurenson, School of Ecology and Environment, Deakin University, PO Box 423, Warrnambool, Victoria, Australia 3280, Tel: +61 3 5563 3115, llauren@deakin.edu.au

ABSTRACT: The productivity of six commercially important dogfish species (*Centroscymnus coelolepis*, *C. crepidater*, *C. owstoni*, *C. plunketi*, *Deania calcea* and *Etmopterus baxteri*) was investigated by examining age, growth and reproductive biology.

Growth bands on the external surface of the second dorsal-fin spine proved to be a novel method of ageing dogfishes that had robust spines. Internal bands in spine cross-sections were also examined for age estimates. The number of both internal and external bands increased with animal length, although most spines had more external bands. Inner band deposition ceased after 15–20 bands even though animal and spine growth continued. The external bands were therefore considered a more reliable estimate of age.

A reparameterized von Bertalanffy growth model fitted the age data well, and allowed the direct comparison of growth. Males grew faster than females, and growth for both sexes began to plateau after maturity. Male *C. crepidater* had a longevity of 34 years and matured at 9 years, while females lived to 54 years and matured at 20 years. Male *E. baxteri* were aged to 48 years, with maturity at 20 years, and females were aged to 57 years and matured at 30 years. *Deania calcea*, *C. plunketi* and *C. owstoni* are also long-lived and late-maturing species, and *C. coelolepis* was unable to be aged.

The reproductive cycle is non-continuous with no seasonal trend. A high proportion of mature females were 'resting' between pregnancies. Mid-slope dogfishes from southeastern Australia have a very conservative life history strategy, indicating a very low resilience to fishing pressure.

TITLE: Sources of variation in the feeding ecology of the piked spurdog (*Squalus megalops*): implications for inferring predator–prey interactions from overall dietary composition

AUTHORS: J. Matías Braccini, Southern Seas Ecology Laboratories, Darling Building DP 418, School of Earth and Environmental Sciences, University of Adelaide, Adelaide, SA 5005, Australia and Primary Industries Research Victoria, P.O. Box 114 Queenscliff, Vic 3225, Australia, matias.braccini@adelaide.edu.au; Bronwyn M. Gillanders, Southern Seas Ecology Laboratories, Darling Building DP 418, School of Earth and Environmental Sciences, University of Adelaide, Adelaide, SA 5005, Australia; Terence I. Walker, Primary Industries Research Victoria, P.O. Box 114 Queenscliff, Vic 3225, Australia; and Javier Tovar-Avila-Presenter, Primary Industries Research Victoria, P.O. Box 114 Queenscliff, Vic 3225, Australia

Poster presentation

ABSTRACT: Sources of variation in dietary composition were examined in the piked spurdog, *Squalus megalops*. This shark is an opportunistic predator that consumed a wide range of prey items. When importance of prey was measured by mass or occurrence, *S. megalops* preyed largely on molluscs and teleosts. However, when number of prey was considered, the main items were crustaceans. A bootstrap analysis showed that at least 20% of variability can be expected in the importance of prey items in the overall diet of this predator. Regional, seasonal and ontogenetic differences in dietary composition were found but no differences were found between mature and immature sharks and between males and females. The spatial and temporal variation in diet exhibited by *S. megalops* and the intrinsic natural variability of the dietary composition of this opportunistic predator suggest that studies that infer predator–prey interactions from overall diet are likely to miss information on the ecological relationships among species and thus account for only part of these interactions.

TITLE: Genetic Analysis of Western Atlantic Spiny Dogfish Stock Distribution

AUTHORS: Dr. Gabi Gerlach, Marine Resource Center, Marine Biological Laboratory, 7 MBL Street, Woods Hole, MA, 02543, (508) 289-7120, ggerlach@mbl.edu

Melissa Sanderson, Cape Cod Commercial Hook Fishermen's Association, 210-E Orleans Rd, North Chatham, MA 02650, (508) 945-2432, (508) 945-0981, mel@ccchfa.org

ABSTRACT: The spiny dogfish (*Squalus acanthias*) extends from Florida to Labrador and is the most abundant shark in the Western Atlantic. Seasonal trawl data over many years indicate that spiny dogfish are highly migratory, moving north and south in sex-specific associations according to season. Presently, the dogfish population is managed as a unit stock. However, tagging studies indicate that two primary groupings may exist. One is a population that migrates from the Carolinas to Massachusetts, while the other group migrates between Massachusetts/ Maine and northward to Canada. We developed DNA microsatellite markers to assess differences among populations from North Carolina, Massachusetts, East Coast of Canada and as an outgroup from the Pacific. Genetic analyses of dogfish from the Atlantic coast showed that at least three different stocks exist (F_{ST} -value=0.037) with the biggest difference between populations from Canada and Massachusetts (0.062). No genetic difference was found between sex indicating that migration distances might not be different between males and females. Genetic differences between Pacific and Atlantic dogfish range from 0.097 to 0.12. Our study shows that dogfish at the Atlantic East Coast consists of more than one stock; management plans should be adjusted.

