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Maine's urchin diver: a survey of diving experience, medical problems, and diving-related symptoms

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Butler WP. Maine's urchin diver: a survey of diving experience, medical problems, and diving-related symptoms. *Undersea Hyperbaric Med* 1995; 22(3):307-313.—A questionnaire was sent to 1,545 licensed, hand-harvesting Maine urchin divers to survey diving experience, habits, environment, medical problems, and symptoms; 323 surveys were returned. Most of the respondents were young males who considered themselves physically fit; however, 17% were over 41 and 4% considered themselves "out of shape." Most had more than one occupation. Only 2% admitted no formal training, and breadth of experience fell into a trimodal distribution. Over half dove 2-5 times daily, most often under 60 ft. "Bounce" diving without decompression stops was usual, and solo diving was frequent. Eighteen percent had chronic medical problems, and 11% chronically used medications. The majority of diving was vigorous work from boats in the cold Maine ocean, not infrequently during poor weather. Seventy-eight percent described diving-related symptoms, and 2% admitted to recompression therapy. Thus, these respondents depict themselves diving within marginal safety boundaries.

urchin diver, urchin industry

For years, sea urchin harvesting was a minor Maine fishery. It accounted for about \$50,000 of the annual multimillion-dollar Maine sea harvest industry. The total catch was routinely about 100,000 pounds (1).

In 1986, Japan entered the marketplace. Because the Japanese consider urchin roe, uni, a palatal delicacy, there is a tremendous demand for it, which cannot be met by the Japanese fishery and must be supplemented by importation. During the 1970s, California and British Columbia were the major exporters harvesting the red, purple, and green sea urchins. West Coast waters were overharvested, and as a result, Japanese attention turned to the Atlantic Coast, particularly to Maine. Maine coastal waters are the home of the prolific green sea urchin *Strongylocentrotus droebachiensis*. Thus an old minor fishery became a new major fishery (1).

The initial impact of the Japanese market was felt in 1987 when almost 1.5 million pounds of sea urchins were harvested at a gross value of over \$236,000. Sea urchins had become 29th in annual sea harvest revenue. As word spread of \$500-\$1,000/day harvests,

increasing numbers of harvesters appeared. The "gold rush" had begun. Both hand harvesting (scuba diving) and dragging (lightweight bottom bags towed by a boat) were used to collect the sea urchin, but scuba diving predominated by far. In 1992, when urchin harvesting licensure began, only 807 divers were licensed, by 1993 there were 1,439, and in 1994 (as of the 15 July moratorium date) over 3,500 licenses had been issued. The fishery produced over 41 million pounds of sea harvest in 1993 valued at over \$26.5 million. Today, the sea urchin fishery is second only to lobster in its value to the Maine economy (2). As expected, this has led to tragic consequences. In 1992, three urchin harvesters died, and this was followed in 1993 by four fatalities and five near-fatalities (3).

These tragedies and near-tragedies created a legislative drive to reform the urchin industry. A licensure moratorium was enacted, certification required, and participation in a 3-day Department of Marine Resources Diver Safety Program mandated. Protection of the green sea urchin as a renewable commodity was also addressed. A harvesting season was created, a legal size was declared, and night harvesting was prohibited.

During these legislative proceedings, many anecdotal observations were made regarding urchin harvesters. However, no formal information was available. Thus, this survey was undertaken to better characterize the urchin divers.

METHOD

Using the list of 1993 hand-harvesting license holders (provided by the Department of Marine Resources), each diver was mailed a one-page survey which consisted of 21 questions with multiple parts. Topics included basic census information, diving certification and experience, diving habits, medical problems, diving environment, and symptoms attributable to diving. A cover letter explained the purpose and potential uses of the information obtained, and it was designed to be anonymous if the respondent so desired. The mailings began in early December 1993, and returns ceased by mid-June 1994.

Table 1: Divers' Profile, $n = 323$

Sex	No. Divers	Age, yr	No. Divers
Male	314	15-20	12
Female	9	21-30	124
		31-40	133
		41-50	47
		>50	7
Build	No. Divers	Physical Condition	No. Divers
Slight/slim	27	out of shape	13
Medium	217	inshape	228
Heavy	70	in top shape	82
Overweight	5		
Not answered	4		
		Health Status	No. Divers
		Poor	1
		Fair	11
		Good	151
		Excellent	160

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Table 2: Usual Occupation, n = 323^a

