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WORKING GROUP ON BYCATCH

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INTERACTIONS OF SEA TURTLES WITH TUNA FISHERIES, AND OTHER IMPACTS ON TURTLE POPULATIONS

1. INTERACTIONS IN THE PURSE-SEINE FISHERY

Sea turtles are occasionally caught in purse seines in the tuna fishery in the eastern Pacific Ocean. Most interactions occur when the turtles associate with floating objects (for the most part fish-aggregating devices (FADs)), and are captured when the object is encircled; in other cases, the net, set around an unassociated school of tunas or a school associated with dolphins, may capture sea turtles that happen to be in the location. In these latter cases, the presence of tunas and turtles together may be influenced by oceanographic features such as fronts, but is essentially a chance event: turtles cannot swim fast enough to keep up with tunas or dolphins.

Once captured, the turtles may be released unharmed, injured, or killed. They can drown if they are entangled for a prolonged time and are unable to reach the surface to breathe. In a few cases, they are lifted out of the water by the fishing gear while still entangled, and may fall from the net at some height and be injured, or may be passed through the power block. It is assumed, for the purposes of these analyses, that all such turtles are killed.

The estimated total annual mortalities of sea turtles in the purse-seine fishery are shown in Table 1; these data are broken down by set type in Table 2. The estimates for the entire fleet were extrapolated from data collected by IATTC observers aboard large purse seiners (over 363 t carrying capacity) during 1993-2003; they do not include data from trips covered by national observer programs[1], and no data was collected from a few unobserved trips and from trips by smaller vessels that do not carry observers. The annual average mortality was about 140 individuals, the great majority olive ridley turtles. Most of the unidentified turtles are probably also of this species, but the observers were unable to identify them positively. The recorded mortalities of some species are very low: only one leatherback was observed killed during the 10 years, and on average, one hawksbill and two loggerheads were killed each year. Figures 1 and 2 show, for the two species most frequently observed in the fishery, the inter-annual variability in the total mortality and the mortality per set during 1993-2002, by set type.

2. OPTIONS TO REDUCE THE IMPACT OF FISHERIES

2.1. Training and awareness of fishers

An extension program for captains and crews of large purse-seine vessels has been in place since 1986. Since 1999, the status of the sea turtle populations, and the need to maximize the release and survival of turtles, have been discussed at the seminars held under the AIDCP. The material currently covered at these seminars includes:

1. Species of turtles taken in the fishery; distribution, areas of high concentration, basic mortality statistics;
2. Status of leatherback turtles, and the need for special consideration; leatherback migratory routes;

[1] Data from the Ecuadorian national program are available, but were not processed in time for these analyses

3. Turtles and purse-seines: entanglement in the net, turtles injured after falling from net on to vessel, passing turtles through power block, entanglement in FADs; possible solutions;
4. Handling and recovery of sea turtles;
5. Recommendations for turtle conservation, and their implementation.

2.2. IATTC Resolutions

The IATTC Resolutions on bycatch apparently have been quite successful in reducing mortality. The estimated mortality in the purse-seine fishery in 2002, around 46 individuals, is the lowest on record, in spite of a very high level of effort.

The mortality caused by entanglement of sea turtles in the webbing that fishers frequently attach under FADs, to increase its attractiveness and/or visibility, remains to be addressed. Two options have been proposed to replace the webbing: (a) a series of "kites" tied every few fathoms to a line hanging under the FAD (an original design by Greg McIntosh), and (b) vinyl strips attached to each link of a chain hung under the FAD (in use in some anchored FADs in Hawaii). Experiments to compare the effectiveness of these alternatives should be carried out, and to verify that they are less dangerous to turtles; for instance, the vertical line in the kite system may entangle turtles, and a weighted line or a chain could be used instead.