TITLE: The results of age determination of *Squalus acanthias* and *S. mitsukurii* carried out in AtlantNIRO.

AUTHORS: Soldat V.T. and F.F. Litvinov.

Atlantic Scientific Research Institute of Marine fisheries and Oceanography (AtlantNIRO) surveys Atlantic since early 60s and East Pacific since 1978, covering many aspects of fish biology. The investigations were aimed to the most abundant and commercially important fish species; however some chondrichthyan species were studied as well, *S. acanthias* and *S. mitsukurii*'s age included. Age determination of *S. acanthias* from the Northwest Atlantic was carried out calculating rings of the second spine's sections, 2097 samples in total. The age keys were created for males and females differently. The age range in females was 1-28 and in males 1-21 years. The Bertalanffy equation is

$L_t = 104,5[1 - e^{-0,095(t+3,36)}]$ for females and

$L_t = 91,8[1 - e^{-0,106(t+3,68)}]$ for males.

ABSTRACT: Age marks calculation in *S. mitsukurii* were carried out on 72 samples, 8 embryos included, collected on the seamounts of the Nazca and Sala y Gomez Submarine Ridges. There were revealed two marks which may be used for age registration: bands on the second spine and rings on its sections. The annual nature of the marks was not considered. It was revealed that females of 85-104 cm TL had mainly 6-7 rings and 9-13 bands, males of 74-100 cm 5-6 rings and 8-12 bands, i.e. much less comparing *S. acanthias* of the same sizes. The difference in correlations of marks number and TL was observed in sharks from different seamounts.

The main results are given in:

Soldat V.T. Age and size of spiny dogfish (*Squalus acanthias*) from the Northwest Atlantic/NAFO.-Scientific Council Studies.-1982.-N3.-P.47-52.

Litvinov F.F. Ecological Characteristics of the Dogfish, *Squalus mitsukurii*, from the Sala-y-Gomez Seamounts. Journal of Ichthyology, vol. 30, No. 4, 1990, pp104-115.

TITLE: Age, growth and reproduction of deepwater dogfishes from southeastern Australia.

AUTHORS:

Sarah B. Irvine, CSIRO Marine and Atmospheric Research, GPO Box 1538 Hobart, Tasmania, Australia 7001 & School of Ecology and Environment, Deakin University, PO Box 423, Warrnambool, Victoria, Australia 3280 Tel: +61 8 9204 4434; sarah.irvine@csiro.au,

John D. Stevens CSIRO Marine and Atmospheric Research, GPO Box 1538 Hobart, Tasmania, Australia 7001. Tel: +61 3 6232 5222, john.d.stevens@csiro.au

Laurie J. B. Laurenson, School of Ecology and Environment, Deakin University, PO Box 423, Warrnambool, Victoria, Australia 3280, Tel: +61 3 5563 3115, llauren@deakin.edu.au

ABSTRACT: The productivity of six commercially important dogfish species (*Centroscymnus coelolepis*, *C. crepidater*, *C. owstoni*, *C. plunketi*, *Deania calcea* and *Etmopterus baxteri*) was investigated by examining age, growth and reproductive biology.

Growth bands on the external surface of the second dorsal-fin spine proved to be a novel method of ageing dogfishes that had robust spines. Internal bands in spine cross-sections were also examined for age estimates. The number of both internal and external bands increased with animal length, although most spines had more external bands. Inner band deposition ceased after 15–20 bands even though animal and spine growth continued. The external bands were therefore considered a more reliable estimate of age.

A reparameterized von Bertalanffy growth model fitted the age data well, and allowed the direct comparison of growth. Males grew faster than females, and growth for both sexes began to plateau after maturity. Male *C. crepidater* had a longevity of 34 years and matured at 9 years, while females lived to 54 years and matured at 20 years. Male *E. baxteri* were aged to 48 years, with maturity at 20 years, and females were aged to 57 years and matured at 30 years. *Deania calcea*, *C. plunketi* and *C. owstoni* are also long-lived and late-maturing species, and *C. coelolepis* was unable to be aged.

The reproductive cycle is non-continuous with no seasonal trend. A high proportion of mature females were 'resting' between pregnancies. Mid-slope dogfishes from southeastern Australia have a very conservative life history strategy, indicating a very low resilience to fishing pressure.