Sea related	285
Construction related	54
Service related	43
Public service related	19
Miscellaneous	25
Not answered	13
Sea related includes	urchin diver, "diver", commercial fishing, lobsterman, commercial diver, scallop diver, clam digger, boat builder, aquaculture, boat captain, seasonal, harvester, seafood processor, merchant marine, marine biologist
Construction related includes	carpenter, construction, mechanic, pipefitter/welder, electrician, laborer, tinsmith, equipment operator, machinist, masonry, paper mill, manufacturer, mill wright, refrigeration, brick layer, supervisor, asbestos worker, sheet metalist, floor installer, contractor
Service related includes	dive instructor, chef/cook, printer, telephone technician, retail seafood, photographer, caretaker, property manager, technical planner, waste vacuumer, surveyor, real estate, estimator, martial arts instructor, flight attendant, landscaper, artist, architect, transportation, bar manager, consultant, truck driver, car salesman, athletic trainer
Public service related includes	firefighter, police, game warden, Coast Guard, teacher, nurse, counselor, emergency medical technician, waste water treatment plant, vocational rehabilitation counselor
Miscellaneous includes	student, self-employed, retired, engineer, disabled, farmer, dog trainer

^aMany divers described more than one occupation (1.36/diver).

Table 3: Certification and Experience, n = 323

Organization	No. ^a	Diving Time, yr	No. Divers	No. Dives	No. Divers
YMCA	51	≤1	55	1-50	21
NAUI	62	<1	25	51-100	24
PADI	182	1-3	96	101-150	21
IDEA	12	4-5	43	151-200	16
SSI	9	6-10	64	201-500	55
Other	31	11-15	39	501-1,000	26
None	6	16-20	28	1,001-2,000	43
		>20	21	2,001-5,000	19
				>5,000	12
Not answered	10	not answered	7	not quantified	59
				not answered	27

Key: YMCA, Young Men's Christian Association; NAUI, National Association of Underwater Instructors; PADI, Professional Association of Diving Instructors; IDEA, International Diving Educators Association; SSI, Scuba Schools International.

^aA number of divers had earned more than one certification (1.12/diver).

Table 4: Diving Habits, *n* = 323

Number Daily Dives	No. Divers	Usual Diving Depth, ft	No. Divers
1	3	<30	128
2-3	59	<60	125
4-5	129	<80	35
6-10	18	<100	25
11-15	1	>100	4
Not specified	11		
Not answered	102	not answered	6
Bounce Diving	No. Divers	Decompression Stop	No. Divers
Yes	195	yes	63
No	118	no	256
Not answered	10	not answered	4
Safety Schedule	No. Divers	Solo Diving	No. Divers
Computer	46	never	37
Dive tables	146	rarely	49
Both	47	sometimes	65
None	56	often	91
		always	78
Not answered	28	not answered	3

Table 5: Medical Problems, *n* = 58

Musculoskeletal	No. Divers	Eye, Ear, Nose, Throat	No. Divers
Back problem	13	Sinus problem	5
Obesity	1	Allergies	3
Arthritis	4	Inner ear infection	1
Chronic shoulder/knee injury	5	Hearing loss	1
Reduced arm use	1	Eustacian tube disorder	1
Osteomyelitis	1	Meneier's disease	1
Tendonitis	2	Left eye blindness	1
Cardiovascular	No. Divers	Endocrine	No. Divers
Hypertension	9	Diabetes mellitus	3
Aortic regurgitation	1	Hypothyroidism	1
High cholesterol	2	Thyroid cancer	1
Gastrointestinal	No. Divers	Genitourinary	No. Divers
Liver problem	1	Hydrocele	1
Gastroesophageal reflux	1	Kidney stones	1
Excess acid	1		
Celiac sprue	1		
Pulmonary	No. Divers	Miscellaneous	No. Divers
Difficulty breathing	1	Migraine	1
Lung scar tissue	1	Low platelets	1
		TB exposure	1

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Table 6: Medication Used, *n* = 35

	No. Divers
Decongestants	11
Anti-seasickness	2
Birth control pills	2
Prednisone	2
Benazepril	2
Lisinopril	2
Enalapril maleate	1
Hydrochlorothiazide	1
Verapamil	1
Insulin	1
Glyburide	1
Cromolyn inhaler	1
Propoxyphene maleate	1
Oxycodone	1
Anti-inflammatory drug	1
Ibuprofen	1
Aspirin	1
Fluriprofen	1
Famotidine	1
Cimetidine	1
Omeprazole	1
Hydroxyurea	1
Azathioprine	1
Tetracycline	1
Isoniazid	1
Gemfibrozil	1
Conjugated estrogens	1

Table 7: Diving Environment, *n* = 323

Percent Diving Time	Commercial Diving	Boat Diving	Cold-Water Diving	Salt-Water Diving	Vigorous Diving	Poor-Weather Diving
1-20	18	10	5	3	25	76
21-40	6	7	4	1	9	62
41-60	17	17	13	8	30	76
61-80	32	18	47	12	38	16
81-100	225	224	215	272	123	17
Not answered	29	47	39	27	98	76

RESULTS AND DISCUSSION

Of the 1,545 surveys mailed, 46 were returned unopened and 323 were returned completed, for an overall return rate of 22% (323/1,499). Many included detailed commentary on the legislature, industry, and fellow divers.