It is not known how many turtles become entangled in FADs, but during 2000–2002 between 50 and 100 turtles were found entangled (alive or dead) during sets on floating objects each year (Table 3). For those that are alive when found, the observer data indicate as follows:

1993-2002 – Sets		%
Left entangled	49	11
Released:		
unharmed	260	56
slightly injured	111	24
severely injured	26	6
dead	6	1
Other	10	2

Estimating the mortality caused by such entanglements is not straightforward, because it is quite likely that a turtle entangled in webbing, dead or alive, may be reported more than once, either because it is left entangled or because it is seen entangled but no set is made.

In recent years, reports of turtles sighted in webbing but not involved in sets has increased, to about 240 individuals (Table 4); for these, the observer data indicate as follows:

1993-2002 – Sightings		%
Left entangled	296	20
Released:		
unharmed	678	47
slightly injured	171	12
severely injured	63	4
dead	5	1
Other	236	16

This indicates a greater awareness by the fishers, and a good initial response to the recent resolutions, but there is still room for improvement.

Document BYC-4-08 presents proposals for amending the *Consolidated Resolution on Bycatch* to strengthen the requirements to release turtles and to prohibit the use of hanging mesh in the construction

of FADs. Other actions that could be considered by the Commission include:

- Verification of compliance with the resolution by purse seiners of less than 363 t carrying capacity;
- Development and testing of alternatives to net webbing hanging under FADs (kites, strips, canvas, weights).

Set types:	
NOA	Unassociated tunas
OBJ	Floating object
DEL	Dolphins

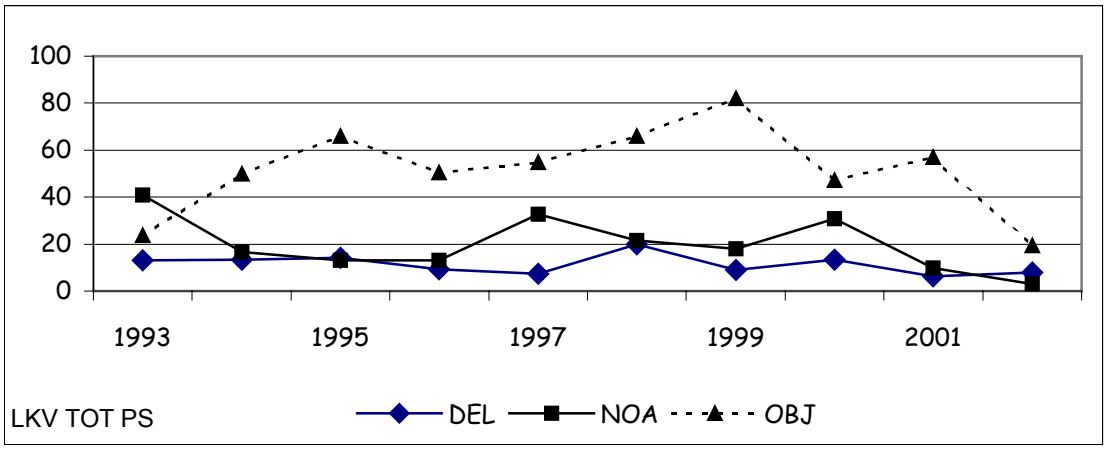

Figure 1a. Estimated mortality of olive ridley turtles in the tuna purse-seine fishery in the eastern Pacific Ocean, 1993-2002, by set type.

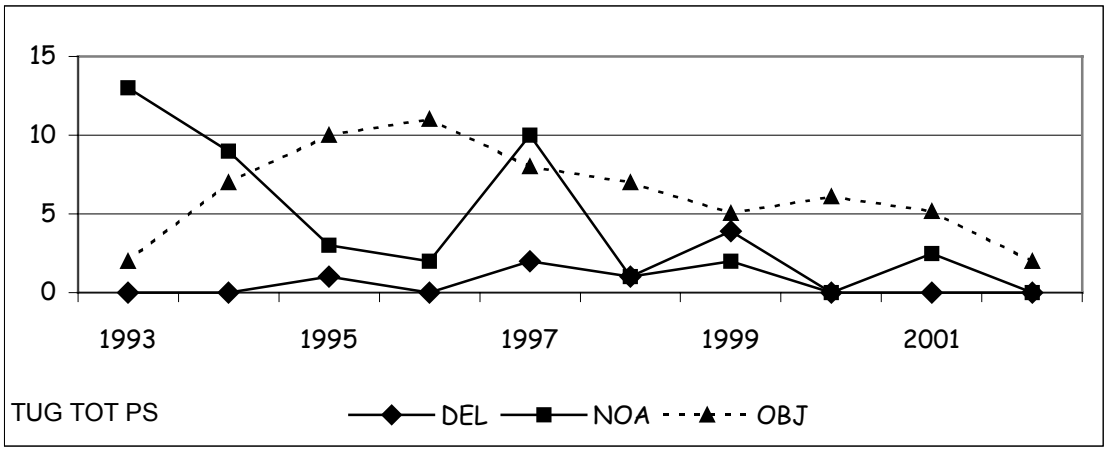

Figure 1b. Estimated mortality of black turtles in the tuna purse-seine fishery in the eastern Pacific Ocean, 1993-2002, by set type.

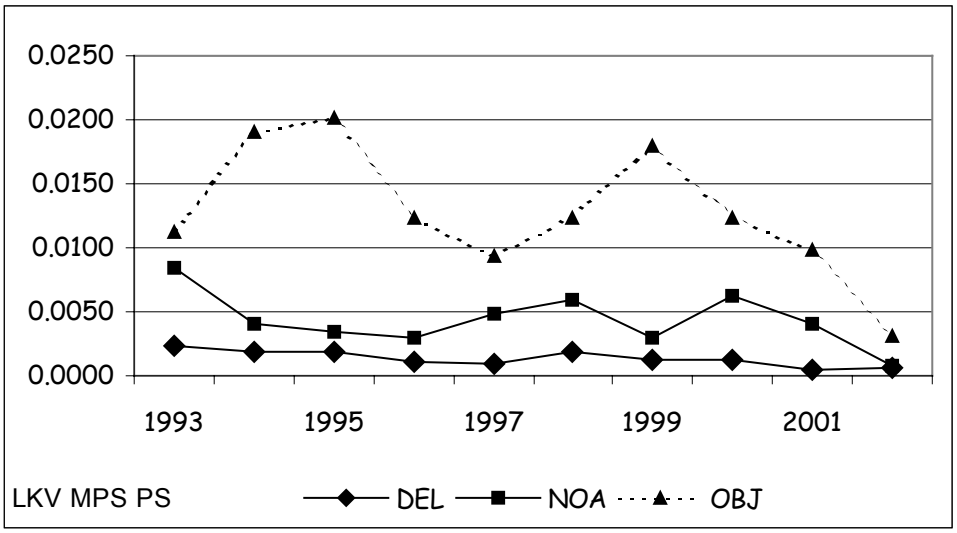

Figure 2a. Mortality per set of olive ridley turtles in observed sets in the tuna purse-seine fishery in the eastern Pacific Ocean, 1993-2002, by set type.