The Maine hand-harvester is usually a young male of medium build who views himself physically fit and in "good" to "excellent" health. A few are over 41 (17%), and a small

number are not physically fit (4%) (Table 1). Most divers are employed in more than one occupation, often outside that of urchin harvesting (Table 2). The majority are open-water scuba certified; however, 2% admitted no formal training (Table 3). In addition, there is a trimodal distribution of experience. Those divers with the most experience have over 10 yr diving (27%) or over 1,000 dives (23%). Those with intermediate experience have 4–10 yr diving (33%) or 101–1,000 dives (38%). Those with the least experience have 3 yr or less diving (17%) or less than 100 dives (14%) (Table 3). Over half the divers make two to five dives daily in less than 60 ft of water. Most bounce dive without the use of decompression stops. Most use a safety schedule (i.e., computer, dive table), and a majority regularly dive solo (Table 4).

A small cadre of these divers (18%) have medical problems (Table 5), many of which would disqualify a military or commercial diver. Also, the medications chronically taken by an even smaller number of divers (11%) create a further list of potential disqualifications (Table 6).

Table 8: Symptoms Experienced, $n = 323^{a,b,c}$

Symptom	No. Divers	Symptom	No. Divers
Fatigue	151	Mottled skin	4
Headache	111	Abnormal speech	4
Ear pain	49	Confusion	4
Ear/nose bleeding	49	“Swollen face/eyes”	4
Weakness	43	Seasickness	4
Joint pain	42	Double vision	3
Ringing ears	35	Unconsciousness	3
Dizziness	34	Temporary paralysis	2
Feeling of spinning	25	“Leg cramps/leg pain”	2
Rash	22	“Back pain”	2
“Cold”	19	“Blocked sinus”	2
Numbness/tingling	18	“Nausea”	2
Hearing loss	17	Blindness	1
Cough	16	Abdominal pain	1
Itching	15	Difficulty urinating	1
Crackling skin	13	“Swollen hands”	1
Hoarseness	13	“Ruptured sinus”	1
Disorientation	12	“Air embolism”	1
Blurred vision	10	“External otitis”	1
Rapid/pounding heart	10	“Burning airway”	1
Tender cheek	8	“Poor thinking”	1
Joint swelling	8	“Sinusitis”	1
“Bends”	8	“Reverse squeeze”	1
Difficulty swallowing	7	“Hand pain”	1
Chest pain	7	“Intoxicated feeling”	1
Rapid breathing	7	“Grade 4 ear barotrauma”	1
Shortness of breath	7	“Vomiting”	1
Loss of coordination	7	“Tooth pain”	1
Near drowning	7	“Nitrogen narcosis”	1
“Bad air”	6		
Tender forehead	5	No symptoms experienced	72

^aMany divers described more than one symptom (2.59/diver). ^bThose items in “quotes” represent problems volunteered to the symptom list by the divers themselves. ^cFive divers related six instances of “chamber rides.”

The diving environment in coastal Maine is characterized by powerful surges, 18–30 ft tides, and rapid, shifting currents. The green sea urchin is most valuable during the winter months. The majority of harvesters dive from boats into cold ocean water, working vigorously, not infrequently during poor weather conditions (Table 7). With this diving profile and this diving environment, symptoms could be expected. In fact, 78% reported symptoms compatible with decompression illness, pulmonary overpressurization, barotrauma, and nitrogen narcosis (Table 8); however, only 2% admitted to recompression therapy.

Thus, mindful of its limitations, this survey has begun to characterize the Maine urchin diver. Its results depict a diver pushing the "safety envelope" to its maximum boundaries.

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THE HISTORY OF THE UNDERSEA AND HYPERBARIC MEDICAL SOCIETY

The Undersea and Hyperbaric Medical Society (UHMS) was founded in 1973 by a group of physicians and scientists who were interested in the medical aspects of diving and hyperbaric oxygenation. The society's primary concern is the promotion of research and the advancement of clinical practice in these fields. It is a non-profit organization that is open to all who are interested in the field, regardless of their profession or background.

The society's activities include the publication of the *Journal of Undersea and Hyperbaric Medicine*, the organization of annual meetings, and the sponsorship of research grants. It also provides a forum for the exchange of ideas and information among its members.

The society's membership is composed of individuals from a wide variety of backgrounds, including physicians, scientists, engineers, and divers. It is a truly international organization, with members from many different countries. The society's success is due to the dedication and hard work of its members, who are committed to the advancement of the field.

MEMBERSHIP

The society's membership is divided into several categories, including regular, life, and student. Regular members are those who pay an annual fee and are eligible to vote in the society's elections. Life members are those who have paid a one-time fee and are eligible for all the benefits of regular membership. Student members are those who are currently enrolled in a university or college and are eligible for a reduced rate.