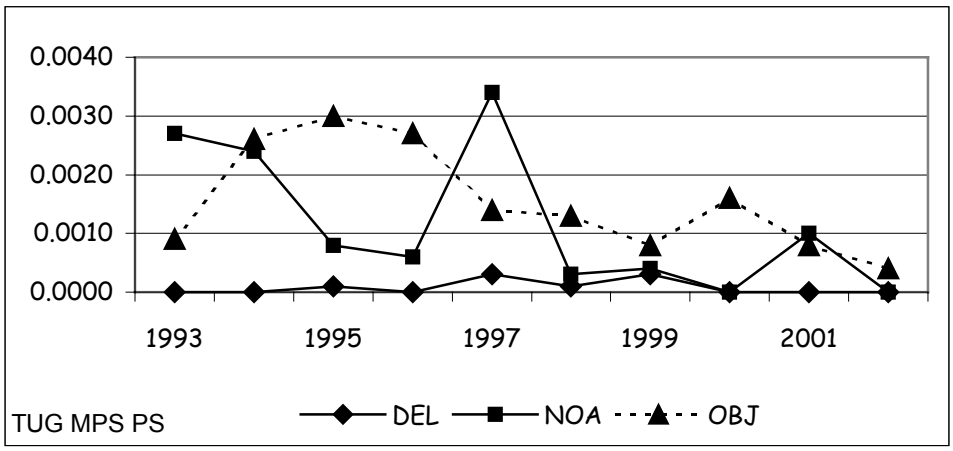

Figure 2b. Mortality per set of black turtles in observed sets in the tuna purse-seine fishery in the eastern Pacific Ocean, 1993-2002, by set type.

Table 1. Estimated annual mortalities of sea turtles in the purse-seine tuna fishery in the EPO, 1993-2002, by species

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Olive ridley	78	80	93	73	95	108	109	92	72	30
Black	15	16	14	13	20	9	11	6	8	2
Hawksbill	-	2	-	1	-	3	2	1	1	-
Leatherback	-	1	-	-	-	-	-	-	-	-
Loggerhead	4	2	2	-	5	1	4	2	1	-
Unidentified	21	45	43	49	51	41	46	29	55	14
Total:	**117**	**146**	**152**	**135**	**170**	**162**	**172**	**130**	**138**	**46**

Table 2. Estimated mortalities of sea turtles in the purse-seine tuna fishery in the EPO, 1993-2002, by species and set type

Set type	Dolphin		Unassociated		Floating object		All
Avg. mortality	**Per set**	**Annual**	**Per set**	**Annual**	**Per set**	**Annual**	**Annual**
1993-2002							
Olive ridley	0.001	11	0.005	20	0.012	52	83
Black	-	0.8	0.001	4	0.002	6	11
Hawksbill	-	0.2	-	0.2	-	0.6	1
Leatherback	-	-	-	-	-	0.1	0.1
Loggerhead	-	0.1	-	1	-	0.6	2
Unidentified	0.001	5	0.003	11	0.006	24	40
1993							
Olive ridley	0.002	13	0.008	41	0.011	24	78
Black	-	-	0.003	13	0.001	2	15
Hawksbill	-	-	-	-	-	-	-
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	4	-	-	4
Unidentified	-	2	0.003	16	0.001	3	21
1994							
Olive ridley	0.002	13	0.004	17	0.019	50	80
Black	-	-	0.002	9	0.003	7	16
Hawksbill	-	-	-	2	-	-	2
Leatherback	-	-	-	-	-	1	1
Loggerhead	-	-	-	2	-	-	2
Unidentified	0.001	9	0.001	2	0.013	34	45
1995							
Olive ridley	0.002	14	0.004	13	0.020	66	93
Black	-	1	0.001	3	0.003	10	14
Hawksbill	-	-	-	-	-	-	-
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	2	-	-	2
Unidentified	0.001	3	0.005	16	0.007	24	43
1996							
Olive ridley	0.001	9	0.003	13	0.012	50	72
Black	-	-	0.001	2	0.003	11	13
Hawksbill	-	1	-	-	-	-	1
Leatherback	-	-	-	-	-	-	-

Set type	Dolphin		Unassociated		Floating object		All
Avg. mortality	**Per set**	**Annual**	**Per set**	**Annual**	**Per set**	**Annual**	**Annual**
Loggerhead	-	-	-	-	-	-	-
Unidentified	0.001	3	0.002	9	0.009	37	49
1997							
Olive ridley	0.001	7	0.005	33	0.009	55	95
Black	-	2	0.003	10	0.001	8	20
Hawksbill	-	-	-	-	-	-	-
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	1	-	3	-	1	5
Unidentified	-	2	0.008	23	0.005	26	51
1998							
Olive ridley	0.002	20	0.006	22	0.012	66	108
Black	-	1	-	1	0.001	7	9
Hawksbill	-	-	-	-	0.001	3	3
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	-	-	1	1
Unidentified	0.001	7	0.002	8	0.005	26	41
1999							
Olive ridley	0.001	9	0.003	18	0.018	82	109
Black	-	4	-	2	0.001	5	11
Hawksbill	-	1	-	-	-	1	2
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	3	-	1	4
Unidentified	-	3	0.001	4	0.009	39	46
2000							
Olive ridley	0.001	14	0.006	31	0.012	47	92
Black	-	-	-	-	0.002	6	6
Hawksbill	-	-	-	-	-	1	1
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	-	-	2	2
Unidentified	-	3	0.002	10	0.004	16	29
2001							
Olive ridley	0.001	6	0.004	10	0.010	56	72
Black	-	-	0.001	3	0.001	5	8
Hawksbill	-	-	-	-	-	1	1
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	-	-	1	1
Unidentified	0.001	10	0.007	20	0.004	25	55
2002							
Olive ridley	0.001	8	0.001	3	0.003	19	30
Black	-	-	-	-	-	2	2
Hawksbill	-	-	-	-	-	-	-
Leatherback	-	-	-	-	-	-	-
Loggerhead	-	-	-	-	-	-	-
Unidentified	-	3	0.002	6	0.001	5	14

Table 3. Turtles found entangled in observed sets on floating objects, 1993-2002.

	No of sets observed[2]	Olive ridley	Black	Hawks-bill	Leather-back	Logger-head	Unidenti-fied	Total
DEAD								
1993	1931	6	-	-	-	-	-	6
1994	2540	4	1	-	-	1	2	8
1995	3226	11	3	1	-	1	10	25
1996	4043	5	-	1	-	-	3	9
1997	5577	7	-	-	-	-	16	23
1998	5251	10	2	-	-	-	15	27
1999	4498	22	1	1	-	-	22	46
2000	3673	11	2	-	-	1	19	33
2001	4779	23	3	-	-	-	21	47
2002	4597	7	2	-	-	1	9	19
	40115	106	14	3	-	4	117	244
ALIVE								
1993	1931	19	2	-	-	-	6	25
1994	2540	13	6	-	-	-	14	33
1995	3226	26	5	1	-	-	5	37
1996	4043	15	1	2	-	-	15	33
1997	5577	19	6	-	-	-	16	41
1998	5251	33	11	1	-	2	13	60
1999	4498	55	6	1	-	-	41	103
2000	3673	17	9	1	-	-	10	37
2001	4779	22	8	1	-	-	24	55
2002	4597	18	2	-	-	5	11	36
	40115	237	56	7	-	7	155	462

[2] On average during 1993-2002, the number of observed sets on floating objects was 92% of the estimated total number of such sets made by the tuna purse-seine fleet (range: 97% (1999) to 80% (2002)).

Table 4. Sightings of turtles entangled in floating objects, 1993-2002.

	Olive ridley	Black	Hawks-bill	Leather-back	Logger-head	Unidenti-fied	Total
DEAD							
1993	5	-	-	-	-	9	14
1994	3	-	-	-	-	7	10
1995	13	5	1	-	-	19	38
1996	13	1	-	-	-	18	32
1997	9	1	1	-	-	36	47
1998	24	5	2	-	-	37	68
1999	50	5	2	-	2	30	89
2000	46	5	-	-	-	49	100
2001	38	4	-	1	-	36	79
2002	10	-	-	-	-	34	44
	211	26	6	1	2	275	521
ALIVE							
1993	50	7	-	-	-	28	85
1994	22	6	-	-	-	46	74
1995	46	10	2	-	1	78	137
1996	24	8	1	-	-	45	78
1997	45	18	2	-	5	93	163
1998	71	24	9	-	3	102	209
1999	126	10	3	-	-	62	201
2000	102	11	4	-	-	48	165
2001	98	13	2	-	9	90	212
2002	43	11	2	-	2	67	125
	627	118	25	-	20	659	1449